University of Cincinnati

Date: 11/11/2010

I, David A Parrott , hereby submit this original work as part of the requirements for the degree of Master of Design in Design.

It is entitled:

Designing Deliberately | Transportation through the Lens of Slow Design

Student's name: **David A Parrott**

This work and its defense approved by:

Committee chair: Dale MurrayMA

Committee member: Peter ChamberlainMFA, MPhil

Committee member: Ken Hogue

1134

Designing Deliberately | Transportation Through The Lens of Slow Design

A thesis submitted to the Graduate School of the

University of Cincinnati

in partial fulfillment of the requirements for the degree of

Master of Design

in the department of Design

of the College of Design, Architecture, Art and Planning

by

David A. Parrott

B.S. University of Cincinnati | June 2006

Committee Chair: Dale Murray

Designing Deliberately

Transportation Through the Lens of Slow Design

by David A. Parrott

abstract

Human mobility is the root of many of our most costly and debilitating societal problems—from urban sprawl to the rising cost of health care. Though the automotive industry acknowledges the need for sustainable mobility, that need remains unfilled in any meaningful way because transportation design remains steeped in a culture of styling and planned obsolescence.

Slow Design is a response to the decadent excesses of contemporary product design. With roots in the Slow Food and Arts and Crafts movements, it is a methodology that replaces sales with human well-being as its foundational premise. Applied to the problem of mobility, Slow Design could provide the catalyst that steers the ship of transportation onto a more sustainable course.

This paper documents the application of Slow Design to create of an automotive alternative for intracity transportation—the Trimtab 3X3, a vehicle designed to provide convenient, healthful mobility and perhaps change the course of the transportation paradigm.

"Something hit me very hard once, thinking about what one little man could do. Think of the Queen Mary — the whole ship goes by and then comes the rudder. And there's a tiny thing at the edge of the rudder called a trimtab.

It's a miniature rudder. Just moving the little trim tab builds a low pressure that pulls the rudder around. Takes almost no effort at all. So I said that the little individual can be a trimtab. Society thinks it's going right by you, that it's left you altogether. But if you're doing dynamic things mentally, the fact is that you can just put your foot out like that and the whole big ship of state is going to go.

