SIMULATIONS OF ARCHITECTURAL
PROJECTS:
Methods and Applications at Full-scale.

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This paper briefly examines five interrelated themes concerning the use of full-scale simulation models in architectural projects, in the context of research and professional practice. First, the meaning of design is discussed. Second, a multi-functional interpretation of building performance is presented. Third, the main reasons for simulating design projects, in general, and for using full-scale models, in particular, are summarized. Then the antecedent or prerequisite conditions for public participation to occur effectively are discussed. Finally, an overview of the use of full-scale simulation models in European workshops enables us to table four main classes of functions for full-scale models.

WHAT IS DESIGN?

Since the 1960s, there has been a large number of studies concerning design methodology and design practice. The growing concern with these subjects indicates an important shift from the study of designed objects to the activity of design. Consequently, a differentiation between one interpretation of design as product and another interpretation of design as process was emphasized. Unfortunately, this either/or approach for the interpretation of design does not aid in the development of our understanding of design theories and methods. In contrast to this approach it is suggested that the term design can be used to denote:

1) the ordering of the built environment; and
2) a scheme of action to achieve desired ends.

Both these definitions encompass simulations and evaluations of design projects. The second definition underlines the principle that design has an explicit political dimension if by politics we refer to the intentions and activities of persons to achieve defined goals. In essence, design is intentional, not haphazard. Design involves choosing between a range of options in order to achieve desired goals. From this perspective, design is much more complex than aesthetic composition, as the protagonists of postmodern design would have us believe. Indeed the complexity of design raises critical questions such as:

1) What parameters are pertinent for a design problem?
2) Whose intentions and goals are to be identified and designed for?

3) How and when will these intentions be achieved?

In order to answer these kinds of questions, both the function and roles of simulations during the design process cannot be overlooked, and a comprehensive model of building performance should be borne in mind. This model of the multiple functions of buildings will now be briefly presented.

WHAT ARE THE FUNCTIONS OF BUILDINGS?

During the last three decades, research by several architectural theorists and building scientists collectively shows that a building usually serves four or five sets of purposes which can be summarized as follows:

First, any building defines and delimits spaces, thus using a small portion of the surface of the globe to shelter human activities.

Second, the building envelope will act as a filter between the enclosed spaces and the external surroundings. An efficient filter will sustain acoustic, illumination and thermal conditions within prescribed ranges of "human comfort" which vary between cultures and societies, and have evolved during the course of time.

Third, buildings are endowed with meanings. They are symbolic artifacts, not merely with respect to the intentions of the designer, or the client, but also in terms of how the public interpret them.

Fourth, buildings have environmental and economic implications in terms of their initial use, and the cost of raw (sometimes non-renewable) materials, labour and energy, as well as the use of these sets of resources during the period of occupation and lifespan of buildings.

Finally, buildings have an ecological impact on the biological environment, specifically with respect to the micro-climate they create, the consumption of resources, and their effects on the health and well-being of people.

This interpretation of building performance underlines the limitations of those studies of buildings which only consider aesthetic or functional criteria. It also implies that the five sets of functions can be considered in a complementary way. Nonetheless, it is most unlikely that a specific building will be intentionally constructed to meet all five sets of purposes; for example, the design briefs for civic buildings usually require symbolic requirements above economic and pragmatic factors. Consequently, it is suggested that the value of this conceptual model of building performance is that it
can identify the multiple purposes or intentions which a specific building is meant to reflect. From this perspective, it would be erroneous to evaluate a specific building in terms of plausible yet different parameters from those stated in the design brief. Moreover, it becomes possible to identify the costs and the benefits of a wide range of factors implicated in the construction and use of buildings.

In this respect, it is noteworthy that a wide range of simulation techniques have been available to architects, urban designers, and townplanners: These include drawings, small-scale models, architectural and building science equipment, full-scale models, cost benefit analyses, and environmental impact assessment techniques. These kinds of techniques enable an intended project to be evaluated in terms of one on more factors. Nonetheless, it would be too restrictive to suggest that this assessment is the sole rationale for the simulation of architectural projects.

