Radical Design Thinking and the Influence of Information Technologies

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When we consider some of the theoretical implications of connecting computation and information technology to the production of architecture, it becomes useful to look closely at two of the most common metaphors used to describe the impact of digital technologies on the field of design: the metaphor of The Digital as Recipe for the creation of physical objects, and the metaphor of The Digital as Rearrangement of traditional practices. These very encompassing metaphors have fixed, for the moment, theoretical parameters for much of the research, practice and speculation about the possibilities for a genuinely new era in design and building. For example, the idea of The Digital as Recipe describes a design methodology engaged by leading avant-garde design practitioners such as Frank Gehry. And the idea of The Digital as Rearrangement has been employed by contemporary theorists such as Manuel Castells to describe how the spirit of our age is in fact societal rearrangements such as globalization, brought on by the use of various new digital technologies.

Contemporary architectural critics such as Terence Riley link the theory of The Digital as Rearrangement to their descriptions of progressive design agendas, to justify the architectural representation of transparency and lightness as the spirit of our age. In short, these two metaphors have already been used to pre-select a favored method of practice and a favored system of representation for the digital age. But the design practices they encourage show only a narrow understanding of the impact of information and digital technologies on architecture, and of the place design and building practices occupy within capitalism. In this paper I will investigate the limitations of these metaphors in order to develop a richer sense of the impact of the digital on innovative design thinking. I will then articulate a more comprehensive set of specifications that guides my development of computational tools designed to enable much more innovative modes of architectural production available to us in a digital age.

CONSIDERING THE TWO METAPHORS

Perceptible improvements in software (to create building model files with exceptional geometries and components) and in hardware (to execute these files as its directive) have enabled both an increase in the degree of realism in virtual representations, and an increase in the direct control of hardware to cut three dimensional models directly from a single digital building model. In terms of the metaphor of The Digital as Recipe, a single building model can generate many executable scripts as computer code to drive hardware in various methods of performing those scripts. Each of these performances is simply a different representation of the same digital building model. The quality of these performances has been escalating. There is a logical crescendo to this, and it is not some perfected mode of virtual presentations, but the direct performance of the real building itself from the executable scripts of a single building model.

The recent work of Frank Gehry is much appreciated as bringing architecture closer to this logical crescendo of The Digital as Recipe. The specific advancement in the case of Gehry's work is as follows: a triple axis scanner measures his cardboard model of a complex building design that could not be readily drawn. The measurements generate a digital building model. Further design and manipulation of the building model occur in a CAD system. Two and three dimensional drawings can be output from the model file, as well as the direct performance of new scale models by a computer controlled milling machine. Finally, digital scripts can direct a water-jet stone cutter or a steel bending machine to yield full-scale building components. The Disney Concert Hall in Los Angeles and Guggenheim Museum in Bilbao are by now visual as well as theoretical icons of this achievement of computation in architecture. What does this achievement prove? For Gehry, by using techniques commonplace for some time in the automotive and aeronautic industries, technology has allowed that which could not be so readily drawn to be built.

The second metaphor concerns how digital technology changes the society, the building types and the commissions architects work with in the first place. According to the metaphor of The Digital as Rearrangement computer networks and telecommunication systems provide information and enable transactions that can be asynchronous and more globally dispersed. This is slowly but surely changing the organization, program and role of the architect in most every building type. The new library and the new retail design program clearly reflect this change and its impact on design.

Library design is becoming a job of creating buildings and computer systems as tools for storing, retrieving, and displaying information. Book stacks and reading rooms are as important as computer databases and information systems, as information is increasingly being accessed digitally, and publishers become suppliers not only of hard copies but of digital information. In retail, the virtual facade is becoming as important as the real building facade. The intelligence and ease of use of the web-based retail interface and its ordering system is as important as the well-laid out floorplan and design of an actual shop: both most visually reference each other as a global image of the business.

The writings of Manuel Castells on The Digital as Rearrangement have enabled critics such as Terence Riley and Hans Ibelings to justify the silent type of physical representation of space and program in the work of Steven Holl, Weil Arets, Herzog and deMureon and others, known as an ultramodern or supermodern architectural style. In architectural discourse such neo-phenomenological work has been building the case that the smooth and the transparent are analogous to the lightness of the flow of capital and information in the global economy. As so far represented through ultra-modernism, the concept of The Digital as Rearrangement builds a facade (light, diaphanous and attractive) on the challenges architects face as they work on, and work out building commissions for clients with real and diverse needs.