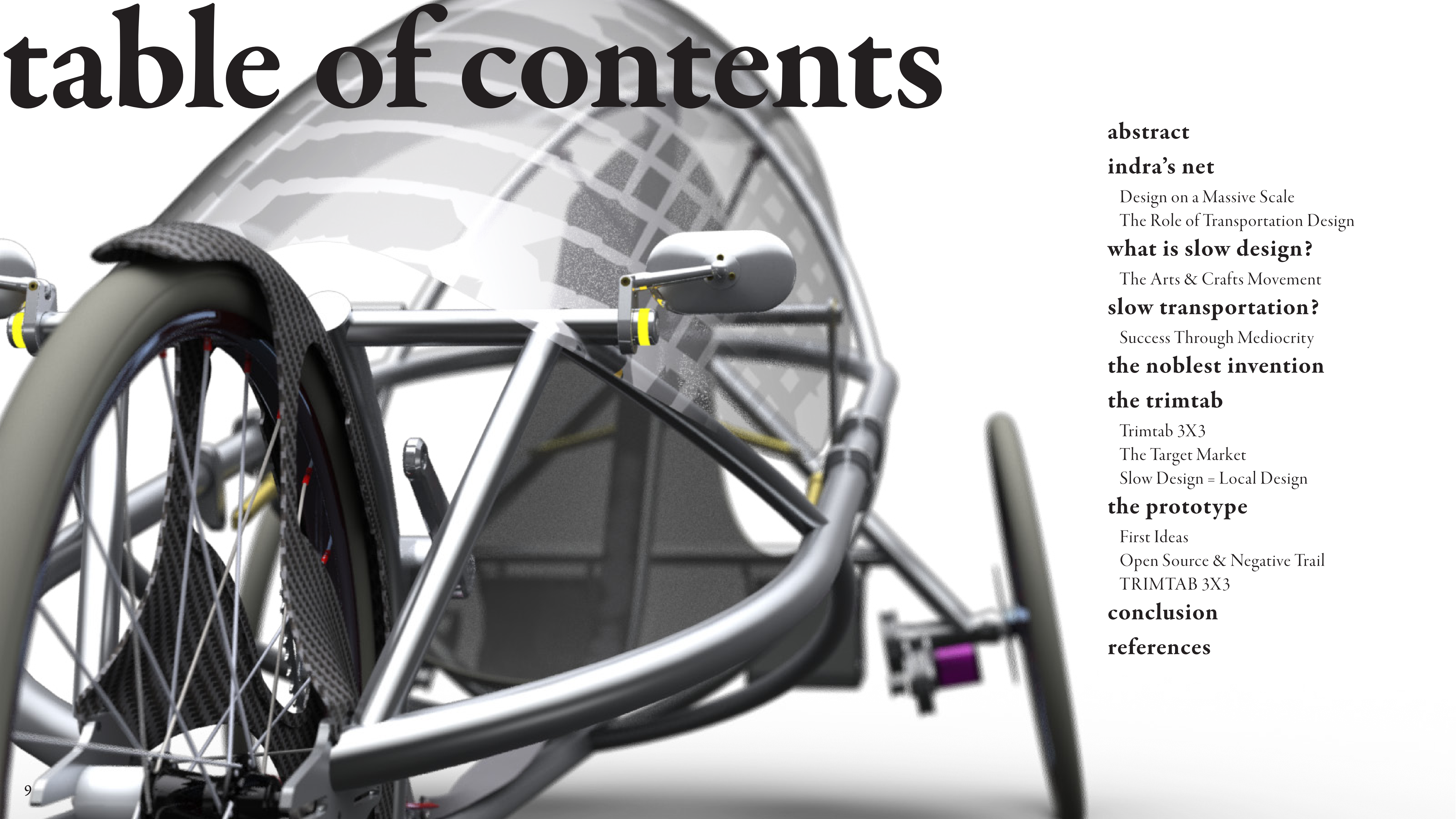
So I said, call me Trimtab."

— R. Buckminster Fuller

acknowledgements

There are simply too many to list here. You know who you are. Thank you from the bottom of my heart.

table of contents



illustrations

intro pages

1. Parrott, David A. Trimtab Render 1. June 2010.
2. Parrott, David A. Trimtab Render 2. June 2010.

indra's net

3. Parrott, David A. Indra's Net No. 1. June 2010.
4. Burtynsky, Edward. Nickel Tailings No. 34. July 1996. Manufactured Landscapes, Sudbury, Ontario. Edward Burtynsky Photographic Works. 30 Oct. 2010 <www.edwardburtynsky.com>.
5. Parrott, David A. Indra's Net No. 2. June 2010
6. Nasa's Terra Satellite Sees Spill on May 24. 24 May 2010. NASA. NASA. <www.nasa.gov>.
7. The Cost of Obesity in the United States. 23 Nov. 2009. Executive Healthcare. Executive Healthcare. Ed. Jodie Humphries. <www.executivehm.com>.
8. IDuke. Markham-suburbs_aerial-edit2. Wikimedia Commons. 12 Nov. 2005. Wikimedia Commons. <http://commons.wikimedia.org/wiki/File:Markham-suburbs_aerial-edit2.jpg>.
9. Takashi2006. Cherry_blossoms_of_the_Yokowa-Sakura01. Wikimedia Commons. 5 Apr. 2008. Wikimedia Commons. <http://commons.wikimedia.org/wiki/File:Cherry_blossoms_of_the_Yokowa-Sakura01.jpg>.
10. Parrott, David A. How Injection Molding is Ruining The American Designer, Consumer, Economy and Ecology. September 2010.
11. Matt's Straight Razor. Catherine Sherman. By Sherman Catherine. 5 Aug. 2008. <www.catherinesherman.wordpress.com>.
12. Parrott, David A. Scale No.1 - Fast. March 2010.
13. Parrott, David A. Scale No. 2 - Aspirational. March 2010.

what is slow design?

