11 Design Thinking and the
Need for Open Access to Multimedia Sources

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To realise the impact of Multimedia Information Technology on architecture, it is necessary first to re-map the position of media technology in the design thinking process. This would then reveal the key issues and priorities facing the development of IT applications for architectural design. In the particular context of Asia, special considerations and opportunities exist which make it even more compelling to have a clear frame of reference. These three interconnected topics constitute the concerns of this paper.

INTRODUCTION

The rising significance of multimedia information technology to organise architectural knowledge reopens the inquiry into the nature of design thinking and poses new questions about how we are to fashion IT tools for creative reasoning. Never before has there been a single media that emulates all the conventional forms of design representation — drawings, sketches, scale models, photographs, and even movies. Whilst the similarities of these 'digital' equivalent with their counterparts are apparent, their subtle differences — and therefore their surpassing advantages — have escaped the scrutiny of skeptics who dismiss them too hastily. To them, the computer is just a "glorified design tool" no different in rank to the T-square and drawing board. Many have therefore acquired misguided expectations of the computer as a draughting machine to "draw up" designs which cannot conceivably be advanced other than by the human mind alone. A concession they may make is the relative ease to make three-dimensional compositions and animations in computer graphics; but even this is viewed only as "3D drawing" extensions, and little to do with design thinking.

1.0 MEDIA TECHNOLOGY IN DESIGN THINKING

Johnson-Laird argued that "the brain exists in order to construct representations of the world". These "mental models" (Johnson-Laird 1983) as he called them, are shaped by thinking. Like architectural models, they help us to anticipate the future. Mental models can take many forms; one of the most common type is 'episodic' — sequences of events are recalled to simulate the circumstances under which a problem at hand may be solved in a similar way. Another well-known model is the "representative" heuristic where an event is judged probable or an object recognisable to the extent that it represents the essential features of its parent population or generating process [Tversky
and Kahneman 1982]. The basic cognitive process of translating external objects, events or facts into abstract mental models — and vice versa — is summarised in Figure 1.

![Figure 1: The correspondence between External Object and Internal Model](image)

The next level of consideration is the filter between the external system and the mental model. Kenneth Craik had proposed that the encoding translation or interpretation is in symbolic form [Craik 1943] and that within the internal system, transformations can be made to the symbols before they are decoded back to the external system. Alan Newell and Herbert Simon [1972] postulated a similar explanation but added that the 'internal' system can be any "information processing system" (IPS), including natural as well as artificial systems, such as computer systems. With these additional considerations, the process now includes a symbolic "transformation" process, and the "translation" process is now elaborated into an "encoding" and a "decoding" process (Figure 2).

![Figure 2: The encoding, transformation and decoding processes in an IPS](image)

Some philosophers have argued that there is no ready-made world — "external objects" do not have intrinsic properties. The ways they are encoded, depend on how they are conceptualised. E.g., Hilary Putnam argues that without conceptual schemes, external facts make no sense. It is therefore through an interface filter that the external world is conceptualised and also through which internal models are posited — represented — in the world system external to the IPS (Figure 3).
Figure 3: The interface between the external and internal worlds

There are limits to the capacity of the human mind to perform transformations, and to store and organise mental models (e.g. see Koslyn 1980 and Marr 1982). There are also constraints to our conceptualisation and representation capabilities, some of which are physiological, e.g. perception of colour. Even if we can have a complex scheme, such as a building, fully worked out in our mind without the use of any external representation, it would pale in comparison to the extent possible even with simple sketches. Any external representation, such as a sketch, act as an intermediate model for further conceptualisation, transformation and representation. This explains how designs evolve in stages and how designers can perceive new — emergent — forms to make creative moves. Designers therefore frequently enrich their design environment with 'external objects' which are general as well as specific to their current design problem, and from diverse sources (e.g. books, magazines and even music) as well as from their own representation process.

Until the advent of computing, 'external objects' have been passive sources of design information. Since the "external" world is common to other IPSs, a designer can also interact with an artificial IPS through its interface — a window into another world system (Figure 4). (Note that when the interaction is with other human IPS, we generally refer to the activity as "collaboration" — an increasingly important component of computer-aided geographically-distributed workgroups; see Tan & Teh 1995). In the case of a multimedia information technology IPS, the full range of representation types enables it to assemble collections of design information from a broad spectrum and extensive treatment of a subject. With global networking and telecommunications, the distributed repository or database of design information is potentially massive; as demonstrated by the World Wide Web.

Figure 4: Common External World for multiple IPSs.
In summary, it has been shown that, a) a designer as an information processing system, conceptualise external objects in accordance with models which anticipates the future; a transformation function manipulates the model for representation back into the external world system where it can recursively influence the designer or other collaborating IPSs; and b) a multimedia IPS is a parallel system to a human IPS, and because they share the same external world system, the models from the multimedia IPS act as 'external objects' to support interactive design thinking.

2.0 KEY ISSUES AND PRIORITIES FOR THE DEVELOPMENT OF MULTIMEDIA IT APPLICATIONS FOR ARCHITECTURAL DESIGN

The key issues for the development of multimedia IT applications correspond to the components of the IPS system, viz.,

a: input interface  
b: output interface  
c: transformation process  
d: model structures

These issues will now be discussed in the context of a recently-completed prototype system at the National University of Singapore. The system was developed within a research project called IMPAGE (Interactive Multimedia Presentation of Architectural Geometries by Example) by the School of Architecture and the Institute of Systems Science.

