The Fate of the Albertian Paradigm: A Pedagogy of Architectural Visualization in Digital Media

Thomas Forget, University of North Carolina at Charlotte
Nicholas Senske, University of North Carolina at Charlotte

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Questions Concerning a Paradigm Shift

Architecture culture is currently embroiled in an awkward transitional phase between established traditions and emerging potentials. While the Modern paradigm of design and fabrication codified by Brunelleschi and Alberti in the early Renaissance still regulates contemporary practice and education, new digital processes are raising questions concerning the extent to which the trajectory of Modernity has finally run its course. Patrik Schumacher, for example, has attempted to codify "Parametricism" as a new paradigm that resolves the transitional confusion of late Modernity and signals the onset of a new aesthetic consciousness; however, both the logic of his argument and the nature of the work that he espouses demonstrate the persistence of Modern thinking. Like the paintings of Giotto, Duccio, and Lorenzetti in the late-medieval era, experiments in digital architecture today are propelling us toward a new aesthetic paradigm, but their significance cannot be compared to that of the work of Brunelleschi and Alberti. The false equivalency in this analogy between late-medieval painters and early-digital architects is intentional. The revolutionary architecture of the early Modern era is rooted in a transformative notion of visualization, and we contend that the next revolution in architecture will be indebted to radical new modes of digital visualization. The current transitional era will unfold over generations, and we seek to interpret it.

This paper summarizes the premises and methods of an evolving digital pedagogy that attempts to raise questions and refuses to stipulate answers regarding the role of visualization in digital design methodologies. Our modest objective is to contextualize recent trends and inevitable developments in digital design within a historical trajectory of visualization that acknowledges the emergence of a paradigm shift and dispels the notion of an imminent revolution. Our pedagogy confronts two primary variables of architectural visualization: graphic manner (i.e., rendering quality) and point of view (i.e., camera position). We integrate tenets of the Modern paradigm of visualization, which privileges analytical drawing over pictorial rendering, into digital practices in order to scrutinize their relevance to and/or dissonance with unfolding trends in digital design.

The pedagogy responds to a disturbing disregard of visualization ethics in the early digital age. Students in particular typically fail to appreciate the profundity of visualization—the ways in which depictions of the built environment during the design process regulate understandings of space and construction. We contend that the spirit, if not the letter, of the Modern paradigm of analytical visualization should be either reinterpreted for digital media or consciously supplanted by a new and natively digital model of visualization. Our current pedagogy argues for reinterpretation instead of replacement, not because we cannot imagine a new paradigm in the future, but rather because we believe that the new paradigm will be somehow rooted in the old one. Without assuming to know the outcome, we commit ourselves to experimentation and, above all, to the development of critical and self-aware design processes that revel in the enigma of architectural visualization.
The Modern Paradigm

Alberti codified the Modern paradigm of architectural visualization in his treatise, De re Aedificatoria (On the Art of Building), and his argument addresses both aesthetic and practical concerns (design and fabrication). His plea for orthographic drawings and unadorned models, as opposed to linear perspectives, reflects an aesthetic understanding of architecture as a complex system of space, material, and proportion that cannot be understood simply by looking at it. The architect’s perception is abstract, not literal—a “multi-view” mode of visualization in which each plan, section, elevation, and unadorned model provides a unique but complementary view. Unlike phenomenological visualizations of lay people, multi-view visualizations provide an almost God-like perspective onto a work of architecture (and the technological implications were apparent to Alberti). The phenomenal reception of the final work is paramount, but the process that leads to an architectural phenomenon is rooted in abstraction: a building will look good if and only if its architectonic logic is good. Architecture embodies underlying qualities that escape the naked eye, and architects must visualize their intentions through analytical lenses.

The conceptualization of a work of architecture, according to the Albertian model, entails multiple rounds of analytical visualization, and the completion of the design process motivates an even higher degree of visual abstraction, a notational system that allows an architect to script the fabrication process through a set of construction documents, so that builders do not stray from his authorial concept. As Mario Carpo explains in The Alphabet and the Algorithm, Alberti considered construction documents to be the original work of architecture and the resulting building to be an identical copy of the documentation. In the Modern paradigm, both conceptualization and construction are rooted in the same modes of multi-view analytical visualization, but they are distinct from each other—design and fabrication are separate and incompatible spheres. As a result, architecture becomes a liberal art and surrenders its pre-Modern identity as a craft.

