DEFINING ARCHITECTURE: DEFINING INFORMATION:

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The rapid onset of information technologies has changed ways we do things and how we view the world. Computation already pervades many aspects of daily life through subtle augmentations and by changing our tools and our professions. Moreover, information technology accelerates the pace of our activities, its speed outstripping our capacity to digest its product.

The changes brought on by this deluge force its chroniclers to create new terms. Neologisms spring up daily, often only adding to the confusion. Conversely, old terms take on new meanings. Their familiarity fading under the rush of new technologies, new disciplines. We are bombarded with a hasty terminology all delivered with the urgency – perhaps intent – reserved to advertising and propaganda.

It's time to consider. To define our terms. Since its foundation ACADIA has stood for the application of information technologies to the profession of architecture. Yet, since ACADIA's inception the uses of architecture and information have changed radically – quite independently of professional distinctions. Arguably only one in ten references to architecture in today's media refers to the profession of building design. The uses and application of information have been extrapolated far beyond the word's dictionary meaning.

By assembling an interdisciplinary and international panel we hope to show the spectrum of meanings attending these words. The panel is draw from three specialties: art, cybernetics and architecture. Each panelist brings a current perspective on architecture and information that may differ from those of the audience members. In dialog with the audience we hope better to understand – and update – these terms so fundamental to ACADIA's mission.

Introduction

Peter Anders

I have a problem with definitions-especially of terms whose meanings are in flux. Take architecture and information for example. We may think, "What's to discuss?" We already know what the words mean. We're practicing professionals and educators after all!

But these terms are slippery. They change with time. Architecture has a different meaning now that in the previous century – even within the discipline itself. Since then the profession of architecture has fragmented, spawning specialties of engineering, urban design, interior design, infrastructure and facilities planning. Architecture, traditionally held to be the mother of all arts, is also the source of these disciplines. But where does that leave architecture? How do we define it? Or, better yet, how do those outside the profession use the term?

I'll bet that over half the references to architecture in the popular press have nothing to do with buildings. Government officials talk of "architecting" new peace accords. A new evening gown features "architectural" lines. An artwork boasts "architectural" strategies. Curiously, architecture floods technology journals. I've seen the term used for everything from chip design to software interfaces – from systems planning to the emergent structures of the Internet. Used in this way, architecture seems less about building than planning and integration. In the arts we see the results of such processes. But in technology, architecture represents the development of coherent systems that act on information.

Now there's a word that's seen a lot of press lately: information.

Though it seems hard to define, like architecture, it has spawned whole new disciplines and technologies. Paradoxically, information has produced a thriving, tangible industry to which we must credit our country's current prosperity. But what is information exactly?

It used to be that information was stable and reliable. "Getting the information" was something that you could act on – accept and go about your business. But then it got harder.

The past century has taught us not to take information at face value. It has taught us to question things. In literature and philosophy overt meaning of texts is increasingly mined to reveal sub-texts and hidden agendas. And these, in turn, are subject to further scrutiny. Information seems produced by the dissolution of larger structures. Taken it to the most fundamental level, the science of information defines it simply as difference. To science, difference is a basic measure of information, just as a bit is the smallest unit of information in computing...the difference between on and off.

In both culture and technology, information has been atomized – rendered into discrete units. In computer processors, these units are electrical charges racing through tiny relays – electricity indistinguishable from the power used to run the chip. Here, information is granular, almost palpable.

And yet, to understand it, we must assemble this information into large, sensable structures. These structures restore information to a human scale - making it both sensable and sensible. Although these structures, too, may be reduced and manipulated, their components must be processed into recognizable form. And perhaps here we see the new understanding of architecture - the design of processes for rendering meaning from information.

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But this is only one way to understand these terms...one person's perspective. We have assembled a panel to provide other views on architecture and information. I would like each panelist to discuss these concepts and, following this, engage the audience in the dialog to expand on the terms presented.

Introductions

Ted Krueger...
is an Assistant Professor of Architecture and the Director of Information Technologies for the School of Architecture at the University of Arkansas. He is currently founding and directing an Advanced Visualization Laboratory for the University. Since the mid-1980s he has exhibited, lectured and published on an international basis.

Ranulph Glanville ...
studied at the Architectural Association in London, where he uniquely gained an architectural qualification for making electronic music. He then took a first Ph.D. in cybernetics and a second in human learning.