THE RATIONALE FOR DESIGN SIMULATIONS

Despite the growth of research in design methodology, planning policy and community participation, scant attention has been given to developing our current understanding of decision making during planning and design processes. It is curious that interpersonal communication between architects, urban designers, planners and citizens has been a subject of minor concern. Although there has been a growing recognition and application of citizen participation in the planning, design and construction of the built environment, some authors have noted that professional planners and designers commonly "employ a language that is detached from the reality of those who presently own and produce shelter as a commodity" (Pysiot and Weber, 1978, p. 203).

Drawings have traditionally been the medium for communicating design proposals. They have been criticized and defended as an appropriate way to convey intentions and ideas. There would appear to be more in Cuff's (1980) defense of drawings, because her argument is based on their misuse as a medium for communication. Cuff has envisaged drawings as an integral part of the design process rather than the end product of that process. In this respect they acquire the purpose of tools for design during the planning and architectural design process. The criticism of the traditional use of drawings can also be leveled at architectural models as Kaplan (1977) has noted. Indeed, the criticism is even more warranted, because design models have generally been considered as the showpiece in a shop window. In contrast, it is noteworthy that Kaplan (1977), a cognitive psychologist, has formulated and applied a hierarchical model of the cognitive capacity of professional

Figure 1: Three sketch plans of one house before, during and after a design-by-simulation process using full-scale models.
designers and laypeople in order to interpret small-scale models as working instruments during the design process.

During the last decade there has been a steady growth in the study and application of the simulation of environmental design proposals. This trend has accepted the principle that planning and design involves a transaction between different groups of people with different goals and values (e.g., the building users, the owners, the government planners, and legislators, and the architects). There has been a reason for the acceptance of this principle: It was one thing to admit that people should be involved in decisions about the built forms of future environments, but quite another thing to find an expedient way of involving the public in the decision-making process. Underlying this problem is the medium of communicating between professionals and citizens. It has been gradually recognized that the medium of representing and communicating projects and plans is a fundamental variable that can account, at least in part, for the success or failure of projects involving citizen participation. Consequently, a number of environmental modelling techniques that enable either small-scale or full-scale simulations of the built environment have been developed and applied (Bentz, 1981; 1988; Eiken, 1975; Hardie, 1988; Lawrence, 1982; 1988; Mason, 1988). These approaches to participatory design will now be given more detailed consideration.

DESIGN SIMULATIONS AND CITIZEN PARTICIPATION

The practice of simulation as a simplified rendition of a proposed or naturally occurring environment or event is not new to the behavioral sciences or the design professions. Rase (1969), for example, notes that it has been an integral part of the decision-making apparatus of diverse disciplines for many decades. Communication of design projects involves some kind of simulations, be it a verbal, an iconic or an analogue model of a static or dynamic kind. Traditionally, small-scale models have been used to translate graphic presentations of buildings into three-dimensional form, but usually only once the design problem has been addressed by professional designers. In this respect, the small-scale model presents one solution to the problem and it has been commonplace for laypeople not to have any say in the elaboration of that solution.

The mode of simulating environmental settings has been the subject of considerable discussion and experimentation in environment-behavior research, as the scope of contributions, presented in this volume shows. A wide range of simulation techniques including
drawings, photographs, films and scale-models involving a variety of scale representations and detail have been used to elicit responses and preference ratings of subjects under experimental conditions. It is clear that the degree of abstraction of these simulations and their pertinence for studying behavior in real-life settings is often treated in a cursory fashion or ignored (Sadalla and Oxley, 1984). Yet, several studies show that the mode of environmental simulation can yield distinctly different results, particularly with respect to the perception and judgement of the third dimension (Lawrence, 1987; Kaplan, 1977; Seaton and Collins, 1972).

These findings bear important implications for the design professions. First, designers communicate their ideas visually, so that those modes of simulation which enhance communication between designers and their clients are advantageous. Second, some professional designers are increasingly aware of the need for the predictability of the behavioral effects of diverse kinds of environments, so that research and real-life settings which are congruent can help anticipate the outcomes of environmental projects. Third, simulation techniques can enhance the predictive skill of the behavioral impact of design projects and also provide a context for the analysis of the pertinence of behavioral parameters in environmental planning and design. Finally, when simulation models are used during the design process to represent incremental changes to the projected environment, then the social scientist and the design researcher have a context for the analysis of the design and planning processes, and the built environment as it evolves.