The Information Model

Carpo suggests that digital processes offer architecture culture an opportunity to reclaim that lost identity through a looser notion of authorship that reintegrates design and fabrication. Building Information Modeling (BIM) is the current vehicle of the paradigm shift envisioned by Carpo, and it is likely the technology that will culminate an inevitable revolution. While BIM began as a production tool that simply optimized the Modern paradigm of construction documentation, it is quickly evolving into a comprehensive platform that regulates design, fabrication, assembly, maintenance, and even demolition. BIM’s reintegration of conceptualization and construction may result either in a medieval-like balance between concept and craft or in an overcorrection of the Modern paradigm that diminishes, or even eliminates, the traditional sense of a design concept. While that traditional sense may be anachronistic, we seek to uphold the relevance of an aesthetic position on form within the overall apparatus of the built environment, which means inquiring into the ways in which BIM may operate as a tool of design thinking.

The implications of BIM are still evolving, especially in terms of its viability as a conceptualization tool. BIM itself will not dictate the fate of the Modern notion of the author. Whereas Carpo urges architects to embrace a notion of design authorship that adheres both to a pre-Modern notion of architecture as a craft and to a digital notion of systems-design (as opposed to object-design), others may interpret BIM as the ultimate realization of a Modern notion authorship that allows an architect to control the entire process. Regardless, even information models are scrutinized through
Visualizations, and theories of visualization must be posited in conjunction with theories of conceptualization and authorship. This paper focuses on visualization because it underlies any potential notion of the design process.

Visualization in BIM is infinitely customizable, and it accommodates every canonical mode of architectural visualization from the Modern era: orthographic drawing, perspectival and axonometric projection, and physical modeling. A varying number of viewing windows may occupy a user’s screen, and each window may offer a different point of view and rendering style. Furthermore, the parameters of the windows may be changed multiple times during the design process according to the idiosyncrasies of a user. While infinite possibilities may seem to complicate (if not prevent) the establishment of a visualization paradigm for information modeling, all tools accommodate infinite customization, and the variables of analog tools did not prevent the emergence of the Modern paradigm. Visualization at its best is a theoretical construct rooted in graphic technologies, not a rote byproduct beholden to them. Today, theories of BIM-based visualization are far less advanced than those of analog tools. Our pedagogy attempts to discern the potential of BIM-based visualization through a consideration of the extent to which it coincides, overlaps, and/or rejects the Modern paradigm. We scrutinize possibilities for the sake of experimentation, not resolution, and we instill in our students a sense that digital design technologies are vehicles of inquiry, not (only) marketable job skills.

Seeing Models

Most contemporary users of BIM visualize their projects through an unintentional multitude of perspectival, axonometric, and orthographic views. Multiple views, of course, do not necessarily entail a “multi-view” (or analytical) mode of visualization in the Modern sense, and rigor in BIM-based visualization (Modern or otherwise) is largely absent. Views in digital modeling programs are easy to generate and therefore cheap in the economy of process. While the benefits of ease and affordability should not be discounted (the fluidness of freehand sketching, for example, is an undeniably valuable mode of design thinking), architectural inquiry requires more rigorous methods of visualization, and the infinite variables of BIM-based visualization provide plenty of fodder for consideration and debate.

Students, we find, gravitate toward perspectival views that are (at least in principle) antithetical to the Modern paradigm of process. Alberti discourages the use of linear perspective as a tool of architectural inquiry because, as a pictorial mode of visualization, it is deceptive and...
incompatible with analysis. The perspectival bias of digital modeling, however, may either affirm the validity of that position (if a given designer considers windows to be phenomenal viewpoints that are detached from a work of architecture and unrelated to it), or it may signal a productive evolution of the Modern paradigm (if a given designer considers windows to be analytical viewpoints that are inscribed within a work and resonant with its architectonic logic in ways not imagined by Alberti). Our pedagogy strives for the latter. While we uphold Alberti’s ethic of analysis, we find it where he does not, in linear perspective (and potentially in the perspectival windows of BIM).

In his treatise On Painting, Alberti instructs readers how to construct a linear perspective through a “visual pyramid” method, which relies on the use of two drawing views, neither of which bear an immediate resemblance to an orthographic drawing view. The logic of plan and section, however, are embedded within the drawing views of his method, as linear perspective and orthographic drawing belong to the same Euclidian-based drawing system. Beyond their obvious differences, each type of drawing is mathematically embedded within each other and may be extracted from each other, and Alberti’s concealment of their correspondence may reflect his argument against the use of perspective by architects.

