On the Visual Agency of Manufacturing Models

Sobre la capacidad de acción visual de los modelos de fabricación

Introduction

There was the true continuity, San Narciso had no boundaries. No one knew yet how to draw them. […] For it was now like walking among mansions of a great digital computer, the zones and ones twisted above, hanging like balanced mobiles right and left, ahead, thick, maybe endless. Behind the hermitage streets there would either be a transcendent meaning, or only the earth.1

With the entrance of an increasingly paranoid Oedipa Maas into the fictional planned city of San Narciso in the dystopian ending to Thomas Pynchon’s The Crying of Lot 49, the media theoretic Friedrich Kittler concludes his 1994 “Stuttgarter Rede zur Architektur.” In light of architecures’ digital turn,2 he writes that “cities, even if or even more so when named after Narcissus, are no longer reflections of the so-called human, but of microelectronics.”3 He expects neither augmented authorship nor potency from the infinite promise of computer-added technologies, but increasing redistribution among techniques and practices, calling for a reconfiguration of architectural agency as a media system: “For design, not only representation,”4 reads a note below his manuscript – yet, if asked today, would he not add manufacturing to his list?

Ever since the digital turn in architecture, the discipline has not only been reviewing its logics, but has been debating whether this was a slight bend, a blind curve or a complete turnaround. Optimistic and positivist rhetorics argue that the promise of computer-aided technologies, but increasing redistribution among techniques and practices, calling for a reconfiguration of architectural agency as a media system: “For design, not only representation,” reads a note below his manuscript – yet, if asked today, would he not add manufacturing to his list?

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Designing, as a cultural technique, starts with examining its material cultures and practices, its workshop conditions and storage devices. […] Finally, this implies reassessing which is usually held to be artistic imagination toward hands, eyes and signs, and secondly to conceive of such signs not as signs but as forms of media. How is the drawing used, how is it communicated, how do media for storing and distributing drawings affect their code? This may open up a path toward different narratives of designing that do not simply valorize artistic genius but deal with the exteriority of thinking, forming and designing.5

The media philosophers Bernhard Siegert and Lorenz Engell consider matters of communication, storage and distribution as ideological of the discourse. Lidd’s efforts in Science and Technology Studies (STS) and Actor Network Theory (ANT) have revealed the roles of manifold human and non-human agents in distributed and collaborative processes of knowledge and design production.6

Such anthropological interest in processes of creation puts manual techniques of notation, drawing and sketching at the forefront; this is mirrored in the series “Wissen im Entwurf,” whose contributions on logics of ideation, notation and recording were fundamental to cultural technique research on these matters.
The Ontologies of Manufacturing Models

So even for architects who are not exposed to, or have no interest in, coding, there still exists this secondary exposure to the logos of numerical representations and software development.

Interestingly, these lines were not written by an architectural critic or a cultural historian, but a former Autodesk software engineer. Michalatos+Parofakis outlines how the ontologies of design software influenced the architectural aesthetics of our built and imagined environments and how ubiquitous logos of differential geometry and boundary representation in early modeling software resulted in a fetishization of the surface. His work outlines how these influences allowed geometric concepts and contents to filter external to architecture into the shaping of its forms and agendas.

Alongside such influences and imprints, an ever-growing number of outside references, vocabularies, and morphologies have augmented the discourse (emergence, material system, continuity, performance, complexity, mimetics). It is striking how concise and systematic studies on the effect of such logos on the discipline, however, largely remain to be made. According to Bredekamp, these would have to trace how the intrinsic logos of modeling are never passive, but instead engage with their respective practices of making and a kind of inventiveness, which cannot be articulated but only developed occasionally alongside its emergence.

The literary and art historian Jutta Voorhoeve delineates how the operations and practices of drawing are constructive per se, as they are developed and constructed on paper. Arguably, this is especially relevant for graphic thinking, because construction eliminates all that which is not truly relevant for the purpose of realization. This is followed by explorations of how every physical realization encompasses epistemic operations, as they involve a change of media, shifts in scale and dimension or differences from an original sketch or concept. These notions of construction, from auxiliary lines to water lines, and their related actions of translation and alteration read as an archaology of drawing and materialization. In his summary of a project that approaches the ‘Digital Turn’ from a media-archaeological standpoint, the architect and critic Mirko Zardini demands these altered agencies of his readers:

In all fairness, a fifth actor should be added to this list: an inanimate actor who takes different forms and names: machine, computer, manual, software, code, script, etc. This technological consensus — sought, found, tested, modified and even invented by the architects themselves in order to realize their ultimate vision — assumed a life of its own and made the production of these projects possible.

