PAPER

Out of Practice: Learning through Entrepreneurial Tools

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The architecture and construction industries, which are notoriously slow to adopt change, are having to adapt to new climate realities very quickly. In particular, reducing the embodied carbon associated with buildings (and not just carbon related to operational energy) has emerged as a widespread mandate for design and building professionals. However, the ways to achieve these ends are still very much in flux, and knowledge around architecture's carbon economy is concentrated in a small subset of sustainable designers, builders, and industry leaders. This course, however, is not a "how-to" guide for reversing the course of climate change by design. What this course attempts to do is empower you with tools for locating, engaging, and learning from active sites of knowledge production out there "in the field." By forming a clearer picture of the complex and ever-changing web of information, practices, policies, businesses, and technologies that constitute an expanded "field," students in the course will emerge better equipped to formulate good questions, build evidence, challenge the status quo, and shape new design-informed practices to address the various spatial, social, and environmental needs of the coming century. To illustrate the course pedagogy, this paper will describe one student project that leveraged EBE research methodologies toward an architecture-adjacent business proposal.

INTRODUCTION

The architecture and construction industries, which are notoriously slow to change, are having to adapt to new climate realities very quickly. The growing mandate to reduce, and be accountable for, the greenhouse gas emissions across the life cycles of a building and its component parts is having diverse effects on material choices and building technologies. From pepper-hull wall panels and carbon-eating cement blocks to vast infrastructures designed to draw down and store atmospheric carbon–the "solutions" are varied and often emerge outside the architect's domain. Many layers of scientific, cultural, regulatory, and market-driven forces are driving the production and selection of climate mitigation strategies, including those that operate at the scale of a building. Within this distributed network of stakeholders working toward a decarbonized built environment, what role should architects play? Does design practice, as we know today, need to develop new tools for moving the needle on architecture's climate impacts? This paper will discuss the pedagogy of an experimental graduate seminar called Out of Practice, which co-author Meredith Miller created and taught for four semesters (Fall 2019, Fall 2020, Winter 2022, Fall 2022).

For Out of Practice, Miller adapted methods from evidence-based entrepreneurship (EBE) to help students learn ways to leverage their design expertise beyond traditional architectural practice. Following the first two iterations of this course, Miller began to apply these methods to understanding emerging decarbonization efforts in the building design and construction industry, situated within the wider context of contemporary climate science, climate policy, and material culture. Following a brief description of EBE tools, the paper will argue for the benefits of applying them as a research methodology within an architecture curriculum. Finally, the paper will provide an example project completed by two M.Arch students. As participants in the Winter 2022 Out of Practice seminar, co-authors Kathleen Bailey and Joseph Johnston, drew evidence from their EBE-informed research to support a speculative proposal for an integrated building technology.

METHODOLOGY

Evidence-based entrepreneurship (EBE), also known as the lean start-up methodology, is a systematic approach to business development that emphasizes learning at the early stages.[1] Popularized by Eric Ries, author of The Lean Startup, this methodology has gained a following among tech industry executives and aspiring entrepreneurs. A central principle of this approach is for the entrepreneur/inventor to "get out of the building," or seek input from people who represent the end-user of the proposed business or innovation early in the process. The idea is not to pitch the innovation but to listen to people's experiences within the specific domain that the entrepreneur/inventor hopes to enter. This process of "getting out of the building" and "talking to people" is referred to as Customer Discovery, an early step in learning and validating the core assumptions behind a business idea before heavy investment is made. The U.S. National Science Foundation (NSF) has adopted the EBE methodology in its Innovation Corps (I-Corps) program, which annually runs several cohorts, each comprising about 24 academic teams seeking to commercialize their technology or innovation. Similar to its application in the private sector, the NSF trains researchers in this approach to learn early on what problems their innovation might solve in the "real world." The intensive seven-week course introduces academic researchers to EBE tools with a focus on Customer Discovery, encouraging them to get "out of the lab" in order to talk with people whose experiences can provide insights into the field their research is aimed to impact. As a participant in regional (2018) and national cohorts (2021), Miller has conducted over 150 interviews with professionals across the building design, construction, and product manufacturing industries. While the explicit purpose of this process was to identify a market fit for Miller's academic research, the experience led to transformative insights on design practice and its embeddedness within larger business ecosystems—a side of building production not typically represented in students' coursework. It creates a notion of drawing the curtain back, to see how various forces play out: competing values, sustainability goals, labor issues, costs, logistical concerns, all to yield a particular built result when unconventional materials and building methods are involved. It's especially informative to understand how these result from a coordinated effort among architects but also a whole host of other stakeholders. This decenters the architect from our imaginations of architectural innovation, an important lesson for the Cosmopolitan architect. Given the primary emphasis is on learning, this methodical approach to gathering information from professionals in the field has potential as a tool for students to gain insights from real-world scenarios.