He has performed, exhibited and published (over 200 papers) in a variety of areas, and has taught at the AA, the Bartlett (University College, London), Portsmouth, and elsewhere. He has lectured in all continents except Antarctica. He is on several conference committees and editorial boards, and writes a regular column for "Cybernetics and Human Knowing".

He is professor and senior research fellow in the Faculty of the Constructed Environment at the Royal Melbourne Institute of Technology. He is associated with a number of centres, including the Centre for Advanced Investigation in the Interactive Arts at Newport in Wales.

Peter Anders...
is an architect and information design theorist and is the author of a book entitled "Envisioning Cyberspace" which presents design principles for on-line spatial environments. The book was published by McGraw Hill in 1998.

Anders received his degrees from the University of Michigan (B.S.1976) and Columbia University (M.A.1982). He is currently a fellow of the University of Plymouth CAiiA-STAR program. He was a principle in an architectural firm in New York City until 1994 when he formed MindSpace.net, an architectural practice specializing in media/information environments. He has received numerous design awards for his work and has taught graduate level design studios and computer aided design at the New Jersey Institute of Technology, University of Detroit-Mercy and the University of Michigan.

His work has been featured in professional journals and he has presented his research on the architecture of cyberspace in several venues including The New York Architectural League, Xerox PARC, ISEA, CAiiA, Cyberconf, ACADIA, AEC, ACM-Multimedia, InterSymp, SIGGRADI, and the World Future Society.

Computation without Representation

Ted Krueger

It has been (too) often said that advances in computing technologies have revolutionized the culture. Desktop, portable and handheld devices and the networks that interconnect them have altered the way in which we work and communicate. What is true for the culture would seem to be true of architecture as well.

There is the old saying that computers help you do what you already do only more so. If you are organized they can make you extremely organized, if your life is a mess - just wait till you get a computer. This is often true because we use the machine to assist us in our tasks-at -and. If one examines the screen of a typical desktop machine one sees a desktop. This is also the case for architectural applications of the technology where we have gone from the mechanical pencil to an automated one. These are difference of degree but not of kind. With this in mind, can we actually speak of a revolution?

But the saying is wrong, of course, in principle. It is wrong when the use of the machine allows one to do something that was not possible before. Granted that it is much more difficult to imagine the new, rather than to augment or amplify the old.

Let me then suggest an alternative interpretation for the impact of computing devices in architecture.

Architecture is radically unchanged by computation.

Architecture, in fact, has proven to be remarkably resistant to changes due to information technologies. What we build today is much the same as that which we have built in the past, but I suggest that it will not always be so.

There are several hundred million computers in use today. If you were asked how many computers you own you might answer two or three (unless you are also counting something inhabiting the back of your closet that featured "dual floppies" when it was new). Two or four or ten is probably the wrong answer. More than 25 billion embedded processors have been produced. Even if a significant fraction of these are no longer operative, the number and the distribution of embedded controllers far exceed those of dedicated information processing machines. Computer technologies not only allow for the transformations in the way we think and communicate but have begun to alter the fabric of the environments that we inhabit and the behaviors that are exhibited by them. Objects and environments with embedded sensor-effector and processing capabilities are becoming commonplace. Adaptive, interactive and autonomous material systems suggest that the relationship between humans and material culture is undergoing a fundamental shift. This transformation will be of far more significance than the computerization of documentation, representation, and presentation strategies in architecture.

Little of the change that has taken place in architecture over the last century can be attributed to changes in the technology of representation, even though, in transitioning from ink-on-linen to VRML, this change has been both continuous and pervasive. The real transformation has come about by the implementation of new materials and processes - the steel and concrete frames, glass, elevators and HVAC - you know the list, it has been cited many times. In each of these cases there was a transformation in capability that became a transformation of the architectural artifact.

The presence of some number of embedded devices within an architectural fabric is in itself an insufficient catalyst for change. To date, most of the uses of embedded devices in architecture have been seen as improvements to existing controls and interfaces. There are already many examples of networked thermostats and as previously noted the effect has been insignificant. They are only further examples of doing more quickly or precisely what has been done before. The transformation of the architectural fabric rests the development of higher-order behaviors that follow from the use of the embedded devices in conjunction with active material systems.