Along what lines should general, societal digital rearrangements be calibrated to architectural practice—to the demands and skills that make architects unique? Is the biggest problem for architects getting complex shapes input into the digital so that they can be built? Perhaps that is the most pressing concern for Gehry, but if that were the most pressing problem for all architects it would indicate that the focus of practice is a competition among architects themselves in particular methods of digital script making. A richer paradigm for digital architectural production won't emerge from the work of one innovator leading the rest using the latest toys, because architects don't essentially compete with themselves. With information technology architects will increasingly compete with "others"—so-called non-architects in the building environment. What remains unaddressed by the two metaphors is the proliferating ability of others—engineers, consultants, manufacturers, clients themselves—to digitally produce buildings, building components and design services. With the emergence of web-based collaboration, this new condition fundamentally complicates any simple metaphor for an innovative design practice.

THE LOCATION OF INTELLIGENCE IN A REMOTE COLLABORATIVE PRACTICE

While a specific building project develops through the work of its core project participants it also relies heavily on a more general class of building object and service providers that contribute to various projects on a competitive basis. The digital formatting of Sweets catalogue and its connection to manufacturers' products as downloadable files enables others to assert the virtues of their products and services more generally. Meanwhile the users of buildings—clients, facilities management—can competently insert and rearrange component parts in a shared building design model accessed through remote collaboration tools. Architectural design proposals must emerge successfully from a series (if not a barrage) of objective tests. A client's access to obvious solutions cannot be kept at bay while design documents are being finished. Even Gehry's "digital" design development process is open to criticism that it is done in an information technology vacuum. All design intelligence is essentially triple-axle scanned into digital format from his one of a kind sketch models. This is particularly inadequate in most architectural commissions, where the obvious solution is presented as ubiquitously as the radical one, and where the simple or the ugly answer will get the job if the client has a mind for it.

This begs one to consider the two metaphors in their combination: The main point to be recognized is that the rearrangement of practices has already enabled that digital recipes for any building object can emanate from anyone. Digital designs do not emanate only from architects. Design and construction information comes from everyone, all at once. It is nostalgic to insist that the architect should draw, and draw first, even digitally. On all but the smallest jobs someone else has always already drawn or specified first.

The general, societal digital rearrangements have their significant impact on architectural production by intensifying the capitalist objective to make for all things that equivalence required so they can be traded. In a collaborative, digital economy of building, building objects and executable scripts become interchangeable parts because of their ubiquity. Such parts are reinvented daily by any number of other people with different personalities with whom we are connected. The increasing presence of building objects and services represented digitally makes each object more and more interchangeable, while the actual function of the whole class of digital objects and services makes architects and clients increasingly dependent upon them for solutions.

To retain creative control over the visual organization of space in such a practice, custom designing one form of discrete production, or custom-learning a discrete expertise, is trivial to the creative task of manipulating and combining the digital production of others. Therefore, like the disciplinary knowledge of any other profession, a digital design intelligence that actually assists architects is one that carries itself, if you will, with the blasé attitude, a psychology of the information rich, (those who have seen it all, done it all, and answered all the boring questions).

PSYCHOLOGY, AI, AND MODELING INTELLIGENCE IN A REMOTE COLLABORATIVE PRACTICE

My argument for what intelligence, innovative practice, and aesthetic creativity really means under the impact of digital technology has a psychological component beyond that just mentioned. This component has a close connection to the computational tools I am developing. It is essentially Freudian, with an awareness of the development of thought models and emergent models of the decentralized mindset. While psychoanalytic and AI (Artificial Intelligence) research is structured to discover "Where exactly is intelligence, or meaning, in a model of the mind?" I primarily ask: "Where is the intelligence in a model of a collaborative design system?" My goals are to see to it that architects are the entities that posses that intelligence, and to develop computational tools that enable architects to control that intelligence as the seat of an innovative design practice. With that in mind, the following describes the relevance to collaborative design systems of certain psychoanalytic and AI models of intelligence.