14. Ausmus, Stephen. Carrots of May Colors. Nov. 2004. USDA Agricultural Research Service. 30 Jan. 2006. United States Department of Agriculture. <http://ars.usda.gov/is/graphics/photos/nov04/k11611-1.htm>.
15. Ee03-P1020528.jpg. Fritzhaeg.com. 9 Oct. 2007. Edible Estates. <http://www.fritzhaeg.com/webpic/gl-pic/gl-pic-ee-nyc/ee03-P1020528.jpg>.
16. Velela. The Red House - June 2004. 10 June 2004. Bexley Heath, London.
17. Fraser, Kathleen. The human chair. The End of an Era. Life 2.0. 17 June 2010. <kathleenfraser.blogspot.com>.
18. Carlo Petrini. La Dolce Vita. Locavore. 4 Feb. 2009. <www.locavore.ca>.
19. Weebee sunset. Tumbleweed Tiny House Company. Tumbleweed Tiny House Company. <http://www.tumbleweedhouses.com/houses/weebee/>.

slow transportation

20. 2008 Hummer HX Concept - Front. General Motors. Serious Wheels. <www.seriouswheels.com>.
21. Swiss Army SwissChamp XLT. Swiss Knife Shop. Swiss Knife Shop. 30 Oct. 2010 <www.swissknifeshop.com>.
22. Tesla S : 2009. Cartype. <www.cartype.com>.
23. I2 lean left on whiteMidRes. Www.segway.com. 24 Aug. 2007. Segway. <http://www.segway.com/images/downloads/i2_LeanSteerLowRes.jpg>.
24. Segwayi2. Www.segway.com. 24 Aug. 2007. Segway. 30 Oct. 2010 <http://www.segway-madrid.com/aboutus/photos.html>.
25. Parrott, David A. Models for the Philosophical Architecture of Fast & Slow Design. January 2010
26. Pontiac_aztek_draw_01. Anomie1.com. 20 June 2009. Anomie Magazine. <http://anomie1.com/forum/index.php?topic=436.0>.
27. Workers on the assembly line at Ford Motor plant in Long Beach Publication:Los Angeles Times Publication date:April 21, 1930. Wikimedia Commons. By Tillman. 25 Nov. 2008. Wikimedia Commons. <http://commons.wikimedia.org/wiki/File:LongBeachFord.jpg>.
28. Rally Fighter. Local Motors. 20 Nov. 2009. Local Motors. <http://www.local-motors.com>.
29. Komar, Vitaly, and Alex Melamid. USA's Most Wanted. 1994. People's Choice.
30. Segway P.U.M.A. Project. Slash Gear. By Chris Davies. 7 Apr. 2009. <www.slashgear.com>.
31. Nimbus 20" Trials Cycle with ISIS Hub. Bentley Cycle & Trading Post. 30 Oct. 2010 <www.bentleycycle.net>.