During the past two decades there has been a shift in the way in which materials are developed and deployed. In the past, materials have been valued primarily for their stable structural characteristics. These properties determine the suitability of the material for particular uses. For example, stone typically resists compressive forces well but fails under moderate tensile loads. The range of conditions under which these properties are obtainable determine the envelope of utility for the material, and so, the stone may be suitable for load-bearing walls but makes a poor rope. The science of materials concerned itself with the specification of properties and the disciplines of design with the specification of materials for particular uses based on those properties. As more is learned about the relationship between molecular organization and material properties, and as materials are fabricated with increasing control at the molecular scales, the relationship between analysis, design and material manufacturing become more intricately intertwined. Materials can be synthesized for particular uses rather than selected based on their specifications.

More recently, materials have become valuable for not only for their stable characteristics but for their behaviors, that is, material science is less interested in characterizing the properties of materials than in understanding the relationship between properties and conditions, especially relationships that are non-linear and discontinuous. It is at these points of qualitative difference that reactive materials can be found. Sensing and actuation become reciprocal activities that develop out of the relationship between conditions and properties. There is no need to a priori establish the dependent variable rather the conditional relationship exists and the choice between measurement and activation of the transition in properties can be multiplexed into a feedback loop.

The objective of research into intelligent material systems and structures is commonly and explicitly biomimetic. The biomimetic approach seeks to duplicate the functioning and behavioral capacities of biological materials and living systems in synthetic artifacts.

Biological material systems have many properties that may be desirable in synthetic systems. These include autolysis, redundancy, self- reproduction, self-repair, learning, interactivity, and self-diagnosis. As materials begin to have a capacity for behaviors, interactivity with environmental and programmatic variability becomes possible. The behavior of the system becomes complex. The use of embedded computational devices becomes important not only in enabling but in mediating and coordinating between these behaviors.

The adaptation of biologically inspired functional capabilities cannot be achieved without also inheriting other aspects of biological systems. Most important of these in the present context is the autonomy of the system. Increasingly complex behaviors on the part of an agent or artifact can not be met with brute force programming. The requirement that all possible states of interaction be anticipated and provided for sets a practical limit on what can be achieved. These limitations are simply a matter of mathematics. Repeatedly, as the combinatorial limitations become manifested, the designer is required to develop some means by which the agent can independently evaluate its context and take action. A measure of autonomy must be granted to the machine in order to be able to deal effectively with the complexity of its interactions with the environment.

Autonomy is a fundamental change in the nature of the artifact that in turn requires a re-evaluation of roles that objects play in both the cultural and cognitive processes. It is this aspect of embedded intelligence that most profoundly alters our relationship to the products of our material culture and requires an accommodation within the interfaces that we design in an effort to craft an interaction with them. Architecture, here the term is broadly construed to include all aspects of the structuring of the environments that we inhabit, can no longer be considered the art of configuring the stable and inert surround in which we undertake our existence. It is not the design of the sets on which the human actors play out their roles. Neither should it concern itself solely with the physical provision for human needs and desires. The task becomes much richer. As autonomous entities, the products of design take on a role that is symbiotic with that of the humans. Architecture must be concerned, not only with formal characteristics that occupy it today, but also with structuring the behavioral parameters of the environment, with opening, widening and shaping the gap between artifacts and users. The status of artifacts and our relationship to them begins to shift from the physical into the social realm.

It is all too easy to understand this process as a loss of control. Architecture as a discipline, and design in general, is propositional in nature. In designating the future condition of some aspect of our environment, design slips to easily into an attempt to control that future. But the future is neither easy to foresee nor to control. Examples of the failure of design to achieve its objectives are not difficult to come by and are frequently motivators for understanding better how to achieve control - how to more tightly couple the results to actions. The task of design, however, is not control but facilitation - not a restriction but an amplification of the space of possibilities. In order to achieve this, it is critical that the objectives of design moves beyond control. The autonomy of objects requires it.

Architecture, Computers and Information: A View from the High Plains of Cybernetics

Ranulph Glanville

The goal of intellectual education is not to know how to repeat or retain ready-made truths. (A truth that is parroted is only a half-truth.)

Jean Piaget.

In order for us to value a field, or anything else for that matter, we have to accept at least the possibility that the value may be zero: that is, there may be no value.