Both cases hint at multiple agencies which are embedded in their respective workflows. Clearly, manufacturing models revolve around this relationship between drawing and construction and may be a catalyst to approaching CAD/CAM from a cultural technique perspective. Their curves and codes are drawn and written to translate numbers into physical artifacts. As they have to take the material properties and constraints of machinery and data into account, they negotiate the constitutive aspects of digital production workflows. At the same time, we need a broader conception of drawing, one that accounts for their related actions of translation and alteration read as an archaeology of drawing and materialization. In his summary of a project that approaches the ‘Digital Turn’ from a media-archaeological standpoint, the architect and critic Mirko Zardini demands these altered agencies of his readers:

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In his phenomenology of the visual agency of the ‘image act’, Bredekamp suspends the strict dualism of subject and object — tracing how images, creators and spectators mutually form and influence each other. As he foregrounds the intrinsic logics of modeling are never passive, but instead engage with their respective practices of making and a kind of inventiveness, which cannot be articulated but only developed occasionally alongside its emergence.

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respectively workflows, whether theoretically, through their assumptions and suggestions, or practi-
cially, through their affordances and presences. Instead of portraying seamless transitions from thought
to material, they would dissect the manifold steps and how they manage, alter and filter the outcome.
Such an interest in actual and tangible mediacy, not some abstract immediacy of designing, would also
put the narrative of the ‘digital chain’ into perspective.
This call for a systematic inquiry into the readability of modeling logics, software environments and
production workflows may go beyond the scope of the present approach. Among the rare points of
reference, the 2009 survey by Sabine Kraft and Christoph Schindler stands out as an attempt to link
larger matters of architectural cultures of research and practice with realities of digital fabrication. On
the basis of 14 compared projects (see image in the previous page), they delineate how foundational
logics of designing and modeling across various typologies (egg slices, double egg slices, folds, pan-
els, braids) appear as fundamentally detached from matters of material organization (fiber direction,
choice of material), function (use, inner organization), construction (connections, statics) and fabrica-
tion, delimiting the role of the architect as author. “Bluntly said, her/his role seems to be confined to
picking an apex metaphor or decorative gesture, that is, creating formal complications, while largely
making any fabrication constraints.” 5 It is in the irresistibility of these metaphors, guiding and shaping
their project outcome through models and processes of manufacturing, in which the ‘intrinsinc image
act’ reveals itself.
In recent years, some have begun asking that contemporary practices develop more adaptable,
resilient and open-ended processes. 6 While doing so, however, one may conceive of the ‘image act’ as a
reminder to consider the filters, scripts, plug-ins and interfaces as much productive parts of real
ization processes as their respective machineries of production – “because the complex and highly
variable contemporary environments of software and hardware introduce a distance – not a void,
but perhaps a filter or membrane – between designer and object.” 7 As the scenographer Sean Keller
has said, Architectural histories of the model are told elsewhere, namely how their recurrent role as an
idea materializes 8 repeatedly challenged the discipline to redefine itself. Yet, it is precisely this faculty
to provoke, challenge and constitute the processes of their generation which appears as an asproma
feature. To the extent that these presumptions prevail today, architects cannot afford missing out on
fully authoring the generation of manufacturing data within their CAD/CAM-driven projects. It is this
moment in which all remaining questions need to be resolved by the authors, before other human or
non-human agents resolve them for them.

Brilliant Models and Physical Correctives

For the beacon of its sparkling clarity is accompanied by the danger of its power to seduce. By virtue of the
compelling influence of their construction, models may become fetishes in the fields of research that in reality
comprise utterly indigestible masses of data. 9

On the case of Darwin’s On the Origin of Species, Bredenkamp exemplifies the epistemic power of scien-
tific model practices as being both guide and shackles in the hand of a researcher. He outlines how his
branching illustrations of natural selection had to be deceptive – partly due to their ideological impli-
cations of growth and direction, partly due to their exclusion of dead, fossil-like structures – and uses
sketches in Darwin’s notebooks to suggest how an encounter with a Patagonian coral (which turned
out to be an algae) may be the actual, figurative origin for this theory. 10 To Bredenkamp, this stands as
an example of how models function both as container and symbol of their underlying theories and how
they may gain authority over the reality they are describing. To us, it is also
an example of how a physical reference may reveal an alternative, corrective pathway to those fables of modeling.