2.1 Input Interface

Two types of user interface modules (UIM) were created — Reader UIM and Author UIM. The Reader input UIMs comprise the following:

- Navigator: (Figure 5; bottom left)  
- Browser: (Figure 5; top right)  
- Bin: (Figure 5; bottom right)
The Navigator has a point-and-click interface which can currently be used in three ways:

- traversing the model structures (Classification System) for suitable descriptors
- searching by keywords
- searching by codes from the Classification System.

The Browser provides the low-level commands for the reader to perform basic search and to access pre-arranged storyboards or "case hierarchies".

The Bin is an intermediate holding place for media files retrieved from a search process. It functions like a lightbox for the reader to further choose and rearrange the files for either individual or comparative viewing.

More ways of getting to the same information is possible and can be added to the UIMs.

Case authors utilise a suite of input UIMs to perform tagging and updating of individual files:

- Inventory:
- Tagging: (Figure 6; bottom)
- Update: (Figure 6; right)
- Node Manager:

At this juncture there does not seem to be a short-cut to the laborious tagging of all media files. Any attempt to automate the tagging process will face the intractable problems of recognition, ambiguity, conceptualisation and classification of the multiple subject matters in each file.
UIMs are modular. They can therefore be enhanced, removed or added with relative ease.

2.2 Output Interface — Viewers

Several specialised media viewers are provided to accommodate the range of multimedia data. The main Viewer supports the display of Hypertext (SGML format), lists of captions and Targa images. Texts are displayed in a separate window (Figures 5 and 6).

For 3-D models, a customised VR (Virtual Reality) Viewer is used to provide interactive navigation and 'walk-throughs', customised views and control of "layer" displays (Figure 7).
2.3 Transformation process — Search and Retrieval

The transformation process of the IPS is essentially the SQL search and retrieval process. Standard SQL queries like SELECT, DELETE, INSERT and UPDATE are embedded in scripts activated via the UIMs.

In addition to Search and Retrieval, the system has a set of Node Editing functions to enable case authors to customise the presentation of media files.

Like the UIMs the Search, Retrieval and Node Editing functions are also modular.

2.4 Model structures — Classification System

The Classification System created for the prototype is a critical feature of the system. It addresses three problems of conventional architectural databases:

Cross indexing of non-sequential order

The strategy adopted by IMPAGE is to free information from any direct (hot) links to each other by maintaining a Classification System rather than data as the model. Information is kept outside the IPS and each discrete item is provided with a tag (not unlike a luggage tag). This way, the information can be freely associated with others as determined by a classification scheme which manages the relationships of different kinds of tags and the information they carry. Also, this means that other IPS can make use of the information collection by tagging them differently; i.e. organising them with different conceptual models.
Regrouping of multivalent connections

Information on a tag establishes its position (or positions) in the classification system. At the most elementary level, this allows all media with the same tag to be gathered for viewing; for example, all "chairs". Whilst this basic index is useful, it lacks the sophistication and knowledge of relations in a classification system to regroup information using 'higher' level or superordinate concepts. For example, "furniture" would also recall "chairs", plus other types of furniture, of course. For this reason, IMPAGE uses a classification system rather than a simple point-to-point indexing system.

Adding to and subtracting from unbounded collections

The separation of media from its classification model enables new material to be easily added to the collection or obsolete ones removed without incurring tedious system maintenance. For example, as the World Wide Web grows, so too it seems, the frequency of 'media loss' - any change to addresses at destinations invalidates all the pointer links at sources. In IMPAGE, once a new media is tagged, it can immediately be recalled by a keyword match or by conceptual grouping maintained by the classification system, along with similarly tagged media. In the same manner, removal of a media (and its tag) would not litter the interface with "media not found" messages.

In summary, the Information Processing System model outlined in this paper serves to show how the components of a multimedia IT application is linked to the designer's IPS. In particular, it shows that a model of the information repository in the form of a classification system is required within the IPS, and that for cross-indexing, multivalency and regrouping of connections, the elements of information should be kept in the open. These concepts have been implemented in a prototype multimedia system called IMPAGE.

3.0 SPECIAL CONSIDERATIONS AND OPPORTUNITIES FOR ASIA

Arising out of the Information Processing System model in this paper to account for the flow of design information relative to designers and information technology systems, there appears to be three areas where significant growth and impact can be expected for Asia:

3.1 Communication Networks

New communications infrastructure to meet the demands of high-speed multimedia information would enable large amounts of information to be transmitted and shared over wide areas. IPSs with different conceptual filers and models would be able to make better use of knowledge from distributed sources. Good telecommunications systems to support an information economy would make up for lack of good transport systems supporting an industrial economy.
3.2 Information Networks

The separation of information from its organisational model would make local knowledge more transparent and accessible — making for better informed designers. The relative ease with which knowledge from marginal sectors and language groups can be accessible would encourage information compilation. The integration of design and planning information in multimedia IT systems would enable more comprehensive life-cycle modelling and enable facilities management and geographic-information systems to be more effective.

3.3 Collaboration Networks

A communication and information network would naturally support collaboration. With different IPS sharing the same 'external' world, both interactive as well as 'off-line' sessions would support distributed workgroups which would be mobile and responsive to development opportunities in the whole region. The collaboration network would support inter-disciplinary as well as intra-disciplinary teams to undertake the complex, urgent and unprecedented challenge of building an Asia for the 21st century.

BIBLIOGRAPHY


