

# DIGITAL-MEDIA IMPACT ON THE REPRESENTATION CAPABILITY OF ARCHITECTS

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## Abstract

*Architects draw to define design problems, to construct concepts, or to explore ideas. Representation not only connects various design activities and tasks, but also is utilized inside all these activities and tasks. Within the context of this research, the Design Capabilities of architects are defined as the skills used during the design process, including Conceptualization, Representation, Form Giving, Knowledge Building and Retrieving, and Decision-Making. Using representational techniques introduced by digital media during design development has altered what we can represent, perceive, and therefore conceive and imagine. Depending on primary data (a global questionnaire) and secondary data (synthesis of previous researches), the results of this investigation have substantiated that there has been a positive impact of digital media settings on the output of Representation capability of architects. The analysis reveals some detailed findings, which provide a better understanding of the subject matter.*

## 1. Introduction

Approaches and tools of digital media used along the design process are in a continuous development, which results in posing additional challenges and opportunities for the architects of the present day.

The use of digital media allows methods with which knowledge can be captured, accumulated, and used over and over. There is a need to look at how digital media can impact the design capabilities of architects. This research investigates the impact of digital media on the Representation capability, through defining this capability and classifying the basic approaches of digital media used in the design process.

The design capabilities of architects can be classified into five types: Conceptualization capability, Form Giving capability, Representation capability, Decision-Making capability, and Knowledge Building and Retrieving capability. Although there is no order of how architects use these design capabilities against the various tasks of design process, the features of a generalized portrait can be discovered. Within this portrait, architects move forth and back inside a reciprocal-influences loop that connects between Conceptualization, Form Giving, and Representation capabilities. Meanwhile architects use a mixture of both Decision-Making and Knowledge

Building and Retrieving capabilities in order to guide the foregoing mental loop in evaluating the tentative proposals they have in mind for solving the design problem or its sub-problems (Abdelhameed 2003).

## 2. Representation capability

Representation capability of architects can be described as the capability to compose their thoughts in representative ways through lines, areas, volumes, colors, etc. Architects use this capability, in conjunction with the other design capabilities, for exploration, presentation, and evaluation of what occurs in their minds during designing.

This capability encompasses two and three dimensional drawing, physical modeling, and coloring capabilities, regardless of the media type (be it manual or digital) used during these activities. All the manual activities of Representation capability including drawing are learned processes, not in-born talents, achieved through confidence and knowledge building, motivation, practice, and application.

Architects draw to define design problems, to construct concepts, or to explore ideas, as drawing is a versatile language (Kasprinsin, R. and J. Pettinari 1995). Representation not only connects various design activities and tasks, but also is utilized inside all these

activities and tasks.

## 2.1. Act of drawing and sketching

Drawing is an essential activity in the Representation capability. Drawing is spatial thinking as architects explore and reveal their schemes with the aid of sketches and other drawings (be it two-dimensional or three-dimensional). The act of drawing is important as a vehicle for communication; it actually helps architects see and understand the forms they work with (Do, Ellen and M. Gross 1995).

Through drawing and sketching, spatial relationships emerge and are formed, and opportunities and implications of forms are assessed. It is hard (one may maintain it is impossible) to have a design idea without using drawing in its germination or its evaluation. While representing their ideas through different methods, architects organize and construct these ideas. The act of drawing associates basic processes of design, which can be summarized in:

- Visual Design Thinking: “The hand moves, the mind becomes engaged, and vice versa” (Graves 1977). There is an inevitable reciprocity between the act of drawing and the thinking related with it.
- Design Idea Germination: While defining, exploring, and redefining the design problem, architects construct, evaluate, and form their design ideas by utilizing different types of drawings.
- Design Development: The foregoing role of drawing plays a major part in forming ideas, so that it has an important part in shaping design decisions and in design developments. Books on the functions of drawing in architecture (e.g. Fraser and Henmi, 1994; Herbert 1993; Lawson 1994; Robbins 1994) remind us that drawing – researchers mean manual drawing - is still the medium of choice for creative design and design development (Do, Ellen and M. Gross 1995).