Building history has been one of lowering such physical grips on real-
ity and precision has more than once served both as rule and workhorse
to these ends. Craftsmanship long measured distances in relation to parts
(foot, ell, cubit, palm) or ranges (bow shot, stone throw) of the body, which
were eventually replaced by metric working: units connected to the reality
of material processing — and related custom of dimensioning masonry in
decimeters, caperency in centimeters and metalwork in millimeters. Later
still, a whole culture of postwar architectural representation was founded
upon the iso 128-compliant nib widths of Rabidograph technical pens
(0.13, 0.18, 0.35 mm), which still populate our tool bars today. When the sci-
ence historian Norton Wise reflects on “why and how precision has become
the sine qua non of modernity,” he illustrates how the ‘values of precision’
form a specific Western disposition toward self-assuring qualities, a tauto-
logical quest.

According to current critics of architectural discourse, “the clichéd immu-
no-late offices and pressed white shirts of the quintessential modern architect
were just the tip of a redundant precision iceberg.” 11 A contractor may build
a 5 m long concrete wall as a German construction site with 16 mm tol-
erance to meet new standards, the finest print layer of the Stratasys J750
amounting to 0.014 mm and Autocad calculating its data set to even 16
decimal places. While the primacy of drawing required the utmost drafts-
manship, the same rigor now weighs heavily upon the standards of digital
representation, models, layer structures and their rendered manifestations.
Paradoxically, such obsessions with ever-smaller margins of tolerance even-
tually appear as detached from sense perception: the two-point discrimina-
tion of our fingertips, as applied to Braille writings, is assumed to be around
2 mm.12

Linking the precision of computational workflows back to human and
non-human points of reference thus takes on special importance. The
Remote Impressions project by Thomas Pearce and Gary Edwards is one
example of such practices. Merging recording, scanning, modeling and
making processes, its authors create a processual, functional and narrative
wall as part of a mobile artist-studio. They draw on 3D scans of existing
objects and merge them with body-related equipment designs and motion
studies; the hybrid outcome instructing the Single Point Incremental Form-
ing (SPIM) panels (see image on this page). What they describe as a form
of ‘cross-contamination’ between bodies, objects, skins and code13 is an
example of such strategies where the physical and the digital augment each
other: as glistens and artifacts from the physical realm are not erased or flat-
tened, but adapted and altered through the following steps of mediation,
they remain active contributors to the process until its end. Other


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as limitations but potentials for auspicious. They stand in line with other examples, where experiments with error driven process chains have revealed the prospects for innovation of glitches and imperfections.

The more precise and reliable we consider the model to be, the more it blinds us with its object. This process generates its own form of indeterminacy and ambiguity because it is no longer possible to distinguish the two. [...] What appears to be exact, faithful and informative has the peculiar qualities of ambiguity, uncertainty, non- or under-determinate.54

In continuation of Bedekamp’s ‘image act,’ the art historian Reinhard Wendler labels such tendencies to confuse model and subject as the ‘brilliance problem’ of modeling, referring to the moment when an (over)definition on the part of the model begins to blur the borders constituting their difference. From science to the arts, Wendler follows historically contingent interplay and transitions between certainty and uncertainty, precision and impression, which he frames as a cultural technique take on an uncertainty principle.55 In order to avoid ‘compression effects,’ critical strategies need to remain conscious of the respective degrees of certainty or uncertainty in their work, ‘embracing – in a way – their margins of error. If they do not, their endless hunt for precision and exactitude runs into a dead end at the very moment when the represented and its representation collapse into one, as illustrated by Jorge Luis Borges’s famous 1946 short story.56 Some have raised concerns about how the infinite promises of digital-visualisation57 and even58 may run into the very same ontological limits in terms of mutual potentials for knowledge production, using precisely computational capacities, the detachment of such excess and ornament from its postmodern provenance and the uncontested look of Big Data, which we are only beginning to visualize, literally and figuratively.59 He encourages us to conceive of work as a technological and computational proof of concept, renovating baroque complexity and working toward multifaceted or voxelated structures and spaces.60 Or to go back to Schindler and Kraft, ‘Anything goes’: it appears as if one could build virtually anything – and if one had to exhibit such technological potency, such capacity to realize the most intricate forms.61