the noblest invention

32. Cullivan, Lee. Spokes. 28 Sept. 2008. Flickr. <www.flickr.com>.
33. Great penny farthing crash picture. Infinite cycles. 11 Nov. 2009. <www.infinitecycles.com>.
34. The Rover Safety Bicycle 1887. 16 Sept. 2010. Conventry. Vintage Bicycle. 16 Sept. 2010. <http://vintagebicycle.wordpress.com/2010/09/16/the-rover-safety-bicycle-1887/>.
35. Hypersport. Windcheetah. <www.windcheetah.co.uk>.
36. Dalrymple, Robert. 1945 Mochet Velocar. 11 Feb. 2006. Www.flickr.com. <http://www.flickr.com/photos/99263997@N00/99230585>.
37. Mochet Velocar. Cycle Genius. <www.cyclegenius.com>.
38. Volac Aerodynamics. Volac Recumbents. 30 Oct. 2010 <www.volaerecumbents.com>.
39. Go one orange-soft-top. Go One Blogger. 31 Dec. 2007. <www.go-one.us>.
40. Aerorider. Forum for Kabinecykler. <www.danetech.dk>.
41. WAW 9 Velomobile. Recumbent Gallery. 2 Oct. 2009. <www.recumbent-gallery.eu>.
42. Tri-Sled Sorcerer Racing. Tri Sled Human Powered Vehicles. <www.trisled.com.au>.
43. Stormy Weather. Lightfoot Cycles. <www.lightfootcycles.com>.
44. Mango Sport Velomobile. 'Bent Rider Online. 2 Feb. 2010. <www.bentrideronline.com>.
45. Quest Velomobile. 'Bent Rider Online. 30 Aug. 2010. <www.bentrideronline.com>.
46. Leitra Velomobile in Traffic. Cyclorama. 30 Oct. 2010 <www.cyclorama.net>.
47. Leiba Classic. Leiba. 30 Oct. 2010 <www.leiba.de>.
48. Aurora Velomobile. Cambie Cycles. 30 Oct. 2010 <www.cambiecycles.com>.
49. Alleweder Velomobile. Liegerad Magazin. 30 Oct. 2010 <www.liegeradmagazin.de>.
50. Versatile Velomobile. Elrey's Velomobile links page. 30 Oct. 2010 <www.lobosolo.com>.
51. Birk Butterfly Velomobile. Flickr. May 2006. <www.flickr.com>.
52. Go-One Velomobile. Go One. 30 Oct. 2010 <www.go-one.us>.
53. Twike. Twike. 30 Oct. 2010 <www.twike.com>.

the trimtab

54. Parrott, David A. Trimtab Render 3. June 2010
55. Parrott, David A. Scale No. 1. March 2010
56. Parrott, David A. Scale No. 2 Equilibrium. March 2010
57. Parrott, David A. Vehicle Complexity Spectrum. April 2010
58. Parrott, David A. Trimtab Features. June 2010
59. Ultra-light Fabrics. www.prismkites.com. Prism Kite Technology. <http://www.prismkites.com/company-tech.php>.
60. Thermarest Prolite 4 Sleeping Pad. Bikepacking. 30 Oct. 2010 <www.bikepacking.net>.
61. Parrott, David A. Power Systems. October 2010
62. Parrott, David A. Trimtab & Details.July 2010
63. Small or Minicar Equals Death Trap or Gas Savings? Automotive Addicts. By Larry. 14 Apr. 2009. <www.automotiveaddicts.com>.
64. Parrott, David A. Trimtab Render 5. July 2010
65. Janot, Gérard. Arcs-boutants de la cathédrale de Milan. 2006.
66. Parrott, David A. Trimtab Business Equation. November 2010.

the prototype

67. Parrott, David A. Trimtab Tilt. July 2010
68. Parrott, David A. Assorted Sketches & Renderings from 2008-2009. September 2008-September 2009.
69. Parrott, David A. Photos of the Wooden Prototype. March - June 2009.
70. Parrott, David A. UV Curing the Prototype. June 2009.
71. Ghislain's Python Lowracer. Python Lowracer. 30 Oct. 2010 <www.python-lowracer.de>.
72. Parrott, David A. Orthos & Screen Shot of Negative Trail Trimtab. August 2009
73. Parrott, David A. Photos of Trimtab Prototype Build. June 2010.
74. Harrell, Patrick. Stress Analysis and Deflection Studies of Gen. 2 Trimtab Frame. April 2010.
75. Parrott, David A. Screen Shots of the Jig in Solidworks. January 2010.
76. Parrott, David A. Trimtab Prototype at Losantiville Kunstwerkhaus in OTR. June 2010.

