Old And New Challenges
ACADIA After 25 Years

Chuck Eastman
Initiator of founding meeting for ACADIA at Carnegie-Mellon University
First President of ACADIA,
Director, COA Ph.D. Program,
Professor of Architecture and Computing, Georgia Tech

The Context When Acadia Was Founded

It is difficult to realize the situation in architecture and computing in 1981. The PC had just been introduced by IBM, but was limited and weak. While commercial computer-aided design systems had been around for 10 years, and there were half a dozen AEC systems, they were Unix-based and cost in the range of $30 - 50,000 per seat. Only a few “technology leader” firms had bought the big systems; because of their high operating cost, they often ran multiple shifts. Universities could not afford them. Architectural schools working in computing were either developing their own CAD systems or developing algorithms for layout, 3D representation, or other computer science type efforts.

The general CAD research community was slowly moving to 3D. Ian Braid’s Ph.D. thesis in 1973 introduced solid modeling, which made 3D work practical. The idea of computing shapes, not creating them surface-by-surface became a reality. Computervision, CADAM, and Intergraph Calma introduced 3D systems in the middle 1980s. However, in 1981 all the AEC systems were 2D drawing systems such as Intergraph, Autotrol, AutoCad, and Summagraphics. Still Building Information Modeling had already been explored. Research systems at CMU and Michigan showed the possibilities in architecture, with BDS, GLIDE, and Arch-Model. The British also had systems such as (their) BDS and GDS, CEDAR, and the SSHA System at Edinburgh (see references). Few of the founding members of ACADIA thought that electronic drafting would become common when modeling the building, in terms of object shapes, relations, and properties was readily available and was being pursued in most other manufacturing and electronic industries.

In this context, what seemed to be lacking was any organization that could potentially provide leadership in the development and proper direction of the new technology. The relation of building modeling showed a strong symbiotic relation between the tools (CAD) and their users. Were the users going to wait for the CAD companies to determine
what operations, what representations, what semantics, would be embedded in their tools? All of the people attending the first meeting were knowledgeable CAD developers, as the only “users” were those people using their own “home built” tools. Discussion included whether ACADIA was to be university focused or include practitioners. Also discussed was how broad it should be, whether it would focus on design, or include engineering and analysis.

In reality, the profession went the other way, adopting a technology that allowed them to continue drafting practices for another 20 years, while the other design fields revolutionized how they designed, engineered, and produced their products. Out of the transition from drafting to product modeling, electrical, mechanical and aerospace developed new approaches to design, such as design automation, parametric modeling, design for fabrication, CAD/CAM and other approaches that led to major improvements in design, productivity, in the quality of the products, and in cost reduction.

**Why Has BIM Emerged Now?**

Architecture, from its beginning has relied on drawings to represent its product. Vitruvius spoke about drawings in the Ten Books. The Renaissance distinction of design from construction was based on the primacy of drawings as the representation of architectural ideas. Why did architecture and construction make this transition? We are all watching it happen. A few of you may think it is not happening, like the farmer who would not buy a tractor because of his affection for the mules he raised and shared work with. But we are in an epoch of change and your children will know what architectural drawings are as well as they know about slide rules.

But why has the change been initiated? I offer three reasons:

1. **Clients.** Clients, particularly industrial ones, that were using product modeling in other areas, began to demand better results and fewer errors. I am thinking of CURT (Construction Users Roundtable) Reports, and Intel, Disney, General Motors and electronics and manufacturing companies and the FAITECH consortium;

2. **Technology.** The base of the technology was available, being developed in the other areas of design and engineering;

3. **Productivity.** The documented reports of slowly decreasing productivity in light of strongly increasing productivity in the other areas. The NIST report on waste due to data re-generation and lack of interoperability (estimated at 18.5 billion dollars per year) was a parallel factor.

**Current Situation**

Today, we are at a transition from the older method of representing a building in a fashion that only a person can interpret to a new one that is fully machine readable and interpretable. Architects, contractors, sub-contractors, building managers, interior designers, building product manufacturers are all trying to understand
whether this transition makes sense for them, what it involves, and how to make the transition. The architectural schools themselves also need to re-think aspects of their curriculum and what the role of Building Information Modeling (BIM) will be in architectural education.

Thus it seems to me that each of us has two important issues to address:

1. The proper role of building information modeling within the architecture school curriculum.
   - Specialized courses or tutorials or embedded in studios?
   - BIM tools are not sketch design tools but more at the design development level; how does this affect their introduction and role?
   - Building modeling relies on pre-defined parametric objects, which are limited to conventional construction; how should we address the issues of parametric modeling and the development of customized parametric objects and assemblies, such as needed for design for fabrication?
   - Interoperability is an important aspect of the change in practices facilitated by BIM; how do we integrate conceptual design with sustainability, with early cost estimation, or other forms of integration and the tool base to support the integration?
   - Interoperability also implies collaboration, such as design/build; how can an architectural curriculum bring into focus the issues of design/build delivery, which is expected to be the main method of building delivery in the future?

2. How to support the profession make the transition to building information modeling.
   - all the issues addressed within the curriculum also apply to practice, and architectural firms would benefit tremendously if schools had expertise that they could share with firms; some examples include:
     - how to generate designs supporting design for fabrication;
     - how to develop new parametric objects, for custom components not supported by current BIM tools;
   - new staff that are able to effectively use BIM tools to produce construction documents, dealing with versions and other production issues;
   - carry out the tool development and integration needed to take advantage of BIM in such areas as sustainable design or cost control during design.

This is an exciting time, where technology and process issues are changing business practices. Firms are aware of their need to understand the new issues and are turning to the architectural schools to help them. It is a time where architectural research can have a real impact and develop strong relations with practitioners.
There is a unique opportunity for architectural researchers to develop long-term relations with practitioners and professional groups.

**Some Threats**

A general concern today is that the BIM tool developers are generally defining the objects, their behavior, and semantics of architectural objects. Architects have only informally contributed to the specification of this knowledge. It is viewed as conventional and public – the automation of architectural graphic standards. On the other hand, it is easy to design something that most of the BIM design tools cannot represent, because of the poor thinking that went into the development of the current generation of architectural parametric objects.

The commoditizing of BIM design tools has serious implications for architecture as a practice, as it also commodifies aspects of architectural knowledge. It has taken place with the assumption that there is nothing special about how architectural objects are defined, laid out, or detailed.

Revit and ArchiCad both have prescribed what is a “wall,” a “door” and “window,” and other objects. They do not conceptualize these as abstract functions, such as space separator, or structural object and then combine these two functions and add geometry. These issues brings back one of the original issues that led to the founding of ACADIA: to provide intellectual leadership to both academia and practice in the definition of the new tools being developed for the field. What I am suggesting is that there is a different way to define architectural objects that allows them to be more easily customized and extensible. However, it takes architectural expertise to define them.

I challenge ACADIA (or an ACADIA spin-off) to initiate a consortium with industry to take some control for the definition of the object semantics that are being used by the field, and to develop specification for the parametric objects with which we design. It is not the role of Autodesk, Bentley, or ArchiCad to do this. It is our responsibility.

**References**

I provide some still available references to the first generation building information modeling systems. A review of early building modeling systems is provided in:


