Pressed For Time: Forays into Architectural Industry

A factory manager from the mid-nineteenth century, transported forward to an architecture school of today, would feel perfectly at home. Particularly if close to term's end, he would see students operating intricate machinery, churning out massive arrays of parts and components, and becoming absorbed in the intricate, repetitive assembly of complex devices. Were he to study this behavior closely, he would see students becoming skillful practitioners of procurement, process management, implementation, problem-solving, and logistics as they manipulated materials, tools, resources, assembly lines, and schedules. He would see work done at a frenetic pace, over long hours and under arduous conditions. He would witness the successes and failures of these mini-industrial sequences, as the plans either proceeded smoothly or encountered inevitable obstacles.

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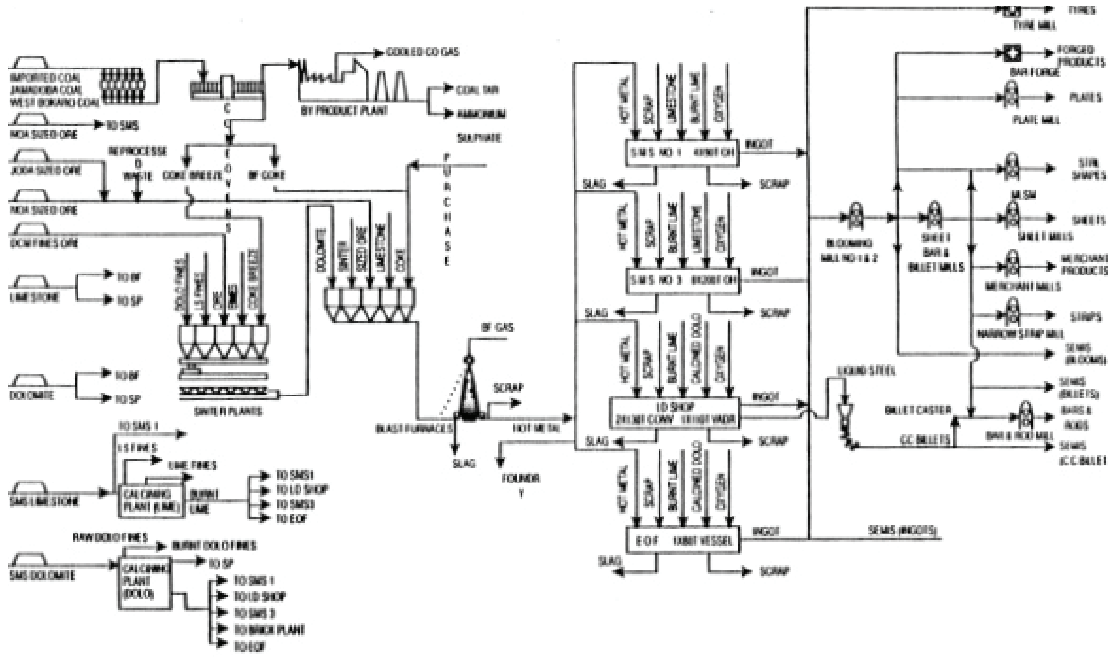
The intensity of this period cements architecture's reputation as a discipline of prolific productivity, albeit hard-won under challenging working conditions. Being pressed for time is more than merely a disciplinary albatross: It is a fundamental tenet of cultural indoctrination into architecture school, a deeply ingrained presumption that pressure begets success. This compressed production timeframe wages an ontological conflict between architecture as a discipline of premeditated, rigorous management versus a more messy practice of improvised tactics and logistical triage. Indeed, the dominant methodological characteristics of the contemporary architectural academy require students to become skilled logisticians and managers of processes in which the scale, structure, and pace of architectural productivity begin to closely resemble industrialized processes of manufacturing, along with its associated risks.

Yet this is more than merely an issue of analogous techniques and capabilities; it is, moreover, a function of the intensification of processes with increasingly prodigious material output. The proliferation of digital techniques of mass production within our discipline ensures a profusion of architectural matter that is rapidly prototyped, continuously varied, mechanically actuated, and extensively distributed. Even the prevalent



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terminology of formal description—aggregation, component instantiation, packing, versions, swarms, arrays, etc.—indicates our dedication to a methodology of the massive.

Furthermore, the broad spectrum of crises that define the contemporary terrain within which we practice—resource scarcity, manufactured landscapes, environmental depredation, globalized proliferation, infrastructural breakdown, ubiquitous militarization, tipping-point urbanity—demand architectural responses that are concomitantly massive in scale—and, therefore, quasi-industrial in their organization and implementation. In this context of crisis and expanded scale, our allegedly "post-industrial" period appears anything but, and any attempt to place a history of mechanized production in the rear-view mirror seems grotesquely naive. Remarkably, architecture students tend not to shirk from these daunting tasks facing their adopted trade; as the topics of this conference suggest, our disciplinary zeitgeist instead gravitates toward extensive systems of architectural instrumentality, industrial ecologies undertaken *en masse*.