## 2.2. Representation tasks

Three stages of Representation tasks can be identified inside the design process, according to their outputs and

the tasks that are interdependent with:

- Early episodic investigations of initial ideas help in defining the design problem and in constructing concepts. These investigations might be through two/three dimensional drawing and modeling. Manual media have the flexibility that allows the architect to start without having a certain idea. “Sketching is basic to conceptual design...it may be that CAD software is too structured for conceptual design thinking, which uses freehand sketching as its primary mode of development” (Do, Ellen and M. Gross 1995). Drawing is “the making of concepts and conceptual developments” (Rowe, P 1987). When digital media are combined with manual in design, manual media dominate in performing this episode, even with the associated use of quite sophisticated software of digital media. For example, Gehry initials design through physical modeling before using digital media (Entous, Marc 1998).
- Later drawing and modeling subsequently revoke refinement and adjustment for the compositional principles of fitting forms and structures, for the formal configuration of circulation and use, and for the three-dimensional conformed consequences. During these episodes, computer representations provide a large aid for architects. Using representational techniques introduced by digital media during design development has altered what we can represent, perceive, and therefore conceive and imagine. Digital media, through 3D manipulating programs and image editing programs, allow architects to project and to manipulate complex geometry in ways that would not occur if these drawings or models were manually created.
- The representation of final drawings that are finalized by the architect with all the required details conforms the nature of computing as an algorithmic process more than the nature of manual media. Digital-media are more accurate, rapid, flexible and effortless in producing a documented version of drawings.

### 3. Digital media impact

Computers have a role in creating an environment within which they are associated in design, by amplifying architects' design capabilities and by offering unanticipated results and forms. Exploring positive or negative areas of impact, introduced by the various settings of digital-media use, on the Representation capability of architects will be investigated through two methodologies:

- Extracting the impact from the synthesis of previous research in the related areas, which have been partially discussed in the last part of the research. This methodology overcomes obstacles resulting from the fact that some concepts of digital-media use are not available for many architects to employ because of the cost (of the sophisticated software or hardware), or because of the relation to computer science (which requires a computer programming background to benefit from these uses).
- Assessing the impact by surveying a sample of experts and professional architects. The impact in this case is according to the vision of the respondents.

#### 3.1. Extracting the impact from the previous research

Representation, through drawings, colors, or models, allows ideas to be effectively evaluated. Therefore, utilizing what digital media introduce in this realm strongly augments architects' performance in representation and evaluation. The main characteristics of digital media introduced in Representation tasks are: 1) the higher levels of geometrical definition and abstraction, 2) the elaboration and coordination of complexity and details, and 3) the transformation and manipulation of both images and models in an easy way comparing to the manual-media use (Nivitski 1991; Kaiser, K. and A. Maller 1993; Barreneche 1996; Bermudez, J and A. Smith 1999; Cheng 1999; Groh 1997; DeLaura 1997). Representation tasks are performed in conjunction with other tasks along design process (e.g. Conceptualization tasks, Form Giving tasks, etc.). Consequently, the impact

of digital media on the Representation capability is interrelated with the impact on other capabilities. This is evident in the basic processes related to drawing and representation, namely: visual design thinking, design ideas germination, and design development.

The potentials of software and hardware that accompany computer use, have changed this use from being just a tool for drawing to being a medium through and by which design is performed and solutions are generated. Many scholars and architects (for example, Marx 1998; Lynn 1999) consider this digital environment more apt and powerful to start design. Representation through digital-media use allows architects to initialize the design in three dimensions in a way which conforms the present nature of architecture. The use of digital media releases form from the geometric abstract to more complex and curvaceous horizons.