Once understood, the reciprocity between linear perspective and orthographic drawing allows for an analytical approach to perspectival drawing that problematizes Alberti’s distinction between them—to draw in linear perspective, in a sense, is to draw in plan and section at the same time, and the well established analytical properties of orthographic drawing may be applied to perspective. For example, once liberated from a notion of pictorial immediacy and an affiliation with the human eye, perspectives may include regulating lines and other analytical notations, and their points of view may be integrated into the architectonic and proportional logic of a project. We promote perspectival abstraction through analytical methods of line construction, rendering, and viewpoint that acknowledges but overcomes the limitations of human experience.

BIM seems to uphold the Modern paradigm in a more conventional way through its capacity to generate orthographic views ad infinitum from a model. The extraction of plans, sections, and elevations from a digital model, however, is profoundly different from (and perhaps even antithetical to) the construction of drawings in a two-dimensional environment (digital or analog). Whereas the construction of drawings relies on a comprehensive literacy in line (an ability to both read and write lines), the automated generation of drawings expects designers to read lines without the capacity to write, or even “speak,” them. The extraction of drawings from models, then, may be a “false friend” to Modern design methodologies. Visualizations of digital models contain lines that define the edges of planes and solids, but users do not construct lines per se.

Fig. 2. An “illiterate” line drawing automatically extracted from a BIM model

While this pseudo-orthographic method will inevitably become less relevant as generations trained under the Modern paradigm retire from practice and pedagogy, the matter of line literacy will remain critical. Architecture will always be geometric, and geometry will always consist of points, lines, planes, and solids. Our pedagogy on visualization is rooted in line literacy because it is the dimension of geometry that is least evident in digital modeling. Whereas points, planes, and solids have relatively clear roles in modeling environments, line is somewhat
elusive. A heightened consciousness of line in modeling environments is therefore important to digital analytical visualization, especially as BIM technologies develop more model-centric modes of visualizations.

The fact that BIM is a model-based environment raises a final provocative question regarding the technology’s relationship to the Modern paradigm. The analytical use of a digital model may indeed perfectly align with Alberti’s promotion of the unadorned physical model as a key component of the design process. Alberti valued process models for their analytical potential, and the architecture culture of the Renaissance includes a rich tradition of large scale modeling in the service of formal and tectonic design investigations. Through its model-based environment, BIM has the same potential. As this brief survey of BIM’s relationship to perspective, orthographic drawing, and modeling demonstrate, BIM may or may not be as new as it seems. Its relationship to the Modern paradigm is complex and begs experimentation.

**Pedagogical Premises**

Our pedagogy foregrounds the application of constraints as a means through which to develop analytical sensibilities. To cultivate depth and rigor, each assignment is constructed to present students with a limited set of tools and prescribed moves. In our experience, restrictions produce more creative results. Rather than searching broadly for solutions or novelty, students focus on narrow themes and iterate them. At the same time, rules enable a degree of recklessness that fosters experimentation.

Our pedagogy introduces students to two-dimensional digital drawing (AutoCAD) and three-dimensional digital modeling (Rhino). In each case, students first utilize the software through an analysis exercise, not a design project. The limited scope of their initial investigations foregrounds the biases and strengths of the tools. As opposed to basic operational knowledge of software, which is easy to acquire, our pedagogy motivates a critical use of limited commands, as well as a mode of design thinking that overcomes preconceptions and conventions. Our goal is intentionality and agility, not technical mastery.

Our pedagogy so far engages only “first-generation” 2D and 3D digital visualization tools, as opposed to BIM itself, because, as many have argued, the latter's ability to operate as a vehicle for conceptual design thinking is questionable. In particular, our emphasis on diagramming, abstraction, and line are incompatible with the current state of the technology. Lines in BIM visualizations are simply “smarter” than the ones in our notion of analytical linear perspective. Whereas lines seen in BIM possess building information, the lines in our drawings may not even represent an actual building component. Furthermore, the representational hierarchies that we promote through weights, types, and colors are meaningless in the context of a database. For the moment, the limitations of AutoCad and Rhino better enable us to study digital modes of visualization related to design thinking. As Renee Cheng writes, “BIM is inherently answer-driven, design thinking is question-driven.” The latter is especially important to foundation design.

Phillip Bernstein of Autodesk posits that the integrated model has already superseded the orthographic drawing as the standard of construction documentation. Because BIM is so comprehensive, he argues, it is “a more interesting pedagogical platform” than conventional drawings and models. Technology, however, may short-circuit critical thinking, as the use of defaults is sometimes misunderstood as true agency. In the future, BIM will undoubtedly be able to accommodate more conceptual forms of visualization. Until then, we find advantages in forms of representation that combine traditional theories of architectural representation with the powerful attributes of digital media. BIM is the inevitable platform on
which our students will work, and our pedagogy prepares them to confront it with critical eyes.