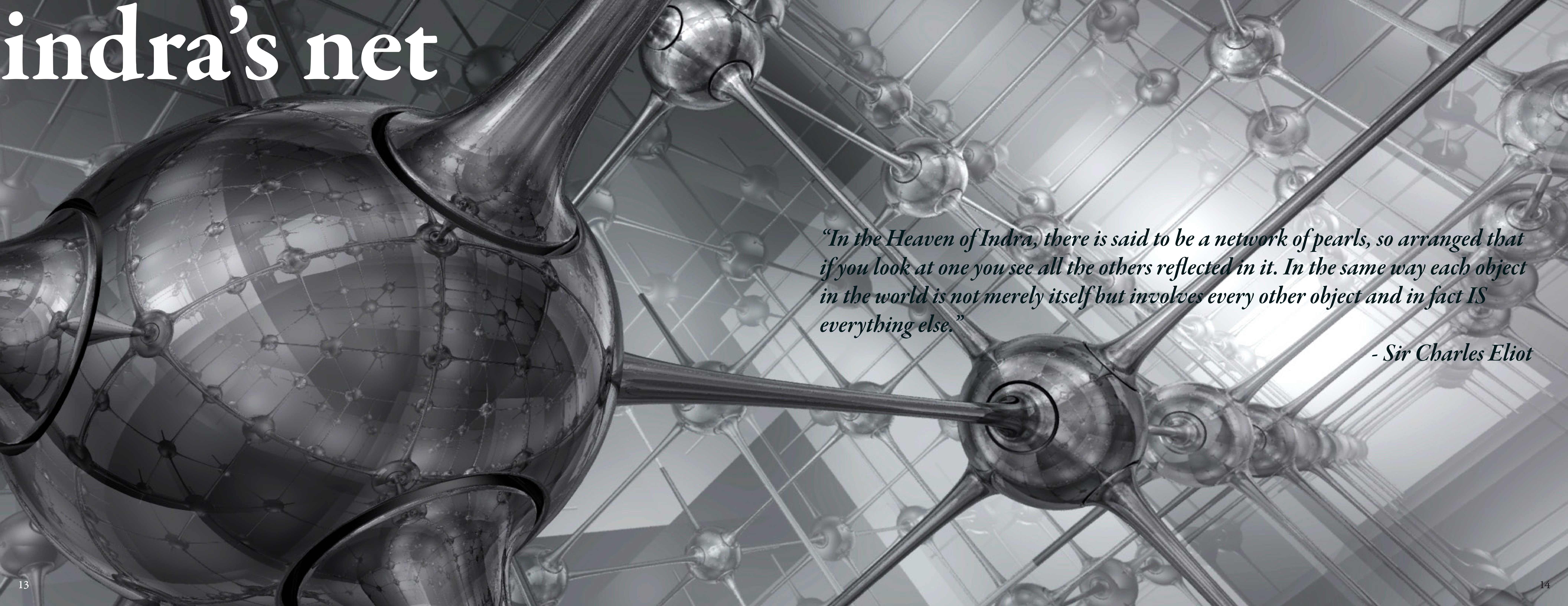
conclusion

77. Icon A5 Wings Folded. Icon Aircraft. 30 Oct. 2010 <www.iconaircraft.com>.
78. Icon CJ Series. Icon. 30 Oct. 2010 <www.icon4X4.com>.
79. Parrott, David A. Trimtab Render 6. July 2010.

references

80. Parrott,David A. Trimtab Render 7. July 2010.

indra's net



"In the Heaven of Indra, there is said to be a network of pearls, so arranged that if you look at one you see all the others reflected in it. In the same way each object in the world is not merely itself but involves every other object and in fact IS everything else."

- Sir Charles Eliot

According to the ICSID1 (International Council of Societies of Industrial Design), design is "the central factor of innovative humanization of technologies and the crucial factor of cultural and economic exchange... an activity involving a wide spectrum of professions in which products, services, graphics, interiors and architecture all take part. Together, these activities should further enhance - in a choral way with other related professions—the value of life."(ICSID.org)

The profession of design has enjoyed half a century of growth, glamour and increasing legitimacy. The *activity* of design—invention, creation, communication—unquestionably enhances human life and is a foundational human behavior. The same, however, cannot be said for the *profession* of design. Built on a foundation of planned obsolescence, styling, and postmodern amorality, product design is the poster child for twentieth and twenty-first century "doublethink"[1]—a profession that simultaneously thrives on, fosters, combats and condemns the mounting ecological, medical and economic disasters of its own creation. For nearly a century, industrial designers have paired with marketeers to create a culture of consumerism of which the United States is the icon and, increasingly, the victim. Design and marketing professionals are the willing (or apathetic) accomplices to the corporations that hire them to generate artificial desire for unnecessary products[2], propagandizing the "religion of consumerism" that drives our culture.