PEDAGOGY

To explore ways architecture can contribute to industry change, Out of Practice was designed as a research seminar, where the tools of research drew from evidence-based entrepreneurship (EBE). Through customer discovery style interviews, students learn from designers, builders, manufacturers and other industry stakeholders about their specific arenas of lower carbon building technologies. This on-the-ground knowledge is particularly important when it comes to decarbonization, since knowledge and implementation is rapidly changing. Business development tools such as EBE and Customer Discovery were developed for entrepreneurs, who by definition take on financial risk in search of high profit margins. However, placing these methods in the context of an architecture course enabled students to consider other forms of risk and gain: environmental, social, aesthetic.

Over the first few weeks, readings and lectures established a broader planetary context (carbon cycles, climate science, governance) and emerging strategies for low-carbon and carbon-neutral building (mass timber, other bio-based materials, circularity). A series of "Decarbonization Talks" by guest experts provided a window into current work at the leading edge of low-carbon building technologies and materials—Stephanie Carlisle (Carbon Leadership Forum), Michael Green (Michael Green Architects), and Anton Maertens (BC Materials).

Students produced a "Carbon Primer" for key terms and concepts to demystify the confusing language around climate science and carbon reduction strategies.[2] This shared visual and text-based document served as an open resource for the class and the basis for exploring how these terms are entering the building industry. Next, students worked in groups to conduct research on specific products representing distinct approaches to materials, assemblies and project delivery. Using EBE style interview techniques, students talked to people who have specified, used, or designed those products in order to understand values, decision factors, and problem areas. By mapping the industry "ecosystems" around each product, encompassing supply chains, regulatory influences, and market forces, students gained a business-informed perspective on the various decisions and transactions that accrue into a built reality. Finally, students proposed entrepreneurial practices to address a need or opportunity they discovered in their research. At a moment that requires a change in business as usual, the premise of this course is to equip students to find opportunities for design to have other, consequential roles "out of practice," or, within an expanded realm of architectural production.

EXAMPLE PROJECT

To illustrate the course pedagogy, this section will describe one student project that leverages EBE research methodologies toward an architecture-adjacent business proposal. Bailey and Johnston's collaborative project, "Passive Direct Air Capture: Breathing Cities," began with an analysis of Climeworks, the company that pioneered the Orca, the first large-scale Direct Air Capture (DAC) plant. Located in a remote area of Iceland near the Hellisheidi geothermal power plant and over a basalt rock deposit, the Orca plant captured about 4,000 tons of CO2 in 2021. Building on the insights from the Carbon Primer segment of the course and the company's business claims, the students found that for Climeworks to reach its goal of removing 1% of the 33 billion tons of CO2 emitted annually, they would have to construct 82,500 Orca plants.[3] Speaking with Climeworks executives, DAC researchers, energy experts, engineers and others, the students developed an understanding of technical limitations to DAC when understood from the perspective of the larger ecosystem, including the particularities of siting, energy requirements, financial structures, and distribution/storage of the recovered carbon.

This project addresses the challenges of scaling up and expanding the possible locations of DAC technology through a speculative design and business proposal that also looks at technological and cost-relative barriers to scalability. By taking the current filter technology and applying it within the urban context, the project tests the potential of using high-speed passive wind flow created both in skyscraper blow throughs and at the top of tall buildings to funnel the wind loads into these