**Line; Viewpoint; Camera; Line**

Our pedagogy is structured as a parabolic trajectory, not a linear progression, of projects. It begins and ends with analytical line drawings. In between, students learn how to construct Albertian linear perspectives in 2D CAD (“by hand,” as it were) and how to manage virtual cameras in 3D modeling programs. The overall objective of the pedagogy is to instill a “consciousness of line” in digital media that both derives from and overcomes the limits of analog line drawing. We seek to interrogate the relevance of theories and methods from old media to new media.

The first exercise focuses on the analysis of precedents through what we call “orthographic diagrams,” which are simple line drawings that distill the logic of a work of architecture while upholding the relative scale and proportion of its components. Students are asked not simply to draw the precedent, but rather to interpret both its built form and its underlying logic (hierarchies, regulating lines, etc.). Line is the only graphic instrument of the analytical process; tone, textures, and hatching are not allowed. Color is used to “render” lines, but only sparingly. These diagrams establish abstraction as a vehicle of analysis, and the resulting presentations seem both familiar and unusual. They resemble normative line drawing but also challenge the conventions of how and what lines communicate.

The exercise takes advantage of the properties and two-dimensional logic of CAD in order to promote the disciplined construction of digital lines. The precision of CAD, its layering structure, and its ability to produce iteration through copy/paste operations are key features of the exercises. The limitations of the 2D interface program are also beneficial, as students are forced to scrutinize the potential of digital line as an analytical mode of architectural visualization. Their drawings cannot be reduced to digital translations of an analog method. Indeed, they raise critical questions regarding the extent to which analog and digital processes may, should, and should not resonate with each other.

In the second exercise, students construct classical Albertian perspectives through a decidedly non-classical, point-based method that demystifies the reciprocity between orthographic drawing and linear perspective and promotes analytical strategies of visualization. Again, CAD offers unique 2D properties (such as point-based precision and an infinite and infinitely malleable drawing surface) that escape the limits of analog methods. The construction of digital linear perspectives, however, is primarily a means to a greater end: an analytical approach to digital modeling. This exercise demonstrates both the analytical potential of lines in perspective and certain ethics regarding the management of the perspectival camera in a digital modeling program. The analytical potential of the viewing point is paramount, as we seek to dispel the pictorial assumptions commonly associated with the use virtual cameras, such as helicoptering around, walking through, and looking at a digital model. We promote seeing over looking, and the process of translating “data points” (i.e., points that describe a Euclidean object in three dimensions) from orthographic drawings into a linear perspective illuminates the potential of three-dimensional visualizations to engage the logic of analytical drawing. Rather than learning a rote process through which to construct phenomenal imagery, our students learn the meaning of points and lines within a system of spatial information. Students are expected to defend the analytical intention of their visualizations through the architectonic logic of a precedent or project.

To catalyze the analytical intention of the digital linear perspectives, students construct them from orthographic diagrams, not full plans and
sections. Students therefore begin the construction of perspectives from an analytical starting point, which means there is less need to “convert” their perspectives into analytical drawings. Additional analysis may be achieved through the rendering of lines during and after the construction process, but the base drawings are analytical in themselves. At the same time, the three-dimensional visualization of diagrams, even through non-literal viewpoints, allows students to understand architectural space more abstractly and even may suggest ways in which diagrammatic ideas may be translated into real spatial phenomena. Final drawings contain both a perspectival drawing and the orthographic roots of its construction; the inclusion of base diagrams and selective perspectival construction lines enrich the presentation strategies of the students’ work. The layering structure of CAD allows students to hide (but not delete) certain construction lines, so that all lines in the final drawings are included for an intentional reason, not just because they were part of the process. Lines of all kinds fill challenge students to interpret both their phenomenal and analytical meaning.

The third exercise of the process asks them to integrate a virtual camera in a digital modeling environment into a given model of a simple three-story building (designed by instructors in the spirit of already studied precedents). The objective of the camera integration is to confront the common misuse (or even abuse) of virtual cameras by digital designers of all ages and levels of experience. During a 3D modeling process, designers typically steer their cameras

Fig. 3. A student design project with integrated camera (the smaller viewing cone) and extended camera (larger cone)
through the model, so that they can “look at it” in multiple ways. Such processes treat the model as a detached object, not as a subject of analysis. They also conceal the settings of the camera, like the x,y,z coordinates of the viewpoint, target-point, and focal angle of the view, all of which affect the analytical potential of the resulting visualization.

