Studying Designers '05

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CRITICAL POINTS FOR CHANGE

A vital mechanism for enhancing the conceptual design process.

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Abstract. Conceptual design is not a linear process; it consists of sub-processes, levels of refinement, which are individual but interact with each other. Each level of refinement corresponds to the types of media and tools used during conceptual design. Architects take advantage of a broad palette of tools and media for design, because each tool has its own strengths and weaknesses and provides an additional value—an added level of vision—to the architect. This closely relates to the notion of Critical Points for Change (CPC) a contribution this study makes towards a better understanding of the uniqueness of the conceptual design process. CPC are crucial moments when the architect suddenly becomes able to "see" something which drives him to go back and either alter his idea and refine it or reject it and pursue a new one. They are crucial parts of the design process because they are a vital mechanism for enhancing design. This characteristic of the nature of the conceptual design process is independent of the tools. Nevertheless, the right tools play an extremely important role. The distinctive capabilities of each tool allow the architect to deal successfully with CPC and overcome the points in the design process where he or she feels "stuck." Four Case Studies on practicing architects and a Survey on Tools for Conceptual Design conducted among architects provide valuable background material and support the arguments of this study.

1. Introduction

A massive volume of research has focused on trying to understand how designers perform design. Researchers have approached the exploration of design activity through different research methods, including protocol studies, interviews, and simulation trials. They all agree on the importance of the sketch as the primary tool for developing design concepts, stimulating thinking, performing design reasoning activities, and facilitating the architect's conversations with himself and others.

2. Conceptual Design Process

The design process is open-ended and problems and solutions cannot be clearly identified and separated. This set of problems and solutions cannot be broken into parts that can be solved separately; it has to be treated as a whole. Moreover, there is no perfect, "right," solution, only preferred, better ones. During the hunt for a better solution there are often back and forths, switches between different media and tools, and constant questioning of ideas through comparisons, tests, and rejections. The conceptual design process is not linear.

Since there is no one "right" solution, but only better ones, there is also no panacea or set of methodologies for approaching conceptual design. As one of the case studies reveals, an architect can use different strategies in every project and cannot prescribe which the right one is. For example, Bernard Tschumi believes that in some projects computer tools are crucial in helping develop the concept (Museum of Sao Paolo) and on some others not at all (New Acropolis Museum). Similarly, in an other case study of the same research, we can distinguish the different approaches that each of the four architects followed, as they prioritized the structure, the function, the form, or the concept.

Furthermore, according to the data gathered from 242 architects who participated in the Survey for Tools for Conceptual Design, most of them tend to explore two to three ideas before they choose the "one" and move on to design development. What is interesting is that, contrary to what one would expect, the more experienced someone is, the fewer ideas he/she tends to explore. In fact, the Survey reveals that senior architects tend to explore fewer ideas than the drafters or interns in offices (Fig. 1).

Also, contrary to common logic, exploring more ideas does not necessarily mean that conceptual design takes a larger proportion of the total design time: architects who explore four to five ideas spend less time on conceptual design than those who explore two to three ideas. However, no matter how many ideas the architects explore, they do often feel the need to go back and revise their design.

In addition, switching between different media and tools creates loss and duplication of information and forces them to re-enter information; nevertheless, they choose to do it even if that causes delays.
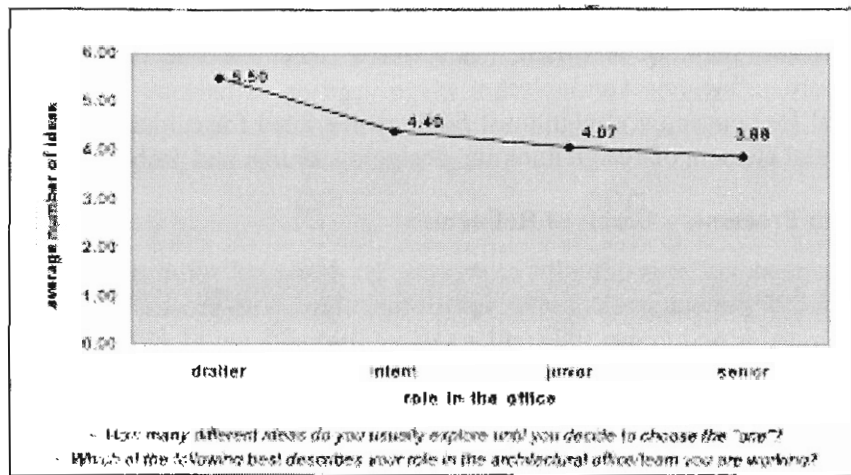
Figure 1: The more experienced an architect is, the fewer ideas he/she tends to explore

3. Comparative Method

One of the most common practices in conceptual design is the comparative method. The architect creates many alternatives in order to be able to compare, reject, and select. It is easier for the human mind to select one solution among others than to conceive of it originally and directly. This preference is similar to the following problem: when given a straight line and asked to mark an eighth of its length, it is easier to divide it in half, then divide the remaining length in half and the remainder in half again. The mind works better when comparing than when calculating.