Designers work to solve the increasingly serious "problems" of modern life, but with every new "solution," they create a new set of problems in an exponentially growing pattern built on finite and dwindling resources. The United States is withering under this onslaught: *economically*, as corporations head overseas to exploit artificially cheap labor; *physiologically*, as an increasingly sick population of Americans copes with self-inflicted chronic diseases, *environmentally*, as pollution, deforestation, and global climate change erode the natural cycles that make human life on this planet possible[3]; and *culturally*, as the traditions that preserved local and regional values, beliefs, behaviors, and solutions are diluted by globalization, a process that accelerates the afore-mentioned problems.

"Consumerism has become the dominant world faith of every continent of the planet today."

- Brian Swimme, p. 17

In the last decade the profession of design has begun the cyclical drift back toward more thoughtful, moral, and sustainable methodologies. "Sustainability" has become the buzz word of the early twenty-first century. Consumers are responding to the conscientious products of sustainable design with an increased desire for "green" branded items including hybrid cars, bamboo cutlery, organic cotton underwear, soy-based plastic cell phones, solar-powered patio lighting, bio-plastic mouse pads and more. These "green" products offer ecological absolution for the cost of a light bulb or an electric lawnmower, but while they offer peace of mind to the conscientious consumer, they often provide only topical treatments to systemic problems—like oil rigs built of recycled materials.

Despite the dilution caused by the rapid commercialization of sustainable ideals, the vocabulary of sustainability remains. By bringing climate change, hybrid technology, renewable energy, etc. into the mainstream vernacular, sustainable design has fortified the ground for a new and uncompromising movement within the profession of design.

"Slow Design," a methodology that replaces consumption with quality-of-life, as its central premise, is a fresh philosophy in design thinking intended to meet the challenges of modern society. This paper explores the roots and evolution of Slow Design and its use to create a holistic solution for intracity mobility.