In our pedagogy, the camera is either integrated into or extended from the architecture. In other words, it is a data point, not an eye. In this exercise, students are asked to integrate the camera into the given model in Rhino in multiple ways that test the analytical potential of perspectival views. Previous lessons from the preceding analyses and the construction of linear perspectives are foregrounded through demonstrations of their relevance to how the control of a virtual camera affects the reading of a work of architecture. Rhino, like our method of perspectival construction, is a point-based system of geometry. Students, therefore, are well prepared to forego processes that take advantage of its automated, intuitive tools of visualization (i.e., the mouse-driven, helicopter-mounted camera). Instead, students understand the camera as a strategic set point within the spatial logic of the model, and they learn how to snap that point both to the geometry of the model and to regulating lines that extend through and/or from it. Furthermore, students manipulate the settings of the camera numerically through a text field, not through the use of the mouse, which is used only to study the general location of potential viewpoints. For example, the viewpoint and target-point in the digital equivalent of an Albertian frontal perspective share the same X and Z coordinates, and while analytical perspectives do not necessarily need to maintain these correspondences, students are required to be in control of their divergences from them and to argue their reasoning on grounds of analytical intent. Numeric control over the camera settings in many cases also produces a more deliberate, even contemplative, relationship to the digital interface than the handling of a mouse. We therefore encourage students to think with their hands on the keyboard as they study the engagement between model and camera.

The final exercise returns students to the construction of line drawings. From Rhino, they export their camera views to 2D vector lines, which they then “render” in Adobe Illustrator. As in “manual” linear perspectives, line weight, line type, and color become tools of analytical intent. The result is a mode of digital visualization distinct from typical production renderings. As in the work of LTL Architects, a digital model is a means to an end that involves a patient and methodical multi-media process. With the creation of the final drawings in Illustrator, the project completes its parabolic cycle: from line-based diagram, to perspective, to model, to line-based diagram.

The final step is to integrate this iterative cycle of analytical methods into a design process. Students are asked to establish a series of coordinated, analytical camera views that allow them to scrutinize the progress of their design work in a controlled and strategic manner that is antithetical to their normal practice of helicopter steering through a digital model. The resulting system of numerically-controlled visualizations (four of which are typically viewable at one time) regulates (and limits in a productive manner) their perspective, so to speak, of the formal manipulations that occur during a design process. This collection of perspectival views, in one sense, seems different from a Modern notion of a multi-window workspace in which plan, section, elevation, and perhaps axonometric views are displayed; however, depending on how one understands linear perspective, it may be more similar to a “multi-view” analytical mentality than it seems. The discipline students learn from our pedagogy allows them to design in perspective with rigor and analytical intent.
The Alberti Code

To return to the primary theme of this paper—the extent to which BIM may challenge the Modern paradigm of architectural visualization—we hope to convey that the technology has multiple capacities. It may replicate the Modern paradigm in both regressive and progressive ways, and it may escape (or at least extend) the known limits of the Modern paradigm. Alberti’s notion of the design process helps us to discern the meaning of some of the possibilities and the deep complexity of the questions. For example, two extreme possibilities (the use of multiple orthographic views to uphold traditional standards of visualization and the use of pure digital code to reject graphic visualization altogether) are simultaneously antithetical to each other and perfectly alike with respect to the Albertian model of the design process. Whereas the former fulfills the classic notion of “multi-view” analytical visualization, the latter posits a different but compatible notion of analytical visualization that strips the process of all phenomenal connotations (literal or abstract). Information modeling (like all data) is neither new nor old, and it does not necessitate a revolution in architecture. Instead, it enables architects to forge perhaps multiple revolutions through varying interpretations of its potential, none of which are more valid than any other. We contend that aesthetic and technical discourses should guide the revolution(s), and that modes of visualization should play a significant role in the formation of those discourses.

Notes:


3 Our notion of “analysis” refers to graphic-based critical inquiry, not the interpretation of scientific data.

4 Alberti’s metaphysical agenda is discussed in Carpo, Mario. The Alphabet and the Algorithm, MIT Press: Cambridge, MA, 2011, p. 61, 69.


7 Carpo, p. 44-48.


9 Carpo, p. 48.

10 One view in Alberti’s visual pyramid method recalls the logic but not the conventions of a section.