Considered together (and perhaps arriving late by 150 years or so) these transformations constitute nothing short of an industrial revolution of the architectural discipline. It would follow that a core competency in logistics, time management, and other quasi-industrial capabilities would be an explicit part of our pedagogical process, going beyond the mere instruction of technical skills. However, with few exceptions this is left up to an empirical baptism-by-fire: a training that cannot be imparted to students, only experienced directly by doing. By contrast, the papers of this session all seek to invigorate the pedagogical discussion of these critical

Figure 1: Mike Mandel [7]

competencies, and thereby respond to architecture's intensified status as an industrialized practice. As Sigfried Giedion noted in 1948—a significant transitional period of mass productivity not so dissimilar to ours—the capabilities involved in the "anonymous history" of mechanization and manufacturing were missing from "the present-day curricula of our universities," and "research [was] desperately needed."[1] Many years later, we are finally beginning to fill these gaps in our education, as the imperatives of architectural manufacturing become newly relevant once more. So what might an industrial pedagogy begin to look like?

TIME MANAGEMENT

If we were to approach the problem analytically, we might begin by taking cues from the scientific management scholars of the past century and undertake a rigorous physical analysis of repetitive processes of architectural production. When methods of digital fabrication produce huge numbers of parts, missteps and inefficiencies are multiplied. Recalling Frank and Lillian Gilbreth's chronocyclograph techniques of the 1920s documenting the movements of assembly-line workers, the reductive analysis of repetitive movement reappears in the careful optimization of robotic arm and automated fabrication tool paths. <FIGURE 1> While it is an amusing if absurd prospect to imagine a school full of students equipped with motion-capture rigs, such analysis might provide a useful survey of synthetic, quasi-cybernetic processes of production and quite simply help to save substantial amounts of time.

More significantly, though, we might begin to uncover the myriad ingenious solutions to various procedural obstacles that students discover in the dark of night but which remain undocumented and obscure. What is at stake is the prototyping of novel processes, a pursuit of innovative, tactical methods that are critical when routine protocols inevitably encounter anomalies, setbacks, and breakdowns. As the Toyota Corporation famously discovered when analyzing their factory supply and distribution chains during the 1970s, the ability of a process to remain resilient lies not in a set of tightly regulated, more prescribed time-management practices, but in the artificially compressed timeframe of the deadline.[2] Here the factory again closely resembles architecture school, in which a "just-in-time" culture of intensified schedule pressures rewards the localized intelligence of tactical intervention and improvisation. This invisible ingenuity takes the form of calibration, tips and tricks, work-arounds, best practices, insider knowledge, and veteran advice that is particularly valuable under intense time constraints.

Such an anonymous culture of innovation constitutes a shadow education in problem-solving, parallel to—and possibly as important as—the capabilities covered in formal curricula. Students here learn vital competencies for rationalizing processes that are often ad hoc, chaotic, and error-prone. The prevalence of such turbulence across the broad spectrum of architectural endeavor suggests that procedural ingenuity might be our most important contribution, and therefore our most important skill to impart as educators.

This is not to suggest that such forms of improvisational capability should be systematically distilled into a formal system of education. Indeed, a rigorous form of analysis and classification may well defeat the potential benefits of trial-and-error, learning by doing.[3] Frederick Winslow Taylor drew considerable criticism for this aspect of his pioneering scientific management practices, in which he sought to extract distributed know-how from the worker and apply it at the systemic level. This not only suppressed worker agency but removed the critical intelligence that allowed for evaluating process and product, identifying problems, and innovating new work-arounds. It converted manufacturing into a series of protocols to be followed rather than a process to be monitored, continually adjusted, and radically transformed.

By contrast, contemporary industrial practices more often seek to collapse management and implementation into an integral non-linear process, one which closely mirrors standard practices for architecture students. While it of course helps that students are often simultaneously playing factory worker, shop foreman, and product designer, the various directives involved in each role rarely follow the hierarchical, linear sequence found in the Taylorist model. Again, being pressed for time ensures that discoveries of savvy shortcuts during the production process proliferate widely throughout design orthodoxy: That toolkit of work-arounds becomes a new formal lexicon of keyed tabs, score lines, and spliced ruled surfaces.

