Supply Chain Materialism

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Keywords: supply chains, sustainability, politics of design, material flow

The goal of this paper is to unsettle prevailing assumptions of sustainability in architecture by analyzing the supply chain of building materials. By closely following the transformations of architectural materials and those that transform them, the tangible effects of design become more apparent (e.g. material extraction, environmental pollution, waste streams), and the intangible forces become more visible (e.g. economic incentives, labor abuses, political spending). The paper begins by outlining several theoretical and representational challenges of supply chains, followed by examples of how these ideas can be applied in teaching and practice.

Methods of representing supply chains fall into two categories. The first category documents supply chains in abstract or distanced representations, in what Donna Haraway might call "a view from nowhere." These often take the form of maps, diagrams, or explanatory text that attempt to communicate the networked topology of material production. However, the comprehensive ambition of these representations often compromises their affective appeal. The second category adopts a momentary or situated representational strategy, often in the form of installations, images, or narrative text. These representations aim to highlight specific spaces or embodied relationships that speak to the character of the process, what Haraway might consider the "partial perspectives" that offer a more visceral understanding of a process. These types of representations, however, often risk underselling the extent to which decisions affect distributed sites and relationships.

To better grasp the impacts of design, this paper argues for hybrid approaches that draw from both methodological categories. It explores these ideas by describing the format and content of a graduate seminar called "Supply Chain Materialism." The course itself is structured as a speculative supply chain. At the beginning of the semester, students select an everyday construction material (e.g. steel, concrete, glass, plastic, wood, brick, silicone) and document its transformations alongside the weekly theme. Paired with this independent research, the course offers a range of theories that help frame a more critical understanding of sustainability, drawing on texts in architecture and other spatial disciplines. The course also presents a catalog of spatial practices that align with different stages in the supply chain, including art installations, activist demonstrations, architectural projects, curated exhibitions, and performances.

Throughout the semester, students demonstrate their understanding of the course content through three representational techniques. First, students make collages using images clipped from trade magazines. These collages exploit the disjointed nature of material production by juxtaposing images of the seemingly dissociated sites, actors, and effects. Second, they create a narrative that documents specific activities involved in each stage of production of their selected material. Third, students design a folly that highlights the invisible aspects of their reconstructed supply chain. By creating a useless object out of a useful material, the folly seeks to challenge notions about the ubiquitous materiality of building design through techniques of estrangement, hesitation, or defamiliarization. Ultimately, the course exposes students to a broadened conception of sustainability and a widened field for intervention through a careful examination of the supply chain of material production.

INTRODUCTION

The goal of this paper is to unsettle prevailing assumptions of sustainability in architecture by analyzing the supply chain of building materials. By closely following the transformations of architectural materials and those that transform them, the tangible effects of design become more apparent (e.g. material extraction, environmental pollution, waste streams), and the intangible forces become more visible (e.g. economic incentives, labor abuses, political spending). Of particular concern in this paper are the intangible forces, as they often escape scrutiny in conversations about sustainable design. The paper begins by outlining several theoretical and representational challenges of supply chains, followed by examples of how these ideas can be applied in teaching and practice. Ultimately, this paper seeks to establish a more rigorous engagement between architecture and climate change that goes beyond current discourses of sustainability.

THEORIZING SUPPLY CHAIN MATERIALISM

Supply chains invite speculation into material provenance. Where does it come from? Who supplies it? How is it made?