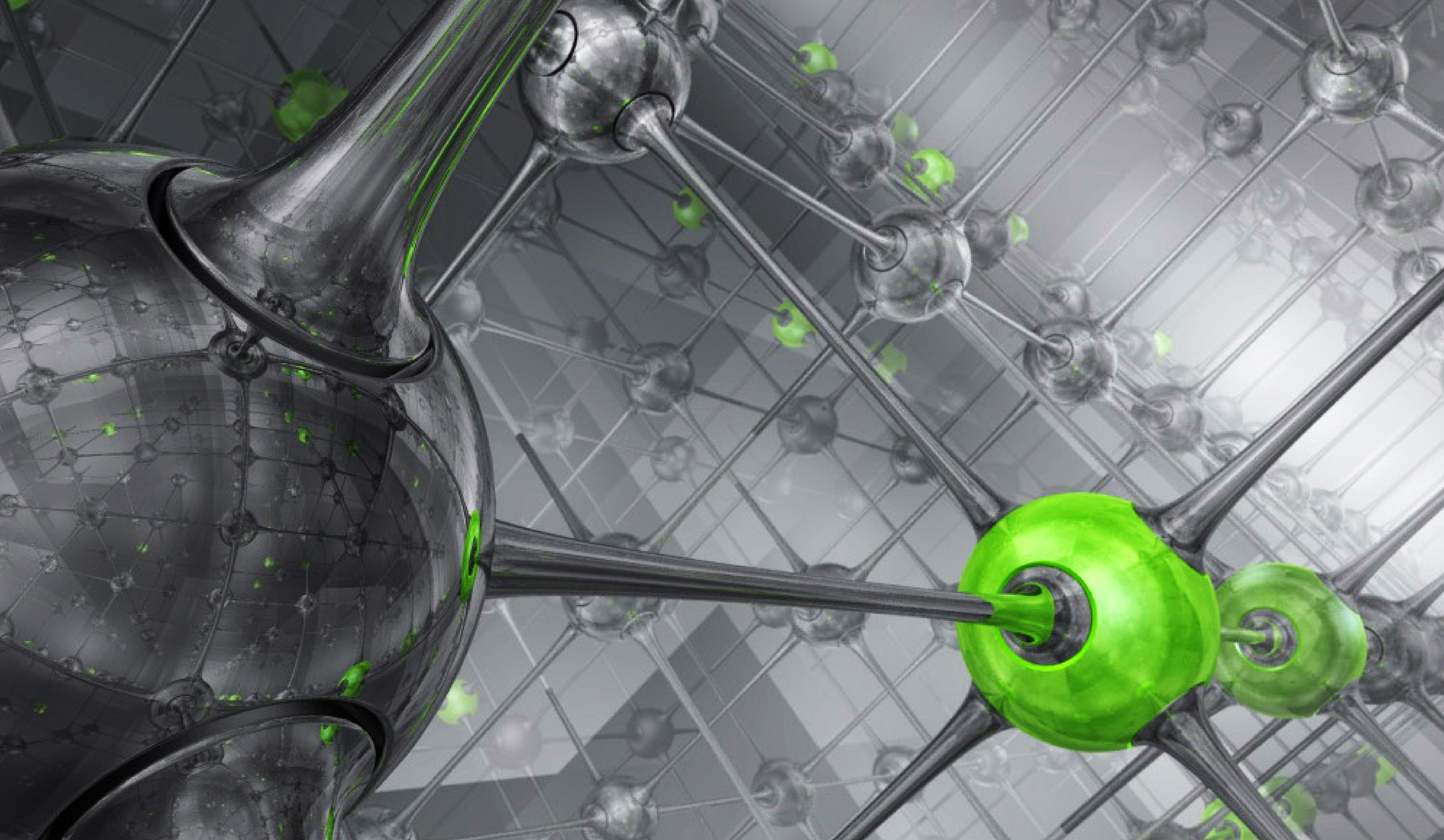
Design on a Massive Scale

"They say there is a vast net containing everything, everywhere, and a multifaceted diamond is caught at each nexus point in the net. Like a sparkling hologram, each diamond reflects every other diamond. Looking at one, you see the entire net throughout space and across all time. If you shake one piece of the net, all other parts tremble; each is codependent on the others..."

- Joel Speerstra

This is Indra's Net—a compelling illustration of the effect of change in a complex and interconnected system. A modern consumer product is such a system within the still larger world macrosystem. Discrete changes at the design level reverberate throughout the product and from the product throughout the entire system. Sustainable design is faltering because it is attempting to manipulate a macroscopic system through microscopic changes.

Because they operate at the seminal level of product development, designers wield enormous power to implement systemwide change. This power compels responsible designers to maintain a comprehensive understanding of the context and repercussions of their work. Unfortunately, the clear vision of a single designer infrequently guides a product's development. Instead, the development



of modern consumer products happens in teams and silos, resulting in a dissonant patchwork of short-term fixes and half solutions lacking elegance, integration, or even simple function. This democratic and reductionist approach to design is incapable of producing a good product by any *comprehensive* definition. On the massive scale at which most consumer products are developed, the level of understanding (of the entire system) required to produce a *sustainable* product may still be beyond the reach of current human knowledge. Life Cycle Analysis (LCA) and other analytical strategies expose this shortcoming. This is the challenge and (and hte power) of Indra's Net. As they reveal, the complexities of designing on such a massive scale quickly add up to a mind-numbing matrix of interconnected and unforeseen difficulties. LCA illustrates the futility of attempting to create "sustainable" solutions on such a massive scale—it indicates that *scale* itself—the volume of production and consumption that we enjoy—may be the problem that makes this type of "sustainability" impossible.