In psychoanalysis after Freud, object-relation theorists began to describe the mind as a society of inner agents—suborganizations capable of generating meaning and experience. From their negotiations and interactions emerges what the subject thinks of as "the self." Psychoanalysis inspired by Jacques Lacan went even further in viewing the idea of a centralized ego as an illusion. For Lacan there is no core self. What we experience as "the self" emerges from our relationships with objects and others outside us, and from chains of linguistic associations that reach no endpoint.

AI theory too, has moved from a centralized to a decentralized model of the mind. By 1985 leading AI theorist Marvin Minsky's model of intelligence, elaborated in The Society of Mind, was based on objects and emergence. In this model, a tremendously large number of agents are discrete objects with only a limited point of view. Intelligence, as well as complexity of emotion and behavior, emerge from the mind as a result of the interplay, interaction, and negotiation of various agents. Minsky's AI model has a natural affinity with object-relations psychoanalysis, and was influential in theorizing emergent AI and its view of the decentralized mindset popularized in the 1990s by the work of educational researcher Mitchel Resnick.

While both psychoanalysis and AI have moved towards a model based on objects and emergence of intelligence, psychoanalysts were initially uneasy with the AI researchers making what appeared to be too simplistic reinterpretations of their own concepts, such as the Freudian slip. Freudian psychoanalysts view mental slips as a window onto the personality, its conflicts and history. The slips are assumed to tell us about people's inner wishes or suppressed thoughts. Under an emergent AI view, mental slips are taken as mere technical data processing errors, only a narrow determination is made, one that does not call meaning into play. This is because emergent AI sees a slip as an error that can be as simple as mistaking or miscoding a plus sign for a minus sign. For example, a man sees a woman sweating in the sun, and mistakenly says "She is cold" rather than "She is hot." If the mind stores information like a computer, occasionally substituting hot for cold is easily justified, and the slip does not tell us about the speaker's inner feelings for her, but is a simple technical matter. AI understands the slip this way because this sort of error is common in math and accounting, and in coding data streams, where the term hot would be coded and stored as—cold.

What does this tell us about modeling intelligence in a collaborative design system? The opportunities for innovation and intelligence lie with the entity that can reap the benefits of having any "slips" of design meaning or intent interpreted both ways. That is to say, as both the window to inner meaning of psychoanalysis, and as the narrow determination of miscoded data of AI theorists. The fact that this is absolutely critical to intelligence and innovation in a collaborative practice is shown through the following example:

An architect intentionally requests his collaborative peers —a Sweets manufacture of prefabricated ticket booths (such as those used in football stadiums) and a structural engineer —tto "install a certain model of prefabricated ticket booth as an enclosure, and engineer a floor to support it, for a high end residential project." This request can easily be interpreted by the manufacturer and the engineer as a "slip," a mistaken specification. A possible reading could be the architect meant to say the ticket booth was for a "football stadium project." That would indicate a mere technical (AI) slip. Or, the slip could be believed to reveal a deep, inner conflict exists in the project as a whole; that placing a ticket booth in a residential project is indicative of a meaningful discrepancy.

Nonetheless the manufacturer and the engineer can operate despite any views they might hold that the architect is malfunctioning. The engineer can proceed to design a floor to support a ticket booth even if he feels the ticket booth is so incorrect as to be an actual error. He has the prerogative to only use the relevant data that describes the ticket booth for his purposes—its weight, load and size attributes—0so that he can provide the agreed upon service: the floor design. The engineer can do this, despite never coming to certainty about whether the ticket booth is really "meant" to be a ticket booth.

The manufacturer of the ticket booth can also operate, and under any of a variety of interpretations of the architects so-called slip. The manufacturer can provide the ticket booth, and guarantee its performance, by gleaning from the project model all the relevant information that affects the placement and performance of his product. Any data that indicates the unusual residential context, but he deems will not affect his ability to provide the specified ticket booth, he has the privilege to ignore. Other choices the manufacturer has include increasing the cost of the object because of the unusual context, or declining to provide the object altogether. The architect is also free then to exercise interchangeability: to seek similar objects with similar attributes from other manufacturers.

