The environment has co-opted sustainability. Just as concerning as the environment, less recognized, and even less acted upon are the escalating costs and declining quality of design and construction. By equating sustainability with the environment, we limit our ability to advance a truly robust plan of environmental reparation. The rising cost of construction (disproportionate to the rest of the economy), the ongoing decline in the craft and quality of architecture, and the daily damage our buildings inflict upon the environment represent a daunting confluence of forces for change. In this challenge, we see great opportunity. Unseen synergies between these factors—quality, affordability, and the environment—offer a broadly based agenda for a more sustainable way forward. And they formed the aspiration for the design, fabrication, and assembly of Loblolly House.

The profession of architecture is in the midst of a crisis of confidence, both in the capacity and the desire to realize much needed improvements in productivity and efficiency. If we continue to ignore the industry’s needs, we do so at our own peril. With each passing year the affordability crisis worsens. Construction costs continue to outpace the general economy by a factor of two-, three-, and sometimes four-to-one, creating an inflationary spiral, year in and year out. With every 1 percent increase, more people are denied access to quality housing and home ownership. Underlying these economic realities is the fact that productivity throughout the design and construction industries has been on the decline for the last several decades. While other sectors of the nonfarm economy have experienced gains in productivity of more than 80 percent over the past forty years, ours has witnessed a 20 percent drop. Compared to the rest of the economy, this 100 percent swing—with other industries experiencing 80 percent growth and ours a 20 percent setback—is not only unacceptable, it’s unsustainable.

Once synonymous with quality craftsmanship and symbolizing the highest levels of human achievement, our buildings are, more often than not, seen by the public as bastions of mediocrity. With each passing year, the litany of problems associated with incomplete, incorrect, or poor workmanship grows longer. In most cases, quality is applied after the fact, if at all. This method of
operation is built into the existing process, with a "fix it later" work ethic and a "talk the owner and designer into accepting the compromises, because we are behind schedule and over budget" approach to problem solving. Only occasionally is quality deeply and intelligently embedded within design and construction processes. The consequences of these inadequacies spill over, rather dramatically, into another realm: that of our responsibility to be stewards of the natural environment. For example, poorly designed and improperly installed cladding systems abound, leading to increased air infiltration and unmanageable moisture transfer through exterior walls. The result: additional and unnecessary energy expenditure and subquality indoor air. These problems are further compounded when substandard cladding systems are coupled with maximum horsepower building systems designed to compensate for the building envelope's unpredictable performance.

The ecological footprint that we leave on the natural world continues to deepen. If we proceed with business as usual, the consequences of this footprint will escalate. Growing worldwide populations will demand more of the world's natural resources, including water, energy, air, and raw materials. Mitigating the environmental impact associated with this rise in demand remains the focus of many environmental groups. While their efforts are beneficial, they do little more than offset the already enlarged footprint associated with our expanding population. In truth, our paradigms of consumption must change, if only to repair the damage exacted over the past few decades.

The mandate of sustainability is threefold: improve the productivity of design and construction, enhance affordability and quality, and do so in an ethical and aesthetically moving manner. This mandate is not optional. Increasingly, our clients demand it, and the people who use our architecture deserve it. The question for all engaged in design and construction is whether we have the desire, insight, and resourcefulness to seize the challenge that the current crisis affords. Sustainability's three main objectives—cost, quality, and the environment—are interdependent. Instead of prolonging our current paralysis, we must seek ways of understanding how these crises connect, rather than confound.
Since there are few models of efficiency in our own industry, we must look elsewhere for solutions. In the early 1990s the automotive industry faced a similar crisis of productivity and responded with a swift and expansive restructuring of its design and fabrication processes. By 1990 the 4,000 parts that evolved from the Model T to compose the contemporary automobile came together one by one at the factory. Over a remarkably short period of time, these production methodologies were reconstituted as subsets of fifteen or fewer integrated component assemblies, each fabricated by external suppliers who assisted in the design. For example, the more than 200 parts that made up a dashboard were collapsed into a single, integrated component with quick-couple connections for attachment at the point of final assembly. Instead of a single point of focus for the assembly of all 4,000 parts, the process was dispersed, allowing for multiple centers of focused design, innovation, and production. Each integrated component undergoes its own quality control prior to arriving at the main plant. Owing to the fact that substantially fewer joints were arriving at the final point of assembly, it became possible to enhance quality control for the few remaining connections. The results of this redesign process were higher productivity, lower cost, and improved quality. In lieu of the sequential, part-by-part weaving together of an automobile, the process is now conceived as a quilt of integrated components.