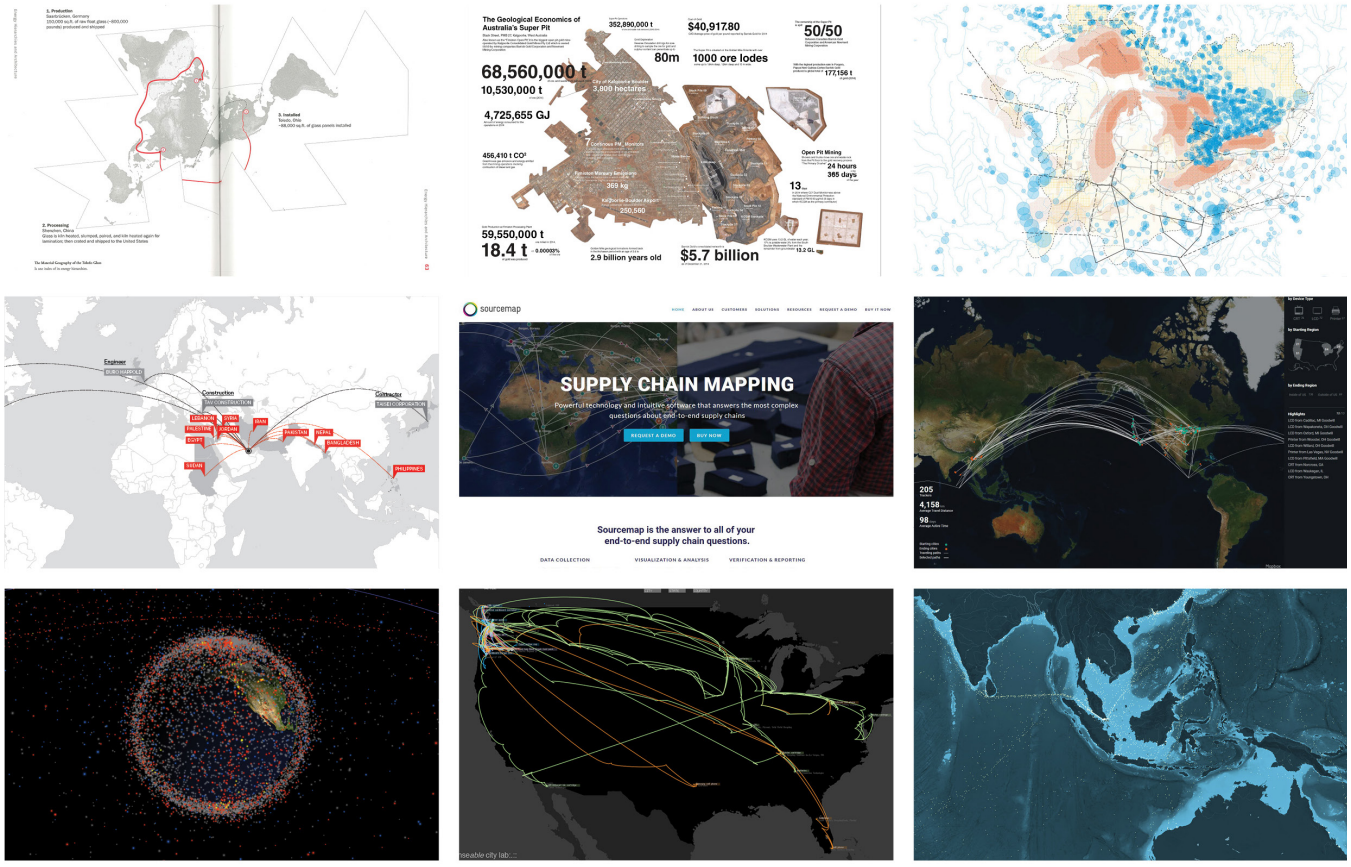

Figure 1. Visualizations of supply chains from a distanced perspective.

Defined as a "generic label for an input-output structure of value-adding activities, beginning with raw materials and ending with the finished product," supply chains neatly map the process of commodity production through its distributed network of sites and actors.[1] Importantly, supply chains are defined by their relationality, and they exist only as interconnected links. If the links hold, the supply chain works and a product is delivered, but if a single link breaks, the supply chain collapses. Moreover, supply chains do not discriminate between tangible and intangible relationships. As much as a supply chain relies on the availability of raw material and working production facilities, it also relies on handshake agreements, policy decisions, electricity rates, and minimum wages. Whereas other research frameworks—such as life cycle analysis or embodied energy analysis—privilege the material effects of design decisions, supply chain analyses accommodate a broader spectrum of influence and consequence.[2] For this reason, supply chains offer a framework for critically examining the relationality of architecture that better accounts for its manifold effects, both visible and invisible.

Beyond the plentiful management literature that extolls the virtues of supply chains for maximizing profit (and, subsequently maximizing economic inequality and environmental damage), the theoretical contributions of several social scientists stand out for the clarity of their critiques. Jennifer Bair, for example, studies material production to reveal "how commodity chains contribute to the reproduction of inequality in the global economy" while offering guidance for using supply chains as a research framework.[3] For Bair, the future of supply chain research must encompass not only the material flows of commodity production, but also "the regulatory mechanisms, market institutions and structural properties of contemporary capitalism that affect the configuration and operation of these chains as well as the developmental outcomes associated with them."[4] Here, tangible effects are only one dimension of a broader understanding of materiality. Similarly, Anna Lowenhaupt Tsing analyzes supply chains to reveal the particular "labor-and-capital-making niches" constitutive of contemporary capitalism. Within these niches, Tsing seeks specific openings through which political pressure can be applied, openings such as legal violations, humanitarian abuses, and environmental degradation. Moreover, she emphasizes the embedded nature of these niches, which she calls the "the matrix of other connected and disconnected niches." From this multiscalar analysis, Tsing ultimately calls for researchers "to turn attention to the full tapestry of gender, race, and national status through which supply chain exploitation becomes possible."[5] As a method for analyzing relations within globalized economies,

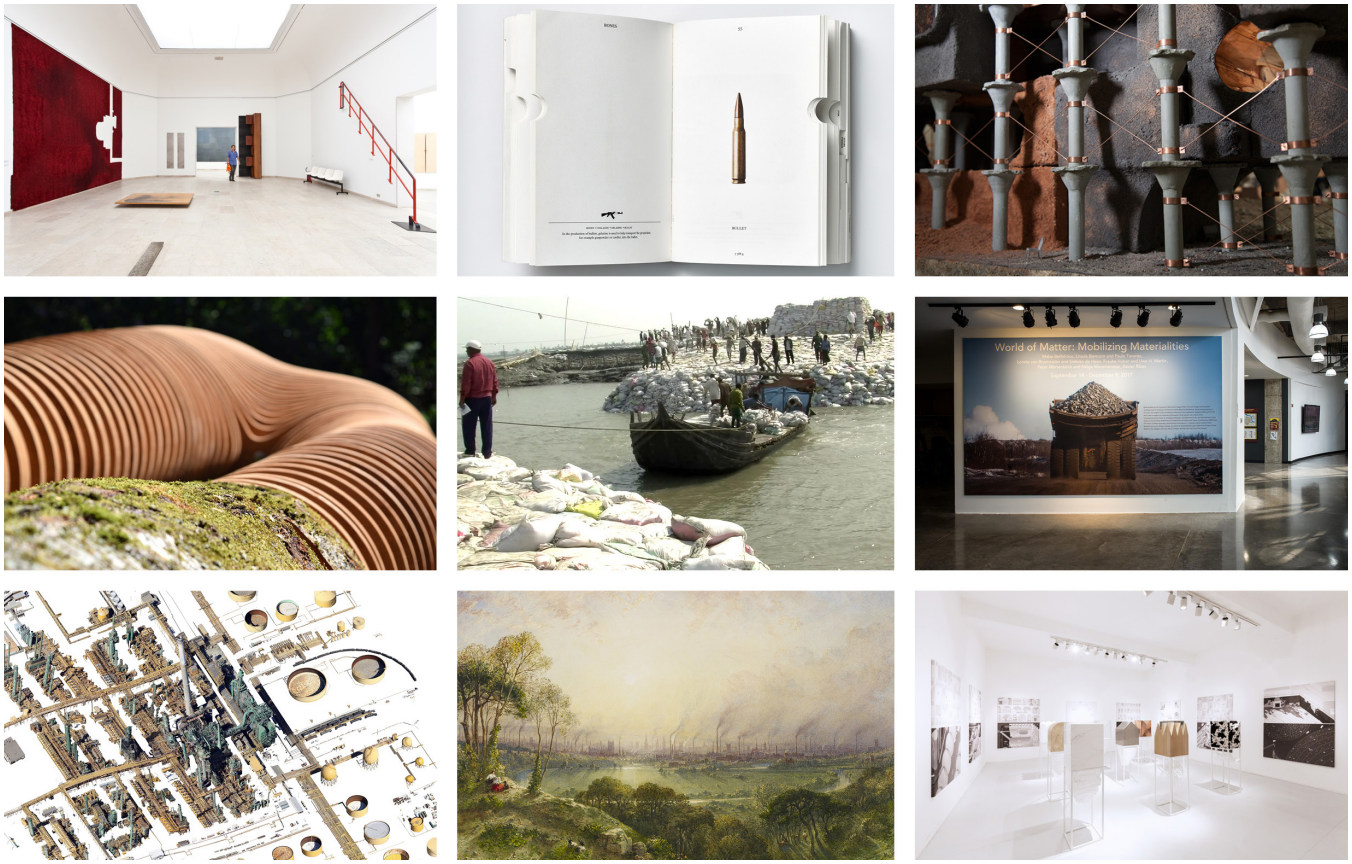

Figure 2. Spatializations of supply chains that often combine near and distant perspectives.

supply chains offer a robust framework for capturing the seen and unseen effects of commodity production.

REPRESENTING SUPPLY CHAIN MATERIALISM

To understand the broader impacts of architecture in relation to its production presents several theoretical challenges, but to describe these impacts in a meaningful way presents significant representational challenges as well. Methods of representing supply chains fall into two categories. The first category documents supply chains in abstract or distanced representations, in what Donna Haraway might call "a view from nowhere."[6] These often take the form of maps, diagrams, or explanatory text that attempt to communicate the networked topology of material production. However, the comprehensive ambition of these representations often compromises their affective appeal. (Figure 1)

The second category adopts a momentary or situated representational strategy, often in the form of installations, images, or narrative text. These representations aim to highlight specific spaces or embodied relationships that speak to the character of the process, what Haraway might consider the "partial perspectives" that offer a more visceral understanding of a process.[7] These types of representations, however, often risk underselling the extent to which decisions affect distributed sites and relationships.

More effective in documenting the impacts of supply chain materialism, then, is a representational strategy that synthesizes these categories, a hybrid approach that attends to both distributed and embodied effects, dispersed and concentrated forces. A similar challenge confronts the representational project of climate change. With such a pervasive daily presence and such a massive global impact, representing climate change has become the subject of much inquiry. For Emily Eliza Scott, the problem is scalar, asserting that "the too close and the too distant—presuppose the possibility of documenting objective, single truths and, as such, I want to argue, they are too literal to contend with climate change."[8] Instead Scott asks, "how to maintain a degree of resolution fine enough to capture interrelations that are dispersed across time and space, and are often radically asymmetrical in nature," a question equally suitable to the representation of supply chains.[9]

SPATIALIZING SUPPLY CHAIN MATERIALISM

The visualizations of supply chains offered by many consulting firms are almost as prevalent as the publication of supply chain management literature. To map the network of producers and consumers on a flat, globalized plane is to know the supply chain