Marples argues that the nature of a design problem can only be discovered through examining proposed solutions (Marples, 1961). He argues that if we examine only one proposal we end up with a very biased view. We need at least two radically different solutions in order to compare them and get a clear picture of the "real nature" of the problem. Nigel Cross agrees that even a conjectured solution is critical because it helps the architect understand the design problem. Generating a variety of solutions is a method of problem analysis (Cross, 1990). Hand drawn sketches have traditionally been the primary tool for design exploration and experimentation. Sketches not only allow the architect to vizualize his or her thoughts; they also provide valuable feedback and facilitate a constructive dialogue between the architect and his or her ideas. John Gero stresses the importance of hand drawn sketches as a means of review: architects generate more meanings when revising their sketches than when drawing them (Gero et al., 2001). Architects have recently discovered the potential that certain

computational tools have in helping them "talk" with their designs, in order to explore, play, be surprised, get inspired, meet the unexpected, judge, compare, refine, reject and select.

A tool for conceptual design must facilitate the need for comparisons, as an essential element of design thinking, design reasoning, and problem solving.

4. Sub Processes - Levels of Refinement

Conceptual design is not a linear process. It consists of sub-processes which are individual but interact with each other. Each sub-process has its own unique value and grants the architect an additional level of vision. The sub-processes correspond to the types of media and tools used during conceptual design.

For example, in one of the Case Studies of my doctoral research we can distinguish four separate sub-processes, which play a valuable role during decision making:

a)   Sketching,
b)   2D CAD,
c)   3D digital modeling, and
d)   3D physical modeling (Fig. 2).

Figure 2. Example of the four Sub-Processes observed at one of the Case Studies.

In this example, only when the architects used a digital 3D model were they able to see an aspect of the design –which sketches and 2D CAD could not reveal- and decide that they had to go back and change the main idea. Going back entails a manual update of the design with new sketches and

new CAD drawings. Similarly, only when the architects built a physical 3D model were they able to see another aspect of their design that needed to be altered; they decided to go back again and make the appropriate changes. Then again they had to re-input information in new CAD drawings, a new digital 3D model, and new sketches (Fig. 3).
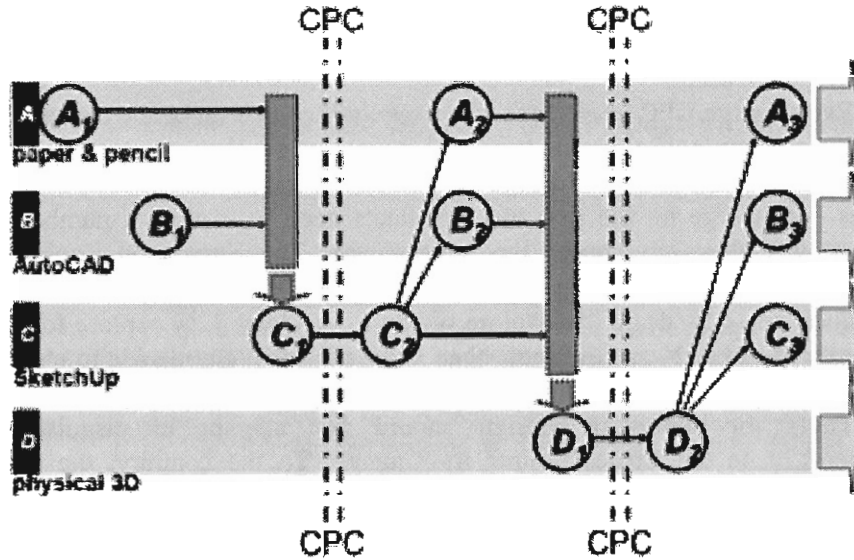

Figure 3. Critical Points for Change occur when the designer becomes able to "see" something that drives him to go back and alter his idea or start with a new one.

These sub-processes operate as levels of refinement for the conceptual design process. Each level functions as a filter for narrowing down the number of alternatives to be explored. The architect begins with a large number of alternatives and at each level confines the choices until it is possible to choose the most preferred one, which then goes on to design development.

5. Critical Points for Change

The levels of refinement are closely interrelated to the notion of *Critical Points for Change*. These are moments when the architect "sees" something that drives him to go back and either alter his idea or start with a new one. They are crucial parts of the design process because they are a vital mechanism for enhancing design. They either trigger alterations that refine the design solution or provoke the architect to reject the idea and pursue a better one.

Often a new level of refinement would provoke a CPC. Through the help of a new tool, the architect becomes able to "see" something that was not

visible before and can decide to go back and a) alter the design idea, b) abandon it and begin from scratch, or c) abandon it and pick an idea that had been discarded or left "inactive". The Case Studies that supplement my doctoral research demonstrate examples where CPC occurred on real projects. Moreover half of the architects who participated in the Survey on Tools for Conceptual Design reported that several times they had changed their minds and that they went back even if they had proceeded to the design development stage.

Even though CPC might look like irregularities that make the conceptual design process inefficient, the truth is that they are absolutely necessary for a creative, genuine course of design exploration. Besides, the desired outcome does not emerge on the first try. Architects need to explore a number of ideas until they can choose the optimal one. The Survey on Tools for Conceptual Design reveals that less than one percent of the architects explore only one idea: 40% explore two to three ideas, 32% explore four to five ideas and 27% explore more than six ideas until they decide to choose the "one".

Tools for conceptual design should not attempt to disguise or underestimate the Critical Points for Change. To the contrary, the tools should assist the architect during CPC cases in six ways:

a. Reveal CPC cases earlier in the process.

b. Provoke the emergence of more CPC cases.

c. Encourage deeper exploration of each alternative by offering additional levels of vision and understanding.

d. Support the architect in the dilemma of whether to alter an idea or abandon it and start again from scratch.

e. Organize all the different ideas and present a broad palette of them.

f. Integrate the different media and tools in order to reduce the inefficiencies that CPC causes.

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