LOGISTICS

For architects, management of a project's development extends far beyond the objects themselves to comprise a carefully orchestrated system of organization, control, and delivery, in which the architect is recast in the role of triage logistician. Our effectiveness—particularly around deadlines—then relies on our ability to manage the complex, fluctuating sequence of events and resources that govern such quasi-industrial processes of production and implementation. Sanford Kwinter claims that logistics is itself a fundamental product of architectural practice, going so far as to claim that "management—or rather logistics—may well represent the preeminent, and perhaps only real, modern, architectural 'object,' albeit an object with a mutable and elusive shape."[4]

It is somewhat surprising, then, that efforts to document formal and strategic organizational logic—through diagramming and other such means of representing logical structure—rarely extend to the description of logistical practices. For example, critical path drawings are essential tools for industrial management, even construction management, to communicate order of operations and track evolving contextual circumstances. Where logistics departs from other forms of technical knowledge is that it contends with the difficulties of context, the messiness that *in situ* implementation imparts to any standardized or routinized practice. In other words, it is more than merely a managerial process of command and control, organization and protocol: It is a spatial practice, or to paraphrase Kwinter, *the* spatial practice par excellence.

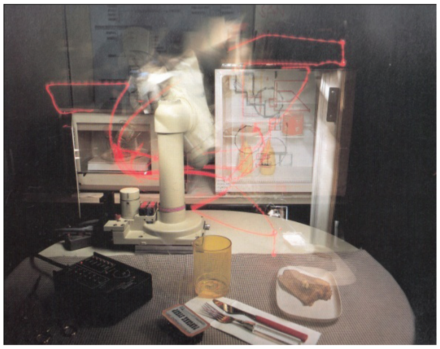

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Figure 2: ET Steel Works[8]

Industrial historian James Beniger describes the radically innovative plan of Pittsburgh's Edgar Thomson Steel Works (1875) as reflecting the manufacturing processes explicitly, in which the layout of the buildings followed the diagram of the assembly line rather than the assembly line conforming to the footprint of the buildings.[5] In this case, spatial and logistical logic become indistinguishable, mutually reinforcing constellations of matter, resource, and organization. Given the proliferation of parametric modeling software, we are now accustomed to thinking of geometry in terms of critical-path genesis and visualizing this procedural structure. We ought to be well-positioned, then, to shift this same sort of thinking to the spatio-temporal concerns of process logistics.

HYBRID MANUFACTURING

If we are indeed seeing new, quasi-industrialized practices emerging within architecture school, these changes parallel those currently transforming the manufacturing of consumer goods. In recent years, the prevailing industrial narrative has focused on the mechanisms of labor-driven economy, a presumed-irreversible shift of manufacturing to the developing world where the low-wage thresholds override all other concerns. Tracking more recent trends in manufacturing, however, other priorities begin to emerge, such as the benefits of close proximity between design studio and factory floor for rapid, midstream adjustments. Indeed, the potential feedback and shortened "upstream" communication paths between factory workers and product designers has many prominent corporations moving some manufacturing back to their developed-world bases.[6] The innovation is to reverse the Taylorist systematization of worker intelligence, finding ways to productively mine know-how from those on the factory floor and feed that back into product revisions. The tides of the global manufacturing diaspora begin to shift again.

If this shift towards micro-manufacturing continues, then architects are remarkably well-positioned to take advantage of these new production systems that are governed by entirely new command and control structures. At a basic level, one may well imagine architecture school serving as a rich educational platform for jobs in this manufacturing sector. Or, architecture institutions might "outsource" production to newly arrived micro-factories, as the capacity of school tools and facilities is exceeded by the demands of *en masse* output. As the spatio-temporal complexity of the micro-manufacturing system grows, the design of those facilities may even require the complex coordination that only an architect can provide. Nonetheless, the most significant implications may well be the new scales of architectural production afforded by our evolving logistical know-how. With factories at our disposal, what might architecture become? Answering this question will require a further reconception of the discipline in industrial terms, with all the complexities and pitfalls that may entail. ◆

ENDNOTES

1. Sigfried Giedion, *Mechanization Takes Command* (Oxford, Oxford University Press, 1948) p. vi
2. Just In Time Manufacturing
3. Indeed, trial-and-error has its own champions who distinguish it from more predetermined, cautious modes of innovation. Economist-agitator Nassim Nicholas Taleb has identified the resilient or "anti-fragile" benefits of tinkering versus more rigorous and institutionalized forms of research and experimentation. See "Learning to Love Volatility," *Wall Street Journal,* November 15, 2012.
4. Sanford Kwinter, *Architectures of Time* (Cambridge: MIT Press, 2001), p.18
5. James Beniger, *The Control Revolution* (Cambridge: Harvard University Press, 1986), p. 239
6. Recent popular-press coverage of this developing trend includes Charles Fishman, "The Insourcing Boom," (*The Atlantic,* December 2012), and Annie Lowrey, "High-Tech Factories Built to be Engines of Innovation," *(New York Times,* December 13, 2012)
7. Mike Mandel, "Robot Makes French Toast, 1985," *Making Good Time* (Riverside, University of California, 1989)
8. Edgar Thomson Steel Works, diagram by Goutam Dutta & Robert Fourer, *MSOM Journal for Operations Management,* vol. 3 #4, Fall 2001