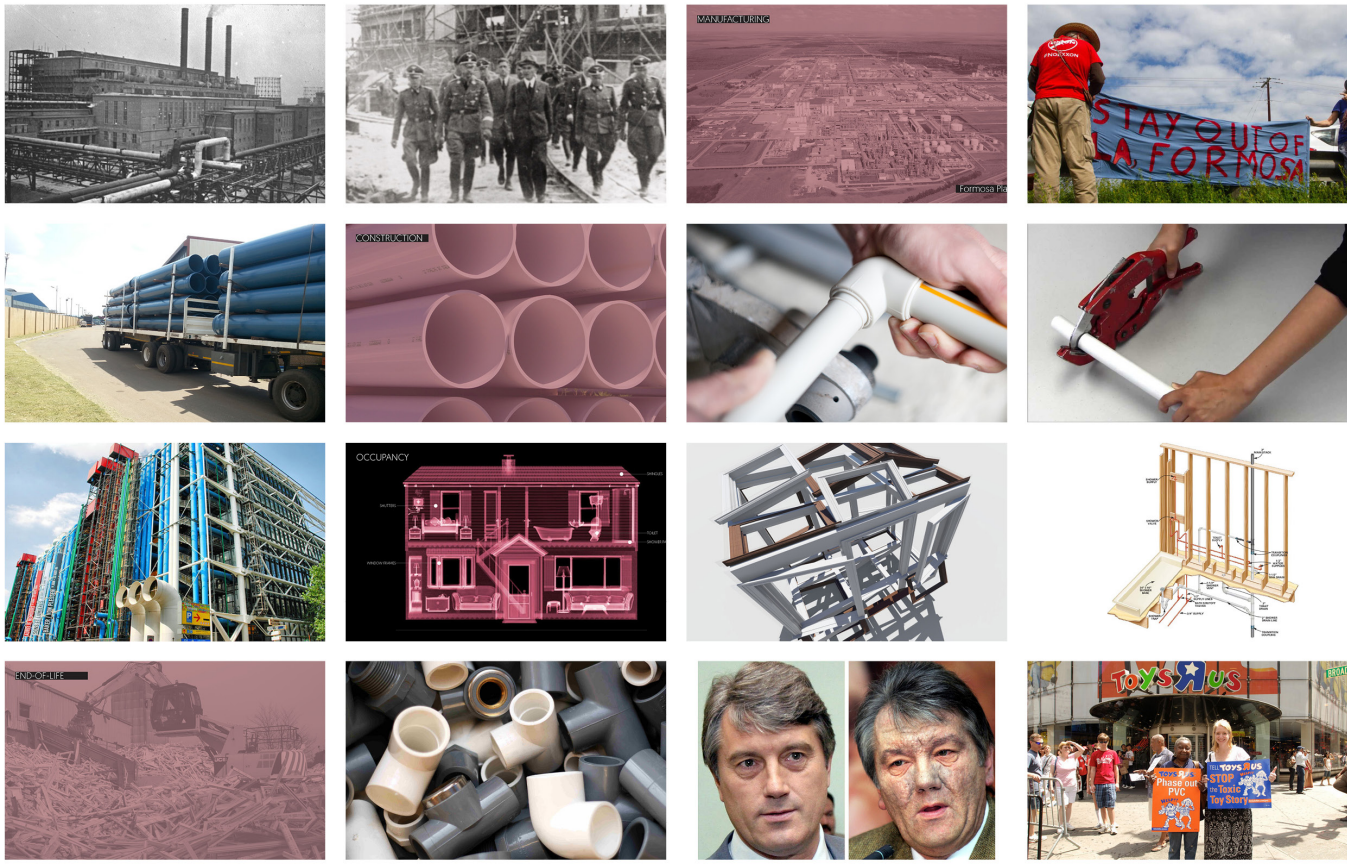

Figure 3. Excerpts from a student presentation illustrating the supply chain of PVC.

more intimately, and in business and management circles, this equates to ever expanding margins. Indeed, the financial success of Apple, one of the world's most profitable companies, is largely attributable to its supply chain that enables a turnover of its entire inventory in less than five days.[10] But if the motivation for visualizing supply chains is not profit, what form does it take? If the goal is to unsettle assumptions about sustainability in design, what techniques can be used? In other words, how might a supply chain be visualized—or spatialized—otherwise? (Figure 2)

In recent years, critical engagement with the supply chains of building materials in architectural discourse has grown significantly. On the international stage, Neyran Turan's contribution to the 2016 Istanbul Design Biennial featured the "long-span of architectural materiality" with drawings and models that juxtapose finished products with vignettes from their making and unmaking. For Turan, these juxtapositions speak to the imbrication of architecture in the present climate crisis, claiming that "architecture is both a background and a measure against which the world might be read."[11] Seeking to capture the supply chain as a gradient or flow, Daniel Ibañez's installation for the 2017 Boston Design Biennial creates public seating using wood that transitions between seemingly unprocessed logs to delicately tooled contours. And in a compelling visual narrative, Lindsey Wikstrom's equirectangular projections show the different sites of material production and their associated energy consumption.[12]

A broadened conception of materiality has also been on the rise in landscape architecture. Jane Hutton, for example, traces the supply chain of "everyday elements of constructed landscapes" as a way of unsettling disciplinary assumptions about what constitutes the site. In her book, *Reciprocal Landscapes*, Hutton writes, "By tugging on one seemingly thin thread, two sites are pulled together and a tangle of relations appears."[13] Relatedly, Pierre Bélanger's curatorial efforts for the 2016 Venice Architecture Biennale sought to connect global urbanization to resource extraction and colonization, drawing together disparate geographies through their supply chain of material and energy.

Many artists have also embraced supply chains in their work. In the book, *PIG 05049*, Christina Meindertsma, for example, meticulously documents the end products that derive from butchered parts of a single pig. Often using the built environment as a subject, Lara Almarcegui juxtaposes the space of the gallery with the materials required for its construction, creating atmospheres of speculation into its supply chain. Filmmakers and photographers have also turned their lens toward the supply chain of building materials, in work such as Edward Burtynsky's series on quarries, and in the recent