In order to avoid such pitfalls of brilliance, authors of CAD/CAM-driven processes may acknowledge how the scientific quest for brilliance and the architectural quest for precision both imply their respective logics of fetishization. This application of the ‘image act’ suggests how both commodify knowledge, and in a structurally complex material architecture, that is, reactivate an analogy to the column as an architectural archetype, that is, reactivates an analogy to the human body which has been effective since ancient times, as it integrates an active, bidirectional relation between spectator and metabolizing object; they also transcend the notion of the object in a form that is itself the result of the active process of its own generation. Referring Alexander Cozens’s Bilthandicraft and dynamic sketching methods from Leonardo da Vinci to Frank Gehry, Wittmann has acknowledged such play with openness as an elemental technique in drawing practices.62 While, to her, drawing logs and practices become productive at the beginning of design processes, as they open up preconceptions and self-contained workflows and release creativity into an uncertain, open-ended contemporary practices.63

Column 21 by Rian Bianco and Daniel Suárez may serve as an example of such a workflow. Its authors install a multi-actor fabrication system which exposes the textile microbiome of a hand-woven jute structure to bespoke reenvironment with idea and calcium chloride. In line with the structural simulation and optimization of these processes, this designed congeomerates con- verses from a textile to a compressive system; as it solidifies into a column (see image on this page) through biochemical reactions – realizing what Wendler frames as an “optimized uncertainty”64 in a structurally complex material hierarchy and performance. In its blending of transdisciplinary and temporal knowledge, the resulting workflow “operates between and utilizes the inherently different domains of binary and ecological computations.”65

Very clearly then, their approach favors the distributed and the complex over self-contained and determined logics – setting the stage for a large number of natural-textile, biochemical, computational, dexterous and environmental actors, leaving space for a well-rehearsed ‘improvisation’ as a crucial part of the script – which may be linked to how Bedekamp frames drawings by Charles Peirce as ‘self-generating, arising in part by chance, but, precisely on that account, symptomatic – of a nature to be found in cont- transient physical and mental movement.”66 Not only do they activate the

The building is characterized as a 1x1x1 metric inside the bioscience, pathologically organic bioreactor as a Column 21 by Rian Bianco and Daniel Suárez, 2017. Source: Bianco, Suárez and Pyk, ‘Biologically Activated Textile Composites,’ 341.

the current cultural technique perspective, such forms of encapsulated knowledge on the part of developers and programmers necessarily result in a redistribution of agency and authorship – a situation designers can only face by embracing technical constraints, physical contingencies and distributions of agency. There is reason to suspect that the rapidly altering instruments, media and processes of digital fabrication are still yet to be fully penetrated across disciplines. The practice may be somewhat haunted, the routines of our new tools conceived behind artistic and rhetorical eloquence67 notions and concepts from art history can serve as vehicles to open up these rather self-contained discourses of computational design and manufacture, while matters of manufacturing modeling may serve as an external, peripheral and largely unexplored approach and a catalysis to discussions of agency within the discipline.

Notes
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4. It should be stated that the notion of manufacture applied in this text drawn on the English use of the word: on making processes of trades and industries and, notably, their furthering in the Industrial and Information Age, such as developed, for instance, in the architect Branko Kolarevic’s foundational text. See Branko Kolarevic, “Introduction,” in Branko Kolarevic, ed., Architecture in the Digital Age: Designing for the 21st Century (Berlin: Gestalten, 2011), 111–112.


9. The notion of the model applied in this paper pays special attention to the forma- tive qualities of drawing, shaping and engineering models; modeling is concerned from its material and immaterial basis, its founding in techniques and materials on the hand and an ability to display and continue abstract matters on the other hand: See Nathalie Bedelka, “Model,” in Barbara Wittmann, ed., Werkzeuge des Entwerrens (Zurich: DAS, 2016), 107–109.