Within using algorithms of form generation, computers are metaphorically allowed to propose architectures of their own. The role of the Decision-Making and Representation capabilities is not prominent in the initial phases of the design process. Form is generated by software, where design capabilities performed by architects are delayed to later design phases, Representation capability included. This leads to a negative impact on the Representation capability and the Decision-Making capability, and their role in design development.

Within digital-media use, the Representation capability encompasses the use of programs, such as image editing, digital video capture, 3D modeling, 3D manipulating, etc., instead of free hand sketching, manual drawing, and physical modeling. Architects can manipulate some layers without affecting the others, always preserving the ability to change back to a previous version. Moreover, the source of images used in presentation, has been expanded to include photographic, hand-sketched, etc. The ability of digital media introduced through these programs enhances the output of the Representation capability, as they allow almost an infinite number of independent layers of imagery and text.

### 3.2. Extracting the impact from surveying architects

#### The questionnaire

A questionnaire was conducted (during the period from June 2002 to April 2003) to assess the impact of various digital and manual media settings on the Representation capability of architects. An invitation of participation was electronically sent to the members of the conferences of: ACADIA, eCAADe, CAADRIA, and SIGraDi. Also, an invitation was sent to the professors and the students of M. Sc. and Ph.D. in Arizona State University (USA), University of Sydney (Australia), and ASCAAD (Arabic Society of Computer Aided Architectural Design).

The total number of replies was 56. Few respondents preferred not to assess all various uses, concentrating only on what they use. The sample encompasses both practical and theoretical views of those who are practicing, teaching and researching in the subject matter: 1) 35.72 percent of participants are architects who are pursuing either Master's or Doctoral degrees

in architecture; 2) 16.07 percent of the sample are professional architects, e.g. CAD managers, etc.; and 3) 48.21 percent of participants are faculty members involved in teaching and research (Assistant Professors, Associate Professors, and Professors). Other important characteristics of respondents, such as the period of computer use and self-assessment of computer use are summarized in (Table 1).

#### Results of the questionnaire

Architects were asked to assess the impact of their use of various media settings on their Representation capability. Table 2 and Figure 1 summarize the results of the survey in a comparative way. The columns represent various media settings, the basic approaches of digital media used in the design process, namely: Fully Manual Media Setting, One-Way Interactive Media Setting, Multiple Interactive Media Setting, and Fully Digital Media Setting. The rows represent the various impact levels of each setting as viewed by the respondents.

**Table 1 Characteristic of Respondents: Period and Self-Assessment of Computer Use**

Characteristics of Respondents		Number of Respondents	Percentage of Respondents
Number of Years of Computer Use	Less than 5 years	17	30.36%
	5-10 years	11	19.64%
	10-15 years	16	28.57%
	15-20 years	5	8.93%
	More than 20 years	7	12.5%
Self Assessment of Computer Use	Low User	1	1.79%
	Below Average User	4	7.14%
	Average User	0	0%
	Above Average User	32	57.14%
	Intensive User	19	33.93%

**Table 2 Comparison of the Impact of Various Digital and Manual Media Settings on the Representation Capability of Architects**

Media Settings \ Impact Level	Fully Manual Media Setting	One-Way Interactive Media Setting	Multiple Interactive Media Setting	Fully Digital Media Setting
Very High Impact	29.09%	0.0%	28.57%	42.86%
High Impact	14.55%	37.5%	14.29%	14.285%
Medium Impact	0.0%	37.5%	28.57%	14.285%
Little Impact	41.81%	12.5%	28.57%	14.285%
No Impact	14.55%	12.5%	0.0%	14.285%