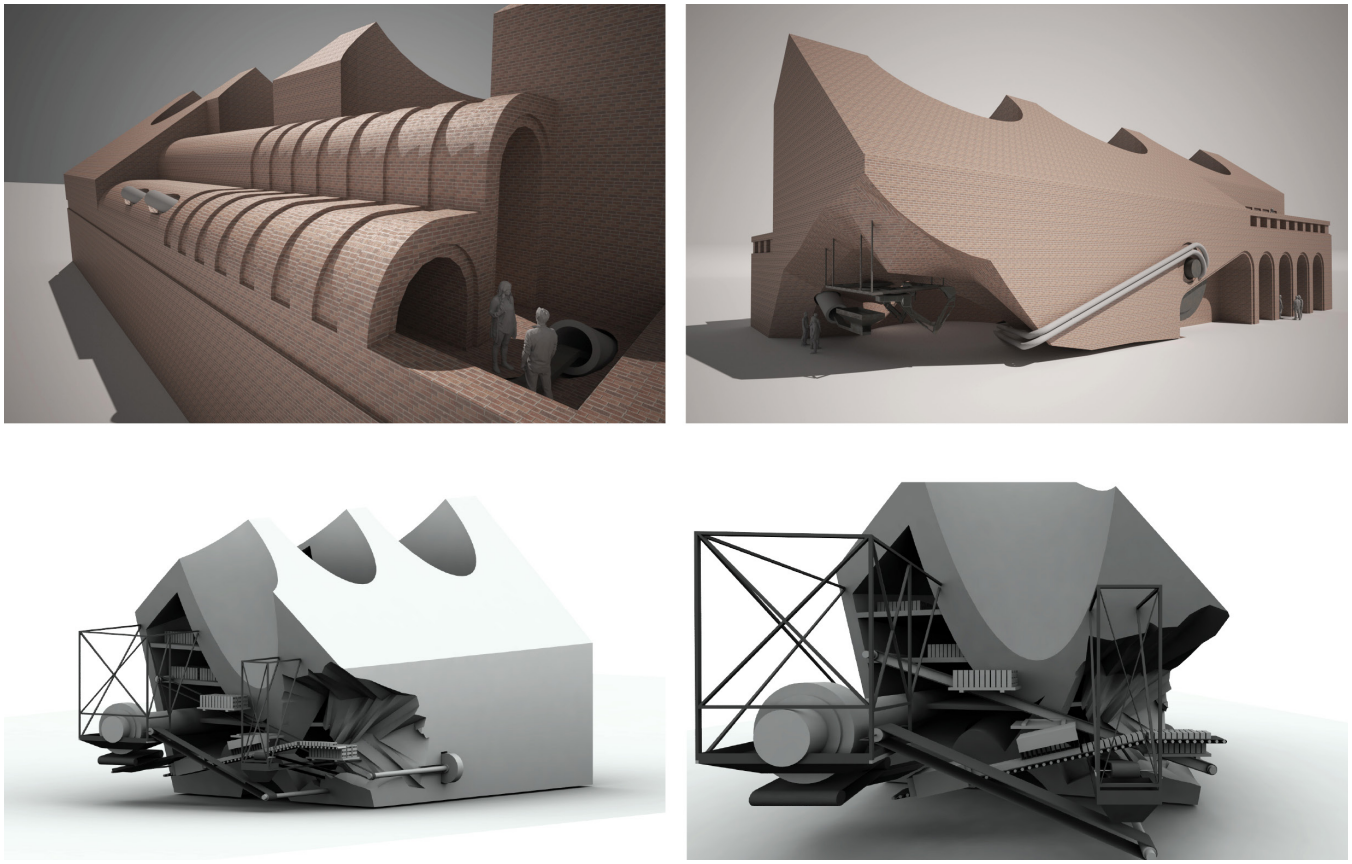

Figure 4. Sample follies designed to reveal specific aspects of the supply chain of bricks.

exhibition, *Mobilizing Materialities*, curated by the art and media collective, World of Matter.

Critical geographers and anthropologists have also examined the supply chain of consumer products, notably theorized by Tsing as "supply chain capitalism" and expansively documented by Ian Cook under the banner of "follow the things." From these accounts, the web of human and nonhuman relations becomes clearer through different ethnographic methods, which have been variously described by Haraway as "staying with the trouble," and by Bruno Latour as cultivating a "system of engendering."[14] In these cases, the argument demands that more actors and more effects be enrolled in the analysis.

Drawing on recent embraces of supply chain analysis in architecture and adjacent fields, I developed a graduate seminar that uses the supply chain of building materials to invite a more critical debate about the state of sustainability in architecture. Implicit in the course description is a rejection of current practices that make claims on sustainable design, privileging instead an explicit need for more effective tools in combating climate change. While this seminar is neither a referendum on current sustainability metrics nor an alternative matrix for sustainability accounting, it is both a theoretical and practical foray into reimagining what sustainability means for architecture.

TEACHING SUPPLY CHAIN MATERIALISM

The course, "Supply Chain Materialism," encourages students to think critically about how sustainability is constructed in contemporary architectural discourse. It does so by framing architecture as an eminently material practice which enrolls a plethora of sites and actors in the supply chain of its production. The course itself is structured as a speculative supply chain, and at the beginning of the semester, students select an everyday construction material (e.g. steel, concrete, glass, plastic, wood, brick, silicone) and document its transformations alongside the weekly theme. Paired with this independent research, the course offers a range of theories that help frame a more critical understanding of sustainability, drawing on texts in architecture, landscape architecture, urban studies, media studies, science and technology studies, geography, and anthropology. "Supply Chain Materialism" also presents a catalog of "critical spatial practice" that align with different stages in the supply chain.[15] These include art installations, activist demonstrations, architectural projects, curated exhibitions, and performances.