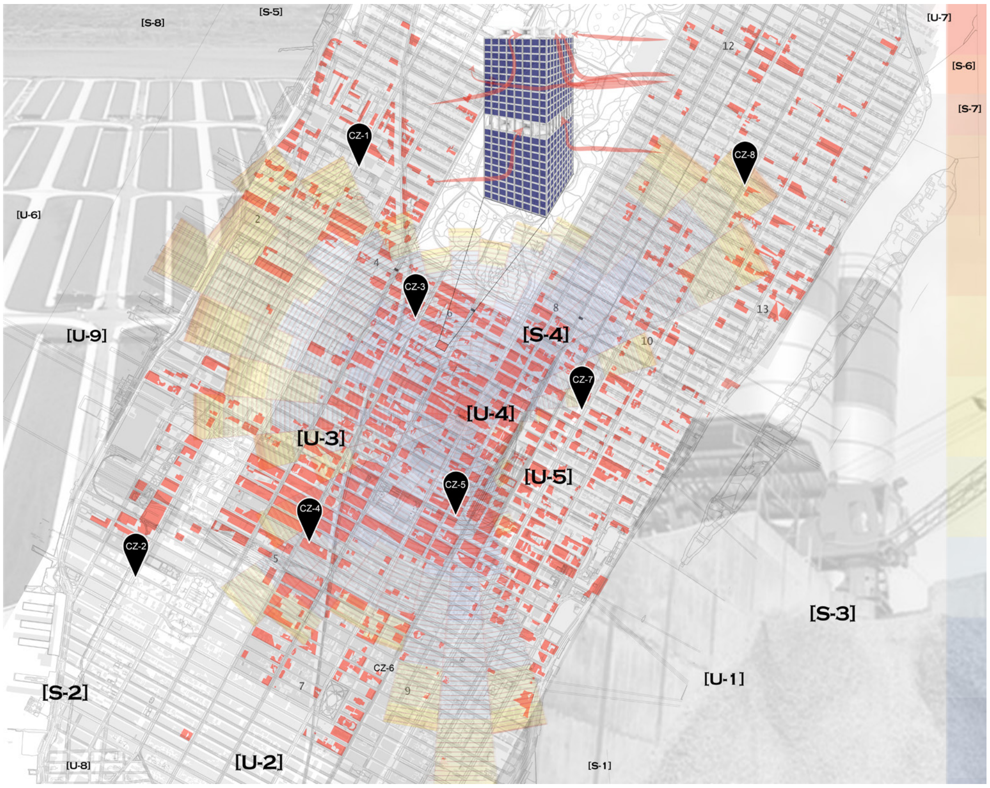

Figure 1. This drawing maps out the buildings in midtown Manhattan that meet the height requirement to capture a sufficient amount of CO2 along with the nearby sequestration and utilization opportunities that will lock the carbon away without re-emitting back into the atmosphere.

DAC filters. Interviews with mechanical engineering professionals led the students to research wind amplification techniques such as building height, long windward edges, concave designs, and venturi effect to maximize the amount of airflow being processed and, consequently, the amount of carbon captured. Replacing an active fan system with passive air flow not only reduces cost, but also reduces the amount of CO2 emitted from any operational energy sourced from fossil fuels. Relocating this technology to the tops of tall buildings leads to the potential use of building waste heat to account for the thermal energy demand of the desorption process applied to the DAC filter. In addition to their technical analysis, the students used insights from their interviews to argue for the cultural and economic significance of moving DAC technology from centralized plants in remote locations to select buildings in urban areas where 70% of greenhouse gasses are produced.[4] The students identified major sequestration opportunities which include geologic storage where there are porous rock deposits, but also allow for utilization of CO2 as a commodity within urban areas that have the market for it. Interviews with Climeworks professionals highlighted that they utilize geologic sequestration of captured carbon and the majority of their funding is received from large companies in the form of carbon contracts, which allow these companies to claim a lower carbon footprint. Passive DAC located within urban areas can still take advantage of these carbon contracts and help stimulate the existing and growing carbon network into an effective, collaborative, and large scale decarbonization strategy.

Within the urban context, retrofitting existing towers or designing new towers with DAC "hats" and "hoods" would change the visual landscape of cities, contributing to a culture of sustainability and a greater awareness of climate change mitigation. A cityscape retrofitted to breathe in CO2 through this dispersed, passive approach to DAC alters how people can relate to it.

CONCLUSION

Out of Practice is not a "how-to" guide for reversing the course of climate change by design. What this course attempts to do is empower students with tools for locating, engaging, and learning from active sites of knowledge production out there "in the field." By forming a clearer picture of the complex and ever-changing web of information, practices, policies, businesses, and technologies that constitute an expanded "field," students in the course emerge better equipped to formulate good questions, build evidence, challenge the status quo, and imagine new design-informed practices that can contribute to decarbonizing architecture.

ENDNOTES

1. Ries, Eric. 2011. *The Lean Startup.* Portfolio Penguin.
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