Toyota, of course, became the master of these new strategies. Underlying the design and production of their vehicles is a set of beliefs aligned with the current mandate of sustainability. At a time when most American automotive manufacturers are under competitive assault, Toyota is thriving precisely because it has comprehensively dealt with these challenges. Intrinsic to their practice is a relentless focus on the process itself. Individual outcomes (automobiles) are seen as stages within a neverending effort at self-improvement. Within their design philosophy the concept of a static type and the notion of perfection are irrelevant. Their culture insists upon ceaseless criticism and continual progress, driven by the ideals of better quality and enhanced design, delivered in less time and lower cost. More often, their processes are focused on environmental concerns, such as reducing
The 40,000 parts that make up the average American house collapse into five integrated construction elements.
Construction and Nonfarm Labor Productivity Index

- Nonfarm Industries (1964 = 100%)
- Construction Industry (1964 = 100%)

Reference: Paul Teicholtz, PhD, Professor (Research) Emeritus, Dept of Civil and Environmental Engineering, Stanford University

0.2

Productivity losses in the construction industry as compared to gains in other sectors of the nonfarm economy.
carbon emissions and improving fuel efficiency. As a result, Toyota not only possesses significant cost and quality advantages, but they have simultaneously become the worldwide leader in hybrid technology. Every member of the company participates in this neverending effort guided by a singular ethic of improvement, with many of the design, production, and environmental process innovations, big and small alike, initiating with workers, not with management.

In contrast to the fields of industrial design and manufacturing, architecture and construction have been devoid of substantive change. Except for a few isolated gains in productivity, the overall trend has been downward, resulting in escalating cost and declining quality. Energy consumption continues to rise, with little regard for water and material conservation. In fact, according to the National Association of Homebuilders, a recent study revealed that the typical American house consists of more than 40,000 parts, most of which arrive one by one at the site for field erection, stick by stick.

If 80 percent of an automobile consists of integrated component assemblies built away from the point of final assembly, then the American house is its polar opposite, with more than 80 percent of its parts coming together at the site to which they are anchored. The time and costs associated with building a home increase as more systems are added. These expenditures stand in contrast to the productivity gains realized by other industries, where integrated, prefabricated assemblies are the norm. Meanwhile, with respect to quality, architecture and construction’s failure to innovate is even worse. A study conducted in Florida found that more than 40 percent of new homes have “significant quality flaws.”

It is widely known that average household energy use in the United States can be as much as four times that of other developed nations. According to a University of Michigan analysis, the conventional developer-built house will consume more than 15,000 gigajoules of energy over a life cycle of fifty years. This figure could be decreased right now, not five years from now, to 5,000 gigajoules, using existing design and fabrication strategies. The fragmented nature of the housing industry, however, works against any efforts to diffuse the skills, knowledge, and resources necessary to realize sizable
reductions in energy use. Judging by the integration strategies adopted by other industries, the means for achieving higher productivity is through controlled implementations that reduce the overall environmental footprint.

Our objectives for the design, fabrication, and assembly of Lobloolly House were as follows: create a house that evokes the extraordinary natural world that is its home; then redesign the process of design and construction, embedding within it an environmental ethic that privileges efficiency and quality. The central tool underlying our process was a parametric building information model (BIM), which provided the level of geometric certainty needed to shift the paradigm of design from a sequential, gravity-driven construction process to a simultaneous prefabrication process with integrated components and on-site assembly. Like automobiles, ships, and aircraft, Lobloolly House was first built as a virtual artifact. This simulation was the mechanism that enabled simultaneity. The site no longer served as the factory, and nearly 70 percent of the effort shifted to off-site integration and fabrication. Our long-term objective, however is to altogether obliterate the Construction Specifications Institute’s ever expanding system of nomenclature. Today, nearly fifty divisions of materials and equipment classify tens of thousands of products into a confusing and disjointed array of parts. In its place, we propose to simplify, merge, and unify these materials and environmental systems—structures, windows, doors, and finishes—into integrated assemblies, which we consider to be the elements of a new architecture.

Just as the site inspires an elemental house derived from nature, so does the process inspire a return to an elemental architecture, almost classical in its nomenclature: scaffold, cartridge, block, fixture, furnishing, and equipment. The 40,000 parts of the conventional American house—spanning fifty CSI divisions—collapse into several component types, ready for site assembly. With this new focus on integrated components, there are fewer joints. Quality, craftsmanship, and performance are greatly improved. While the existing on-site practices for home construction remain dispersed among thousands of small-scale builders (who lack knowledge of or access to best-practice environmental initiatives), a
limited number of well capitalized, off-site integrators could provide leading-edge environmental components across the housing market. Essentially, these players will redefine the housing supply chain in the United States.

In this new paradigm, construction is no longer a linear, ground-up process but an integrated and simultaneous effort. Off-site fabricated elements are integrated hierarchically into cartridges, blocks, panels, and equipment while on-site work, including foundations and utilities, is underway. Fabrication and assembly replace construction, increasing productivity and quality while decreasing the environmental footprint.

Loblolly House is a provocation to seize the sustainability challenge by focusing on productivity, quality, and our need to forge a symbiotic relationship with the natural world. Its design and assembly mark our firm’s passage from desire to deed.