This holds for the ways we use computers just as for anything else. Already, in this very young field, there are deeply held and rigid orthodoxies. There are Grand Old Men and Great Authorities. Yet I would claim that we hardly have any idea at all of what the computer offers, and we limit the ways we use them: limit them to what we can think of. So we trap computers in the paucity of our imaginations.

For the computer is an amazing device: for the first time, humanity has acted as God, making something in our own (intellectual) image. And we have only one first time: this one!

I shall look at how we can understand the computer through the lens of cybernetics, an area often thought of as almost synonymous with computing, yet remaining distinct.

Cybernetics, as indicated by Norbert Wiener (in contra-distinction to all the cyber-this and cyber-that that we have invented since William Gibson's cyberspace in Neuromancer) is an area of investigation concerned with control and communication.

To demonstrate the cybernetic spin on these concepts, I will consider each in turn.

Firstly, control. A familiar control system is the thermostat, made up of 2 main components: the switch on the wall and the heating unit. The traditional understanding is that the switch controls the heating unit—which it does. But the interesting question is, "What controls the switch?" And the simple answer is, the heating unit.

It follows, then, that in this example control is circular: A controls B while B controls A. In effect, the control exists in neither the switch nor the heating unit (in neither A nor B), but between them. In fact, in any effective control system performance must be monitored and fed back—thus creating a circularity. So circularity is a standard feature of control systems.

And what about communication? There has been a view, associated with Claude Shannon and Warren Weaver's The Mathematical Theory of Communication (which appropriated the term "information"), that communication is based on coding. That is, there is a message that is unambiguously encoded, transmitted and decoded so that the message (and hence the meaning assumed to be the same as the message) is transmitted and the same meaning I have exists now in you. This will be familiar as the model generally used in most computing. It is a model that comes from a deeply determinist view of the world as we understand it, a view that is not so generally accepted nowadays, but seems inappropriate in a field that, by definition, is based in humans generating novelty!

In the coding model, messages are simply encoded, transmitted and then decoded, avoiding any question of understanding. But if there is no understanding, it is hard to think of communication having been successful. We all think differently, and we make our meanings: we are not coding systems. If this is in any doubt, consider the process of dehumanization and enforced uniformity that new recruits into the armed forces go through, to make them treatable as one and to turn communication into a code.

If we want to communicate without the limitations of the coding approach, we need an alternative form and means of communication. This, as shown by Gordon Pask (who worked extensively with architects) is conversation—in the everyday use of the word. In conversation, we do not communicate our understandings (how could we do that). What we do is present our understanding so that someone else may make their own understanding, as an equivalent. They then re-present that understanding back to us, the first person, for us to determine whether the understanding really is equivalent, by comparing our understanding (or their understanding (of our understanding)) with our original understanding.

This is another circularity. Cybernetics is well thought of as the study of circularity in systems, including the circularity between the observer of the system and the system itself. This circularity has been recognized in the way cybernetics has spawned a cybernetic study of cybernetics (Heinz von Foerster's second order cybernetics, or cybernetics of cybernetics).

Both these (circular) processes happen between elements. In conversation, the between is between two conversational participants. In control, it is between what we had thought of as controller and controlled, which we can now see as being arbitrary roles. Thus, cybernetics is as I have shown) also concerned with the between, and the space this betweenness occupies. In this respect, cyberspace is an entirely appropriate concept.

Taking another example, the Black Box as presented by Ross Ashby and by myself, we can see the process of betweenness very clearly. The Black Box is a postulate. We observe some difference in behavior (in a signal), and we want to find a reason for (explanation of) this. We propose that this (the cause) is hidden inside a Black Box that we invent to house it. We observe changes in the behavior (in the signal) by treating it as an input that is not the same, on at least one occasion, as the output. In order to change the input, we are inclined to feed the output back, to become the next input. This way we can observe and, based on our observations, predict the behavior of the Black Box. But note that what we do has no "truth" to it. We invent an explanation, treating it as a cause. This gives us an explanation of the relation between the input and the output, which is a functional description of what we imagine goes on in the Black Box—of its mechanism. But where does this functional description exist? In the Box, in me? No! It exists in a comparison between the links that connect, and the space between them so that one can be seen as input and the other as output.