Both Appleyard (1977) and McKechnie (1977) have provided a useful typology of simulations which are classified as perceptual (concrete) or conceptual (abstract) and either static or dynamic. McKechnie (1977, p. 172) states:

"Building plans, for example, provide much conceptual information - dimensions, angles, abstract shapes; when perceptual information is given it usually involves construction details that subsequently will be hidden from view in the finished building. Little is provided in a set of blueprints to show the observer how the building will look. In contrast, the scale model at its best provides abundant perceptual information; colors and actual three-dimensional shapes of building textures, of vegetation, variations in terrain and ground cover, etc."

Static simulations exist for both conceptual and perceptual modes of representations. Photographs and scale drawings are static perceptual simulations, providing a specific, unchanging rendition of the

Figure 2: Design-by-simulation in the Laboratory for Architectural Experimentation in Lausanne. The interrelations between internal spaces frequently becomes the focus of attention of designers and laypeople.
represented space, and the interrelationships amongst the components of the setting cannot be manipulated.

In a recent contribution, Stea (1988) has provided a synthesis of Appleyard’s and McKelvie’s contributions, as shown in Figure 3a. Stea not only combines these two contributions but subdivides dynamic simulations into participatory and non-participatory modes, in order to introduce environmental modelling. This new subdivision is shown in Figure 3b. The dynamic capacity of perceptual simulations is illustrated by those full-scale simulation laboratories presented in these proceedings of the 3rd European Full-Scale Workshop Conference.

WHAT IS CITIZEN PARTICIPATION?

The recent attention given to citizen participation has been broad in scope and applications, and can be illustrated by examples from around the World. Nonetheless, it would not be unreasonable to suggest that more attention has been given to accounts of specific projects than to debate about theoretical and methodological issues (Lawrence, 1987). In one recent overview Churchman (1987) states that there is no shared core definition of community or public participation. Indeed her overview found that authors from several disciplines provide no definition ‘or give pseudodefinitions that deal with its goals or outcomes, rather than actually define what it is.’ (p. 116) Churchman presents some definitions from the fields of political science, community studies, planning and environment-behavior studies, whereas Lawrence (1982) analyses recurrent interpretations of public participation by architects and urban designers. Clearly, these overviews indicate that there is no consensus between academics and professional practitioners, either across traditional academic and professional boundaries, or within specific disciplines or groups.

Bearing in mind the aforesaid, the following definition recently presented by Churchman (1987, p. 116) shall be adopted herein:

‘... participation exists when individuals who are not elected or appointed officials of agencies and of government take part in decision making in the institutions, programs, and/or environments that affect them.’

It is noteworthy that this definition of participation focuses on who, as well as how and why it occurs. Therefore, it is necessary to account for both these aspects of citizen participation in the next section.
ANTCEDECENT CONDITIONS FOR CITIZEN PARTICIPATION

Several authors have identified and explained the historical antecedents for citizen participation, in general, (e.g. Langton, 1978; Susskind and Elliott, 1983), and with respect to architectural and urban planning, in particular (e.g. Castells, 1983; Lawrence, 1987). These circumstances can be traced to the gradual yet continual growth of "the bureaucratic distance" separating (1) citizens from their national, regional and local governments (especially the politicians who enact policies and programs and the bureaucrats who administer them); and (2) diverse professional groups who are meant to offer specific services to the public. Furthermore, given the increasing polyvalence of groups and sub-groups of citizens within specific societies, a growing number of "minorities" seek to express their aspirations, life-styles and values. Citizens have increasingly seen fit to challenge the status quo, or new projects and programs, which have an impact on their daily lives.

Given this trend in many contemporary societies, the concept and practice of citizen participation in environmental issues has broadened. Nonetheless, just how successful citizen participation has been is a moot point for many authors, whose assessments are undoubtedly influenced by ideological frameworks (Castells, 1983; Churchman, 1987; Lawrence, 1982; Susskind and Elliott 1983). Until recently, few authors had examined (or considered it appropriate to question), whether it was participation per se, or the specific methods inducing participation, or the aspirations and goals of those different groups of people collaborating in participatory programs, that could be identified with the success and shortcomings of specific participatory planning projects. Following some recent studies of citizen participation in community organizations and environmental planning projects, the limitations of earlier studies have been corrected, at least in part. Castells (1983), for example, has identified four prerequisite conditions for citizen participation, which he classifies as institutional, technical, social and political antecedents. These circumstances can either favor or inhibit participation. However, according to a series of studies by Wandersman and his colleagues (Wandersman 1979;1984) these prerequisite conditions for citizen participation in community affairs should be enlarged to account for the personal characteristics of the participants, as well as their attitudes toward the administrators, politicians and promoters of specific projects.