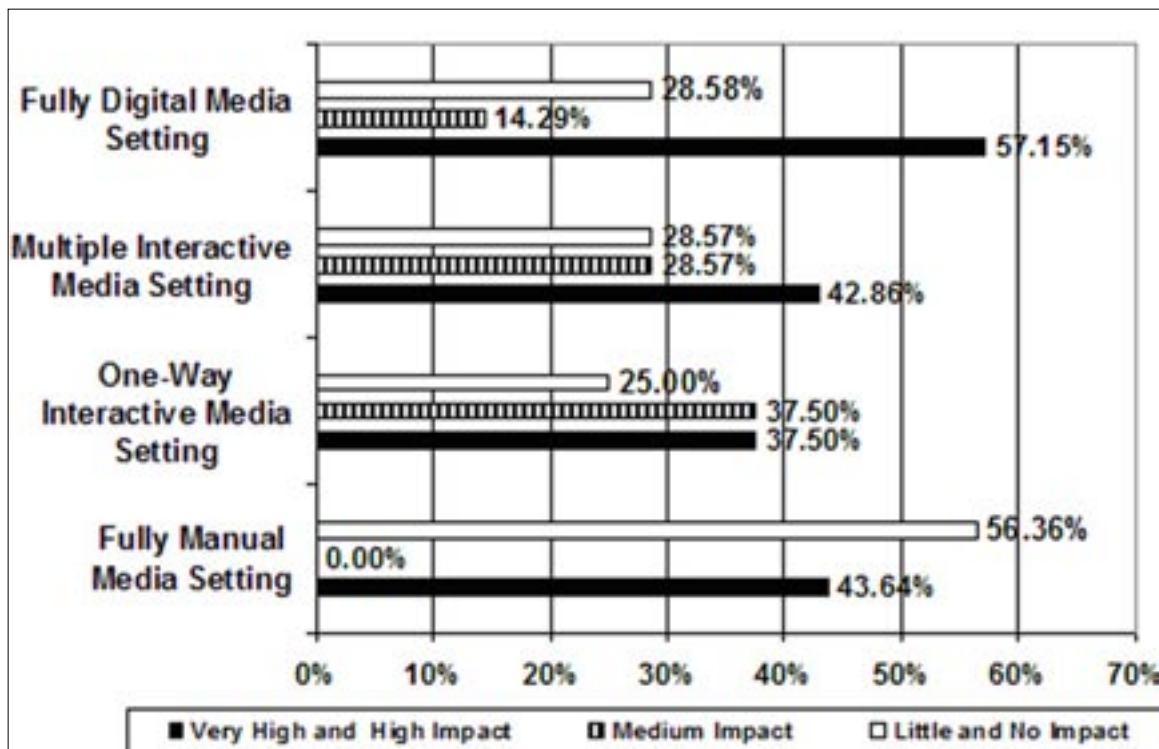


Figure 1 Comparison of the Impact of Various Digital and Manual Media Settings on the Representation Capability of Architects

- The Impact of Fully Manual Media Setting: The result refers to a controversy between the respondents regarding the impact of this kind of media setting on their Representation capabilities.
- The Impact of One-Way Interactive Media Setting: The result shows that 75.0% of the respondents find that there is a certain impact of this kind of media use. Half of the previous percentage (75.0%) finds that this impact is very high or high.
- The Impact of Multiple Media Interactive Setting: The result refers to increase in the positive impact of the use of multiple interactive media setting on the Representation capability.
- The Impact of Fully Digital Media Setting: This result refers to increase in the positive impact of the use of fully digital media on the Representation capability.

#### 4. Conclusion

- Developing the designs in digital environments elevates the output of the Representation capability of architects to horizons beyond what would have been possible if these designs have been manually developed. Digital use gives architects the full clarity of what is being created.
- In general, the use of digital media releases form from the geometric abstract to more complex and curvaceous levels. However, form generation programs have a negative impact on the Representation capability and its role in design development because of delaying this role to later design phases.
- From the results of the questionnaire, the major trend represented the very high and high impact of various uses of media on the Representation capability of the respondents, increases towards the use of fully digital media. This result of the questionnaire conforms to the synthesis of previous research regarding the

powerful role played by the use of digital media in exploration, manipulation, and presentation of drawings.

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