Thus, the functional description is consequent upon the action and reaction between the two components, which becomes interaction because it is not predicated in either the one or the other. That is to say, because each contributes, the contribution of each must be at least partially outside the range of the contribution of the other. Thus, each gives something the other does not have to give.

It is interesting to consider such circularity in relation to the notion of information. Before the absolutes of Information Theory (a name I believe Shannon and Weaver came to regret encouraging), and the concomitant the trivialisation of communication into coding, we understood information in a manner similar to the way artists use the idea of forming. In fact, information's etymological roots (according to the shorter Oxford Dictionary) have to do with giving shape.

But this is what circularity does. A conversation is a way by which ideas in the head of one may take form through a space shared with another, and in which the ideas of each contribute to the form the conversation takes (which neither knows beforehand). If we think of the processes used by designers in designing, perhaps the main one is the circular process of drawing, considering the drawing, and finding surprise and novelty in the drawing that leads us on (by holding a conversation with ourselves). Thus, following the process of circularity leads to the creation of form. So circularity is informational. And designing, being circular, is in-formational. Which is just as well, because if design was not informational (in the older, richer and more interesting sense), we would have some questions to ask and answer!

But this is in direct contrast to the coding notion of information, to the notion that there is a clear specification and a way of arriving at a correct (and uniquely unambiguous) way of embodying that specification in an object - which is the notion that drove much early design methods work and which is still present in how we think of the computer.

I believe that most of the design work done using computers uses them as tools. We have our intentions, and our computers help us execute them. We use them as if all they could do is to carry out our commands: as slaves. This is to use them as having less potential for contributing to the design than a simple sheet of paper! They just do what we want, amplifying some aspect of our behavior. In other words, we use them with a model inspired by coding, not conversation. We do not use them as conversational partners, either in the sense of the sketch on a piece of paper, or of the friend we spend the evening with in the bar. Even though we know from experience the benefit of the sketch and of talking about our designs as we go on with them. We have forgotten the creative aspect of working with and in the space between. And this, in turn, means we are not using computers to help us giving form. The notion of information we employ when we use our computers is the recent and impoverished usage of Information Theory, rather than the notion of information as giving shape.

What cybernetics has to teach us about our use of computers is, in the first instance, that if we want to reflect and thus benefit from the circularity that is at the heart of design, we should encourage this (this is, of course, why cybernetics and design are so mutually sympathetic). But when we use computers, we do not encourage this circularity at all, and so we miss out. We do not use them in our image, any more than any society that held slaves used the slaves in the owners' image. (In the end, those who enslave others themselves become at least as enslaved their slaves.)

Nor is it necessary, now that we have computers, for the conversations to occur in the virtual world of the drawing board and screen, the architect's studio. We can now think of buildings that compute. But, again, we fail in our imagining. We think of the building as somehow adapting to and interacting with the environment in an intelligent manner, as being sensitive to our needs and desires. I would like to use inverted commas! As Gillian Hunt has pointed out, there is nothing interactive or intelligent, for instance, about this behavior. It is purely servile and encodement based. What is not interesting when computing is inserted into a building is a building that behaves as at the moment, but with some aspects automated (I could have adjusted those louvers!). The introduction of computing into a building opens the possibility that the building itself might enter into conversation with us, thus joining in the space between to create real and unexpected novelty (e.g. Cedric Price's Fun Palace—which he worked on with Gordon Pask—and Generator). How might we live if our buildings were our talkative friends, our drinking buddies, our work mates, in some respects our partners, helping form new ways of living through interaction with us, and giving shape to shelters that might give us new ways of conceiving living.

We might be inclined to think of such an arrangement as very unstable. But there is nothing unstable about a conversation, nor is there about the control loop of the thermostat, to return to the cybernetic origins of this article. Stability is the ability to go on being. It is a quality that exists within circular systems, although it may well appear, when viewed from the outside, that the arrangement is quite unstable. But that's the nature of design, of giving form, of communication—in the space between. When I design, I am involved in a continuing and therefore stable activity. But what is seen, from outside, may appear to be anything but stable. After all, designs change, sometimes dramatically, as we proceed with them.

We hold these truths to be self-evident. That all men are created equal and are endowed by their creator with certain unalienable rights. Among these are life, liberty and the pursuit of happiness.

The Declaration of Independence of the United States of America.

Update for computers, please!