In making a building, the architect and client are the only entities really invested in the built work that emerges from the overall effects of the interplay of disparate objects, entities and views. The intelligence in this model of collaborative production resides in the privilege of determining the "correct" interpretations at all turns. There is a tremendous amount of freedom and creativity available here. Any object or service provided by others can be arranged so that its interpretation can be any – sublime, mundane, ironic, beautiful. It is my view that the management of interpretations is equal to the aesthetic act, and that only that management brings about complex relationships, behavior and intelligence.

How can digital technologies be used to develop computational tools that enable a liberating system of collaborative design? My general concern is for the retention of a creative subjectivity amidst the objective relations of building. My view is that a devastatingly better IT-enabled practice would necessarily enable architects to frequently produce radical design proposals while at the same time ensure those proposals are feasible. As a result, I have focused on three areas of importance in developing computational tools for the design and management of shared building models in collaborative design practices. They revolve around the issues of (1) Sales, (2) Visualization and (3) the Decontextualization of needs.

SALES: INCORPORATING THE OTHERS INSATIABLE DRIVE TO SELL

From the point of view of consultants, general contractors and manufacturers, a shared building model in a collaborative design environment accommodates their desire to have their products and services seep directly into the designer's electronic drafting board. We must not mistake the fact that it is economic gain that motivates the makers of discrete building objects to insert them into the collaborative design environment. The burden of providing their own digital recipes (intelligent digital files with embedded product attributes and 3D representation in an exchangeable format) is compensated by actual sales and the benefits of all types of digital marketing that are enabled by extensible programming languages and interoperable collaborative design systems.

The others' push to sell, analogous to an insatiable desire of sorts, is mitigated by the coy by comparison actions of architects, by the seduction of what are essentially architect-presented opportunities to sell. In a collaborative design environment a default value that represents a manufactured product in a design cannot be hidden as much as a unique design component by an architect cannot be hidden. The default specification is controlled by the owner's/architect's lack of satisfaction, the unique design component is controlled by the others competition to fill it.

The shared building model database then, has only two forms of content: unique architectural design components drawn as design needs, and the existing production of others. It is misguided that architects should alter any content emanating from others in ways those others do not agree to produce. Therefore the computational tools I am developing include a tunable, three dimensional object search function, enabling architects to innovatively solve their needs through iterative, three dimensional trial and use of the production of others. It must be pointed out that tools that aid commerce also enable creativity here, because the required 3D visualization of the production of others evolves from the broad establishment of confidence that selling opportunities exist in the computational design environment. This is an existing condition for any broad acceptance of new digital tools.

VISUALIZATION: OVERCOMING DISJOINTED PRODUCTION, AND THE DEFAULT VALUE OF OBJECTS

It is pivotal that architects be enabled to see and acclimate, for their own style of decision making, where problems and innovative juxtapositions lie. But the digital production of others, despite being exchangeable and neatly classified into rational divisions, exists in a completely uncoordinated state. The coordinating responsibility, when attempted as such by hand, (i.e. without digital speed) actually IS excessively daunting. Producers strictly demarcates their responsibility and liability at the borders of their production, and justifiably architects have deferred to their skill at custom designing solutions. One implication of this is that the designs, scales and proportions of existing building objects are never necessarily related. Any computational proposals in this context cannot be a sort of Europeanizing of Sweets products and production. The approach I am taking is in a particularly American–pragmatist tradition: it does not change the actual products themselves, it changes the architect's relationship to the information. Therefore, also part of the computational tools I am developing is a 3D geometric change engine. Simply, architects require a geometric search tool and a workspace for testing iterative design scenarios, where online products and solutions are compared directly in the emerging design model.

