Large-scale Design Project Integration across Computer Networks

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Abstract

This paper presents the study of a computer system capable of supporting the information work connected with a design project at an urban scale.

The computer system must fulfill a number of specific requirements. First, it must integrate a complex set of instruments for creating, retrieving, manipulating, processing, managing the interaction between the users and the overall information regarding the project. Secondly, it must operate at a geographical level to connect the various actors involved. Third, because of the heterogeneity of the participants involved, it must be compatible with numerous systems, even low entry, to ensure effective accessibility even to small companies, firms and citizens.

The computer networks extend the possibility of accessing the information beyond the project employees, towards the citizens. In the computers and in the networks, which connect them, the idea of interaction as communication and reciprocal action is inherent. A result is the possibility of interacting dynamically with the information, of assimilating, modifying, and redistributing it in progress. An high level of accessibility and interactivity with respect to information points to different approaches to architectural design and urban planning.

1. Large-scale Design

The Design Network Laboratory, of which we are a part, has set up the planning of an information system which has the aim of co-ordinating all the information, regulations, and suggestions on an urban scale project. The aim of the information system is to distribute information to participants in an international contest on this area. A further aim is to provide the telematic instruments to facilitate links and collaboration among the workers involved in the design, in particular with regard to architects and researchers with different skills or even with similar skills but developed in different cultural contexts.

The design operation which will be the subject of the contest is concerned with the urban area around Porta Susa railway station in Turin (Figure 1, 2). The station, according to the General Regulatory Plan (Piano Regolatore Generale) of the city (Figure 3, 4), will increase considerably in importance as a result of the quadrupling of the lines and will become the fulcrum of the complete system of interchange between high speed trains, local trains, the metropolitan, buses and private transport. The work will proceed in two successive phases, of which the first, concerned with the doubling, laying and covering of the lines, is under way.

The laying of the new tracks will result in an expanded boulevard which will join two urban areas at present separated, producing considerable changes both physical and in the activities pursued. The station itself will be relocated and in large part constructed underground. Taking account of the anticipated interchange with the other systems of transport, of the administrative activities recently set up in the neighbourhood (Palace of Justice) and of the offices and private businesses which are predicted, the station is destined to become an urban pole with further consequences for the fabric of surrounding buildings.

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2. Information Workspace

The information workspace is the environment conceived to support the information work required by a project at an urban scale. The information workspace is expected to support the operation both vertically, in relation to the various design, analytic and construction aspects, and horizontally, in relation to the various participants (commission, planners, companies, contractors, public administration, citizens). The information workspace comprises a complex of techniques and instruments for creating, retrieving, manipulating, re-using, processing, managing and in general supporting the interaction between the users and the information regarding the project. The information on the project comprises thousands of documents, which continually increase: pages of reports and technical specifications, data, documentation of past and proposed historical transformations, drawings and elaborate graphics, realised by many people with many different functions and skills (Figure 5).

The World Wide Web and Lotus Notes are among the most widely used programmes for sharing, both at a local and geographical level, the various and different documents of the project. At the same time research has turned to new tools to ease the sharing of information related to the project (Khedro, 1995), co-ordination between the contributions of individuals (Caneparo, 1995) and communication between individuals who share a virtual space rather than a physical one (Harrison, 1995).

The information workspace can take advantage of the rapid development of Internet and of the ever more numerous multimedia applications created for this network. Potentially the widespread diffusion of Internet, the possibility of access through various different systems, the modest cost of modems and the use of commutated telephone lines allow even small companies and firms to utilise the information workspace. The challenge is to bring about integration between already available individual applications as a means of achieving a complete and coherent information workspace.

Figure 1. Plan of the urban area around Porta Susa railway station in Turin.
3. Cyberspace

The set-up of the “information highways” project and the rapid development of Internet are extending the network at a global, planetary level, and giving access to a growing number of offices, companies, corporations and even families.

Through Internet, information on the project can cross the barrier between project employees and ordinary citizens. However, to hypothesise an undifferentiated access to the information diminishes the potentiality of the networks, since they are compared to the current mass media. Television and newspapers give prominence to this, as to other urban-scale projects, either in very general terms or, on the other hand, by providing information on specific themes encountered according to successive editorial policies.

Contrary to what happens in mass-communication, one and only one network does not exist, but rather multiple networks which are constantly created and modified on the basis of the communications which one computer can establish with another or with numerous other computers. Internet allows an individual and personalised access to information on the project. The idea of individual access to the network proves inadequate in that it is extremely undifferentiated: the individual citizen may be a car driver, a cyclist, an elderly person, a mother, a tax-payer, or a user of trains, the metropolitan and buses.