Churchman (1978) discusses the balance of power between professional and community groups, the kinds of influence citizens can have, and a comparative
assessment of a range of projects including citizen participation in the upgrading of neighborhoods. Nonetheless, Churchman, like Wandersman and many other authors, overlooks (or rejects?) the important function assumed by diverse mediums for citizen participation. This shortcoming has been equally common amongst social scientists and designers, but there are some indications that this limitation is being corrected. In essence, a handful of recent contributions concur that the concept and practice of citizen participation cannot be disassociated from mediums and methods, because these serve as catalysts for interpersonal communication (Canter, Krampen and Stea, 1988). Consequently, a primary focus of some recent contributions is how participatory procedures can offer explicit ways of reducing the communication gap between different groups of citizens while enhancing interpersonal dialogue. In essence, methods of communication and techniques of representation are required to dissolve (as much as possible) academic, ethnic, social and professional boundaries that inhibit meaningful communication between people who wish to participate.

DISCUSSION

The preceding sections of this paper indicate that both institutional and political antecedents regulate whether citizen participation can occur in a precise context, whilst the social and technical antecedents influence how citizen participation will occur. Furthermore, this example, as well as the research and design practice reported in these proceedings, have indicated how three-dimensional simulations of the built environment are a more effective medium for the elaboration, representation and communication of proposals than more traditional approaches used for the planning and design of the built environment. According to Raser (1969) the principal reasons for making simulations are the economy of experimenting with a facsimile rather than the real object, the observation and measurability of a visible model and the reproducibility and safety of simulations. The purpose of the simulation model ought to be addressed with respect to these parameters and, above all, with respect to the inherent capacity of its simulation mediums and methods. The task can be descriptive or evaluative, and it can focus on some variables over the passage of time. In general, the purpose of the simulation model determines the degree of approximation to reality. A simulation is not a replica of a real-life situation but a representation of it. In most instances, the degree of abstraction from reality impinges on the kinds of purpose simulations can serve in any situation; in environmental design and planning, the representation of contextual contingencies is fundamental to the definition and resolution of design problems, and this principle must be born in mind.

Figure 5: The limitations of full-scale simulation laboratories ought to be acknowledged, especially in accounting for the contextual conditions of the site, daylight and views.
Consequently, the proposed role for full-scale models is to represent diverse possibilities, to give laypeople and professional designers a medium to think and communicate with, and to appraise and modify alternative design solutions. These models are not meant to be replicas of future buildings because:

(1) they cannot be detailed during the initial phases of the design process, when many decisions about fittings and furnishings have not been made;
(2) they ought to be simple renditions of buildings that do not inhibit the development of alternative designs and enable design proposals to be simulated and evaluated as simply and quickly as possible;
(3) they ought to focus on the size and shape of rooms, and the interrelationships between the interior and the exterior, while bearing in mind that when any environmental simulations do not occur on site severe limitations are inevitable in the replication of daylighting and views.

In each of these respects, the role of full-scale models as mediums for citizen participation is quite different from the traditional use of architectural graphics and the more recent application of computer aided design.

CONCLUSION

This paper has examined a range of subjects that have been evoked by the use of full-scale three-dimensional models as mediums for citizen participation during environmental planning and design processes.

The practice of using three-dimensional models instead of two-dimensional representations of the built environment raises certain issues which can be discussed in terms of four roles of full-scale simulations as:

(1) an effective medium for studies of the interrelations between people and the built environment;
(2) an effective medium for research on design methodology, especially how simulated built environments express the values and intentions of designers and laypeople;
(3) an effective medium for environmental design practice, including citizen participation in the planning and design of the built environment;
(4) an effective medium for design education, specifically the formal principles underlying diverse types of built forms and construction methods.
In each role, the rationale and limitations of full-scale simulation techniques can be identified and discussed in terms of the contextual conditions that will be applied. In sum, it is appropriate to recall, as Woolley (1987) has observed, that full-scale mockups are effective mediums, but not a panacea, for citizen participation.
REFERENCES


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