The semester is divided into three stages, or modules, that constitute the speculative supply chain. These include Production, Consumption, and Vitiation.[16] Within these modules, weekly themes address specific aspects of these stages. As such, the course establishes a framework for students

Figure 5. Models of student-designed follies seeking to highlight unseen forces of material production.

to imagine intervening in the supply chain of a specific material toward more sustainable ends.

To begin, the production module accounts for the early phases in the supply chain of commodities. Within this module, each week examines a different subphase, around which the course material is organized. During the week on Labor, for example, students read excerpts from Karl Marx, Maurizio Lazzarato, and Peggy Deamer, and are presented with examples of spatial practices that foreground issues of labor and design, including Superstudio's "Histograms" (1969), Mierle Laderman Ukeles "Manifesto for Maintenance Art" (1969), The Architecture Lobby's "Manifesto" (2014), and Who Builds Your Architecture? "A Critical Field Guide" (2017). Alongside these examples, each student researches the specific arrangements of labor unique to the production of their chosen material. Also included in the production module are the themes Extraction, Transportation, and Assembly, each with accompanying histories, theories, and practices.

Once a product has been assembled and purchased, the Consumption module designates its dimensions of use and occupancy in the supply chain of building materials. This module begins with a week on Energy that features texts by Kiel Moe, Timothy Mitchell, David Benjamin, and Rania Ghosn. The examples of spatial practices that explore the relationship between energy and architecture include Buckminster Fuller's "Global Energy Grid" (1938), Pedro Gadanho and Mariana Pestana's "Eco-Visionaries: Art and Architecture after the Anthropocene" (2018), DESIGN EARTH's "Of Oil and Ice" (2017), and the Center for Land Use Interpretation's "Texas Oil: Landscape of an Industry" (2009). Like before, students research the energy implications of their selected material at different stages in the supply chain. The consumption module also includes weekly themes of Maintenance, Logistics, and Utility, each of which corresponds to a set of texts and projects.

Finally, the Vitiation module includes themes that describe the different afterlives of architectural materiality, beginning with a week on Erosion. For this theme, students read texts by Caitlin DeSilvey, Svetlana Boym, and Neyran Turan. Featured projects that examine erosion in architecture include MOS's "Erosion" (2009), The Living's "Hy-Fi" (2014), Daniel Arsham's "The Future Was Then" (2016), and NEMESTUDIO's "New Cadavre Exquis" (2017). Alongside these examples, students explore the unique ways that their chosen material breaks down. Also included in the Vitiation module are histories, theories, and practices relating to the weekly themes of Subtraction, Waste, and Reuse.

Throughout the semester, students demonstrate their understanding of the course content relative to their chosen construction material through three representational techniques. In each case, the representations reveal the relationship between architecture and sustainability through the supply chain of building materials.

First, students make collages using images clipped from trade magazines.[17] These collages exploit the disjointed nature of material production by juxtaposing images of the seemingly dissociated sites, actors, and effects found along its supply chain. Constrained as they are by the availability of imagery in the selected publications, the students often rely on intuition or hunches in making the collages. And rather than seek to capture the entire web of relations, the collages depict the disjunctions themselves. Additionally, these collages effectively deliver fragments of prepackaged narratives that intermingle to create new relationships and readings of everyday building materials.

Second, students create a narrative that documents specific activities involved in each stage of Production, Consumption, and Vitiation in the supply chain of their selected product. The goal of the narrative is to showcase the seen and unseen forces that participate in the lifespan of an everyday building material. The narrative consists of a visual presentation and written account. Organizationally, both narrative devices follow the course structure, beginning with an exposé of the various aspects involved in the manufacturing stage of the material, followed by a tour through its consumption phase, and concluding with a description of its afterlife scenarios. The visual presentation supplies images of impacted territories, landscapes, and actors, and the written account provides details specific to each material. (Figure 3)

Third, students design a folly that highlights the invisible aspects of their reconstructed supply chain. By creating a useless object out of a useful material, the folly seeks to unsettle assumptions about the ubiquitous materiality of building design through techniques of estrangement, hesitation, or defamiliarization. (Figure 4) The folly may highlight a specific aspect in the material supply chain, or it may seek to communicate a more general awareness of its production. (Figure 5) In the process of designing these follies, students draw from the weekly set of spatial practices featured in the course. While follies often reinforce a detached position on materiality, their scale and complexity befit the seminar setting.[18]