The networks reduce the dualism inherent in mass communication between the universality of the communication and the personalisation of the information. This information occurs via symbolic spaces, in collective virtual worlds which bring together individual intelligences. Cyberspace, according to the definition of William Gibson (1984), is the total digital network, a place of meeting and communication. “Cyberspace signifies less the new aids to information than the original modes of creation, navigation in knowledge and social relationships which these make possible” (Lévy, 1996).

Figure 2. Plan of Porta Susa railway station.
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4. Navigation in Knowledge

Navigation is a metaphor for knowledge and represents the exploration of information according to individual criteria. Everyone is his own steersman in the networks. But, just as navigators require reference-points and aids to orientation, so the cybernaut of information (the neologism from the Greek kybernetes reveals a reinforcement by repetition: steersman and navigator), who moves in an increasing quantity of information, requires criteria and reference-points. We identify these criteria as coherence and orientability.

The coherence is local and global. We define as local the coherence between the instruments and the applications to trace, question and update a document according to a common method of access and modes of interaction. Local coherence has the aim of facilitating effective use in the general process of information work. We define global coherence as the intelligible organisation which places the single document in relation to the thousands of other documents of the project. The existence of this organisation of the information on a grand scale makes possible a mental representation which connects the particular with the general, the single document with the complete plan of the information workspace and vice versa.

Coherence ensues orientability within a mass of heterogeneous documents. Orientability is appreciated by planners, employees and individual citizens. However, future users of the data may be interested in information substantially different from that required by those who have practical and executive responsibility for the project. This distinction concerns not only the information in itself, but also the scales of representation and the kind of language in which the information is represented. For example, plans and sections constitute an instrument favoured by designers and contractors, while people not employed in the work are more used to the image, to realistic representation in perspective.
Virtual reality allows the structuring of information according to explicit spatial metaphors. Drawings, reports and in general the greater part of the information connected with the project possess specific spatial references and relations. These references can be used to structure the information on the project. By means of Virtual Reality Markup Language (VRML) every computer on the Internet can visualise and explore a virtual three-dimensional model of the project, complete with buildings, streets, piazze. For example, to find the drafts of a building, the user can move in a 3D representation of the project until he finds the building in question (Figure 6, 7). A click with the mouse on the building, or on the part to which the draft refers calls up a list of the information associated with it, among which the user can choose what interests him.

5. Social Relations

Plans, elevations, photo-realistic simulations, three-dimensional models of spaces and buildings are all symbolic representations, a form of language through pictures, which express by means of different icons the information on objects, their properties and the connections between them.

The computer, symbolic machine par excellence, allows free movement through the different languages, through multiple forms of representation of knowledge. The networks extend the possibilities of exploiting these virtual worlds and symbolic spaces beyond the individual sphere, towards a collective group dimension.

Marshall McLuhan (1964) describes thus the shared dimension brought about by the networks: “It is a principal aspect of the electric age that it establishes a global network that has much of the character of our central nervous system. Our central nervous system is not merely an electric network, but it constitutes a single unified field of experience. As a biologist point out, the brain is the interacting place where all kinds of impressions and experiences can be exchanged and
translated, enabling us to react to the world as a whole.’”

The networks also bring back into discussion the concept of the social contract, as defined by Rousseau, through which the individual gives up his own natural rights in favour of society, in this way acquiring a new freedom. The social contract formalises the individual’s renunciation of the dictates of natural freedoms in favour of the decrees of the general will. In the age of the mass media the general will, the majority, assumes form and identity also in surveys which, by means of statistics, redirect the individual will to general assumptions.

In 1964 McLuhan hypothesised new forms of social organisation and interaction according to principles of organic and interdependent unity with regard to information. In cyberspace the flux of information allows groups to be created and reorganised in real time and through communication to move towards a co-ordinated structure which puts to good use the individual units of which it is composed. Organic and independent unity takes the place of a universal acceptance of a general will, which often absorbs the particular in the general and in so doing simplifies the specific in the interests of the general.

The networks are the means of expressing the needs and aspirations, on a scale of thousands, of hundreds of thousands, of those, for example, interested and involved in operations concerned with the planning and the future of a city of a million inhabitants.

The unified field of experience of the networks may establish contacts between individuals: users of services, transport, public and private spaces, that is, people with precise demands and aspirations. This brings us back to the idea of technological innovation not as the linear result of scientific and technological progress, but as the product of continual and open interactions between a great diversity of social actors (Flichy, 1995). We recognise the ring of conjunction between individual and group in awareness: awareness in the first place of particular needs and aspirations, which is not, however, simply consciousness, but relationship both active and social, and

![Figure 6. The reference themes and a VRML model of the area around Porta Susa.](image)
therefore to be adapted to the resources, to the restraints, and finally to the range of possible decisions.