DECONTEXTUALIZATION OF NEEDS: OVERCOMING THE LIMITATIONS OF CLASSIFICATION SYSTEMS

The concept of decontextualizing the needs of the architect refers to the possibilities for innovation, which are as follows:

Within a proprietary application for an object, innovative technological development is generally performed by its manufacturer. Innovative use of an object is generally achieved through the creative management of the choice of objects. Innovative use is a spontaneous function of an existing object being pushed to a heretofore unknown—a decontextualized—application. It may not have been planned that an object would be applicable before it was pushed into the context at hand. Innovative use is enabled when computational tools are designed to free of irrelevant restraints all queries to the database of building objects. To free design queries of irrelevant restraints is the act of decontextualizing design needs

Consider the daunting task of decontextualizing one's needs "by hand," which is a task of finding what one deems to be relevant objects for a spatial design need from the entire spectrum of classified building materials. First we will note that the semantics of any classification scheme, such as the CSI divisions, are arbitrary distinctions. That is to say, although we traditionally honor the idea that materials have "functional distinctions" we nonetheless have witnessed the historical process of material substitution, whereby stone can be replaced by wood, by aluminum, by vinyl, by who-knows-what, all functioning along the way as exterior siding. And while we recognize "material distinctions," we have witnessed the development of glass into other functional categories such as glass beams and glass structures. Yet we organize and categorize building materials not by their inherent properties but by "functional" and "material" classifications (industrial, residential, retail, commercial, institutional, or high-end/low-end, upgrade/standard, substrate/finish).

So what does classification gain? It is the endorsement of the idea of proprietary building technology; of the commercially protected status for any direct application of a certain technology to a building need. Although every technical advance has a wide span of potential applications, that potential is often limited by the very forces that develop it, and the material or functional classification it is hustled into for commercial protection. Yet this is an interesting contradiction, for we know capitalism breeds innovation, and that many such innovations are not related to the way in which a new technology is initially made to function.

Nonetheless I am sure of one thing—innovation can still come from architects and proprietary technology is a condition of capitalism that architects will not overcome. Fortunately the computational environment can make working around it on a project by project basis a process that is fast enough to be both profitable and creative. The computational "work-around" I have developed makes any classification scheme momentarily invisible by hiding irrelevant restraints just long enough for subjective design judgements to be made.

Decontextualized, attribute-based searches code the requirements of the need at hand, but as search criteria these requirements can indiscriminately transcend many proprietary technologies, classifications and arbitrary distinctions. Thus classified data structures are superseded, while they are also used and remain intact. With such decontextualized queries posted to building object databases, any and all adequate applications will appear as potential solutions in an unbiased way. Yet architects ultimately color their own interests to a greater degree through the decontextualization of their needs. The previous example of the ticket booth used in a residential project can again be looked at here. How did the architect come up with the idea that the ticket booth was desirable in the project at hand? All of the rationale for what sort of enclosure he wanted – as part of his subjective design intent—was worked up in his mind. The objective activity, the search that took place, was done with all of those subjective intentions embedded in him, thus embedded as attributes of his search. This describes the presence of subjective/objective criteria in design. No pervasive attempts to communicate the subjective (the intentions) were as valuable as his finally finding the "right thing" (the object) that represented his intentions in actual space: in the architecture.

Many custom structures/spaces were sketched by the architect; many existing structures/spaces were seen or shopped. As possible solutions were discovered, he had to "try" them. The mere practice of architecture itself cultivates the mental equipment needed to make imaginary trials of solutions. At one moment something know as a ticket booth, with its objective description, proprietary specifications and limitations, as best as could be judged, sat well with his intentions. So the architect came to desire the ticket booth.

In the computational environment the required tool that enables that creative process in a digital building economy is a tunable, 3D search tool. Such a search tool operates with a decontextualized language of queries made to building object databases. It enables dialing-in the attributes of exchanged data. The computational method by which I am achieving this dialablity employs XML, an extensible programming language compiled at runtime, and is composed of an A/E/C industry specific programming hierarchy of material properties and geometric attributes as the search terms. This hierarchy is developed from a limited chunk of the open standards being developed in the aecXML working group, and the geometry characteristics of the resources layer of the IAI's open Industry Foundation Classes for object model geometric properties.

The geometric change engine drives decontextualized searches based on the geometric characteristics of any freely drawn three dimensional design component selected by the user. It is in this way that loosely conceived and sketched three dimensional design ideas drive the search for their real building solutions. This can be dome iteratively, and at any time. Solutions with the desired range of property and three dimensional similarity are returned as usable objects to a private design workspace for comparison and contrast directly in an iteration of the building model. The user can start at the outer limits—complete decontextualization from existing material classifications—or can dial-in subjectively determined, tolerable limits and classifications to adhere to in each situation.