These representations seek to complicate discourses of sustainability in architecture, enrolling a more entangled set of actors into the frame and compelling more responsibility from designers that proclaim a sustainable practice. The course exposes students to a broadened conception of sustainability and a widened field for intervention through a careful examination of the supply chain of material production. Following Bruno Latour, it ultimately aims "to multiply the sources of revolt against injustice," thereby rendering the pursuit of responsible design an eminently political project.[19]

CONCLUSION

To be critical of sustainability discourses in architecture is to be concerned about its complicity in the climate crisis, and by expanding the scope of the discussion to include both tangible and intangible forces in the supply chain of material production, this paper argues for the enrollment of more actors, more sites, and more effects into the process of design. Instead of creating a metric that ignores the many unseen forces involved in creating the built environment, the framework presented here invites speculation into the vast networks of influence. As discussed, these networks involve multiple stages of production of myriad materials that are touched by many hands, and by better understanding the extent of these entanglements, the consequences of design grow, as do the responsibilities of designers in combatting the intersectional problem of climate change.

ENDNOTES

1. Gary Gereffi, Raphael Kaplinsky, "Introduction: Globalisation, Value Chains and Development," *Institute of Development Studies Bulletin* 32, no. 3 (2001): 1-8
2. For recent accounts of embodied energy analysis and life cycle analysis, see David Benjamin, "Embodied Energy and Design," in *Embodied Energy: Making Architecture Between Metrics and Narratives* (Zurich: Lars Muller, 2017): 13-25; and, Stephanie Carlisle, "Getting Beyond Energy: Environmental Impacts, Building Materials, and Climate Change," in *Embodied Energy: Making Architecture Between Metrics and Narratives*, David Benjamin, ed. (Zurich: Lars Muller, 2017): 164-175
3. Jennifer Bair, "Global Capitalism and Commodity Chains: Looking Back, Going Forward," *Competition & Change* 9, no. 2 (June 2005): 171
4. Ibid, 171
5. Anna Lowenhaupt Tsing, "Supply Chains and the Human Condition," Rethinking Marxism: A Journal of Economics, *Culture & Society* 21, no. 2 (April 2009): 172
6. Donna Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," *Feminist Studies* 14, no. 3 (Autumn 1988): 575-599
7. Ibid, 575-599
8. Emily Eliza Scott, "Archives of the Present-Future: On Climate Change and Representational Breakdown," in *Climates: Architecture and the Planetary Imaginary*, James Graham, ed., (New York: Columbia Books on Architecture and the City, 2016): 134
9. Ibid, 135
10. Alexis C. Madrigal, "Wow! Apple Turns Over Its Inventory Once Every 5 Days," *The Atlantic* (May 31, 2012)
11. NEMESTUDIO, "Nine Islands," http://nemestudio.com/projects/nine-islands (accessed October 11, 2019)
12. Lindsey Wikstrom, "Three Material Stories," in *Embodied Energy: Making Architecture Between Metrics and Narratives* (Zurich: Lars Muller, 2017): 36-49
13. Jane Hutton, *Reciprocal Landscapes: Stories of Material Movements* (New York: Routledge, 2020): 3
14. Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2015); Bruno Latour, *Down to Earth: Politics in the New Climate Regime* (Medford: Polity, 2018)
15. I borrow the term "critical spatial practice" from Jane Rendell, who is often credited with coining the term; see, Jane Rendell, *Art and Architecture: A Place Between* (New York: IB Tauris, 2006) and Jane Rendell, "Critical Spatial Practices: Setting Out a Feminist Approach to Some Modes and What Matters in Architecture," in *Feminist Practices: Interdisciplinary Approaches to Women in Architecture*, Lori A. Brown, ed. (London: Ashgate, 2011): 17-56
16. While the term vitiation is an uncommon descriptor of end-of-life stages in supply chains, its definition is the most suitable to describing the course content: "to make faulty or defective; to debase in moral or aesthetic status; to make ineffective;" *Merriam-Webster*, s.v. "vitiate," accessed October 11, 2019, https://www.merriam-webster.com/dictionary/vitiate
17. For an extended discussion of this assignment, see author's paper, "Culture Jamming and Climate Change," *Association of Collegiate Schools of Architecture Fall Conference Proceedings* (Washington, D.C.: ACSA Press, 2019)
18. I am indebted to an anonymous reviewer for pointing out the limitations of examining materiality through the design of follies.
19. Latour, *Down to Earth*, 88