6. The Information System Experiment

The proposed interaction may occur at different levels of involvement and of effectiveness in relation to the final choices.

The information system on which we are working utilises, on the one hand, the participation of a qualified group of experts and designers with different skills and cultural backgrounds; on the other it uses interactive tools to realise the highest possible level of local and global coherence together with ease of access to the project with a view to a wider interaction with possible final users of the work.

Even if the result is not a complete project, but rather the dialectical phase of definition of the complex of information and details necessary for the contest, the intermediate phases of experiment include an architectural design at the urban scale, as well as alternative designs, at different levels of definition and of scale.

We believe that such a method of proceeding may reproduce significantly, at the moment of defining the specifications, the situation in which the architect participating in the contest finds himself and would want to find himself. Among other things the contribution of qualified people from very different cultural and geographical backgrounds will ensure improvement in the comprehensibility of the information to be supplied.

The international and local work groups, which also include representatives of the clients (the Council, the Railways Company) also lend themselves to a partial simulation of relationships with final users, at least as far as the interactive tools are concerned. It is proposed, however, with the

![Figure 7. The reference themes and a VRML model of the area around Porta Susa.](image-url)
agreement of the administration of the council, to insert in the networks accessible to all citizens the largest amount of data and information with a view to a large scale experiment in “participatory democracy”, compatible with the means now available.

The points which follow are theoretical considerations about architectural design and urban planning (the creation, the transformability of the project, etc.) and express our convictions about the potentiality of the networks, their limits in relation to the design which will be the subject of investigation and partial verification in the course of the research which we are setting up.

6.1. Creative Contribution of Users

Through Internet information on the project is decentralised, that is, accessible to every place and individual. It reaches the interested party directly and is personalised in the sense of being tailored to specific interests and wishes.

A further central aspect is interactivity. In computers, as in the networks that connect them, the potentiality of communication as a reciprocal action is intrinsic. However, it is necessary to clear up a possible misunderstanding: that a possibility which is a potentiality should automatically transform itself into reality.

The computer networks permit citizens to ask questions directly about the information on the project and at the same time allow the opposite process: they give citizens the active possibility of expressing their ideas on the project, on general or particular aspects which interest and involve them.

Citizens’ access to information on the project starts from their expectations of and questions about the project. The complete project is presented in a series of reference themes: new activities, green issues, viability, transport, investments, costs (Figure 6, 7).

Under each theme is presented a range of choices and alternatives. If, for example, six alternative hypotheses are presented for the road network, plus a further open hypothesis, by a click on the mouse the user can choose the hypothesis which he considers most relevant and interesting. The “View” command transmits the choices of the user to the server. On the basis of these choices the server shows the plan of the area with various media: drafts, images, animation and VRLM. The choice of the medium is left to the user according to personal preferences and to the system available. If the user chooses the VRLM format, he receives the virtual model of the plan which reflects his specific choices. The different browsers available for the standard VRLM allows the user to move within the plan, to visit piazze, streets and buildings before they are constructed, according to personal roots of exploration. There are no constraints in the interaction between citizen and system: He is left free to test different hypotheses and to see how these may be transformed into an urban form.

The user, on the basis of his own specific interests, often focuses his attention on some themes at the expense of others. However, the server, to present and show a design of the area, requires a minimum number of indications, also on themes which the user may have neglected. In this case the server has recourse to a number of reference plans to complete the unexpressed options. The configurations, the options in these plans, although predefined, are updated periodically as a result of the choices previously made by all the users of the system.

6.2. Design in Progress

The continual interaction of users with the server envisages the plan of the area as a system in continual mutation.

The initial configuration of the system is defined by the architects and includes descriptions of thematic groups, the alternatives within them and the urban forms associated with them. Starting from this initial state, the system continually evolves through interaction with users. Without this interaction the plan could have only a limited evolution in that it would be based on a circumscribed number of hypotheses and alternatives. The plan must, rather, be able to evolve towards conditions not initially foreseen.
Through the interaction with users the server can, over time, save and store new alternatives and themes, and consequently new urban hypotheses. At the moment the interaction is occurring either explicitly or implicitly.

The explicit interaction consists of directions, criticisms and suggestions expressed directly by users. Even if, at the moment, this interaction can occur only by means of the imperfect tool of written messages addressed to Webmaster.

The implicit interaction uses the choices of users in favour of certain themes at the expense of others, or the preferences for certain alternatives rather than others, in order to infer individual preferences and interests, which over a period of time will determine a scale of preferences and values.

On the basis of the indications of the interaction, the system can be updated to include new possibilities in existing thematic groups, new thematic groups and the equivalent new architectural forms. If the architects receive the stimuli of users of the system and integrate them in a continuous development, the process itself of design becomes an integral part of the total organic and interdependent unity foreseen by McLuhan.

6.3. Simulation

Cyberspace allows citizens to express their own aspirations, requests and expectations about an important part of the city. However, this interaction is bound to become a kind of book of dreams if the system does not provide at the same time a feed-back, a direct confirmation of the expected choices (Figure 6, 7). This feed-back consists of indicators on the project and on the area: necessary economic resources, indices of density, green areas and traffic and pedestrian movement. At the same time virtual reality makes it possible to give a form, to represent spaces and construction corresponding to these choices. The role of the architect is to foresee a form according to the different individual hypotheses for each theme. The result is a kind of simulation game, of "what-if", which reveals the cause and effect connections in the choices at this scale of the project. The networks permit the simulation of complex configurations and social requirements in a project on an urban scale before that project is carried out, in the same way as occurs for structural and lighting aspects, which are already intensively verified and tested by means of computer simulations.

By means of simulation the predictability of actions increases and the constraints imposed upon the participants, whether in terms of functioning or uses, become stronger. On their part, in order to respond to a social context which demands a constantly changing input, the designers are drawn back to methods and techniques of co-operation which make the behaviour of all those who contribute to the design more predictable.

6.4. Design across computer networks

In cyberspace one can also imagine a different configuration at the moment in which the architecture is to be created. As Lukacs (1975) says, architecture, like the other arts, reflects reality (understood as an organic relationship between social man and nature), represents it to the community and in a certain sense explains to the community its own aspirations, its own relationship, always evolving, with the physical and social environment.

The operation is highly creative in that, in order to reveal, it discovers, invents and creates a form which did not exist previously, and this form is recognised as human, tied to the interests and feelings of man.

Not every architectural design produces these effects to such an extent that one can speak of artistic creation, and yet every work, despite the author and his conscious intentions, reflects human reality in some measure. We could also say that there is a concentrated art, that of the great works, and a more diluted art as found in other writings, drawings, songs, buildings, etc. In general it is believed that the creative deviation into unexpected paths, that which makes us see things (we mean the physical and social environment) in a new way and one more suitable to mankind, is the work of the individual artist. In fact, since Idealism, the contribution of the individual artist has
been emphasised, neglecting exactly that part of the reflection which passes through collective processing, repetition of traditional models, convention itself, to those very small but frequent and widespread creations which form the linguistic context on which even great works must depend.

It needs to be said that architecture, because of the long periods of time needed for construction, the high costs and the large number of people involved, has always retained the image of an art more choral or collective: one need only think of the great religious buildings, and the great cities famous for their art and architecture.

Perhaps only in recent times, particularly during the age of what is called the star system, an age which is closely connected with mass communication, has the idea of the architect, deliberately characterised as an individual, become dominant.

In general there have always been and still are design studios which call on the abilities of many people, and where the creative contribution of particular individuals is not always distinguishable from that of their colleagues.

Another collective aspect, not only of architecture but of all the arts, is the relationship the work has with the public and, through this, with other works of art. The work performs its task of regiving form to, of re-interpreting the human world, to the extent that it is understood and accepted, and this occurs in relation to public expectations and in comparison with other works. The sub-community of collectors, of art-lovers with particular tastes, of readers of specialised revues diminishes the works, limits their comprehension and their contents.

We wonder how artistic creation may change if, at the moment of design, we insert the computer networks. While, in relation to the technical aspects of design we have no doubts about the great usefulness of disparate contributions, of continual multimedia brainstorming, for the artistic aspects we suggest the need to test the results.

We have observed that design has always been, and today still often remains, collective. Nevertheless, with design across computer networks something changes.

If the large collective studio behaves in some ways like an individual, (don’t let us forget that Raphael and Bernini already had hundreds of collaborators) either through the charisma of one strong personality or through the sharing of experiences resulting in a general growth, what will happen in collaborations between designers of different education and cultural background?

Cyberspace inserts the design in a creative circle: from design to design in progress.

Potentially the architect’s role itself changes, from creator of spaces and forms in which an epoch and a culture can identify itself and reflect itself. The forms emerge and originate during the long course of communication, in which a designer can, when he masters them, cause to evolve forms inherited from preceding generations. “The classic work is similar to a bet. The more the language changes, whether musical, plastic, verbal, or any other kind, the more its author runs risks: incomprehension, lack of renewal of the language” (Lévy 1996). However, it must not be forgotten that the change of significative forms is always a collective process, part of the total continual flux of languages and signs. The computer network can change the evolution, the acquisition and diffusion of these forms in so far as it “proposes signifying machines which will allow the invention of their own languages” (ibid.).

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