Our perennial answer is to patch the problem with more technology rather than challenge its underlying assumptions. Today we live with the repercussions of this patchwork of solutions to problems of our own invention.

The Role of Transportation Design

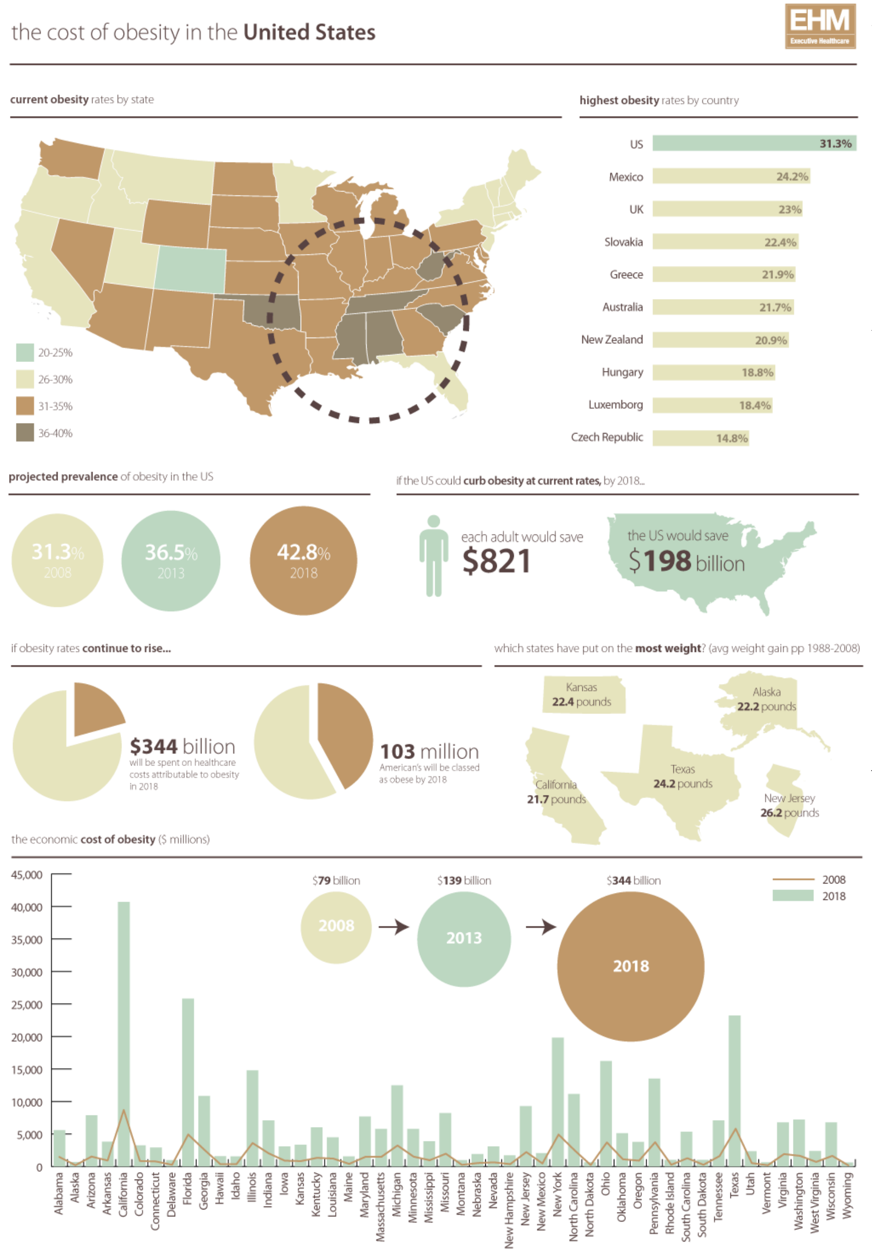
Transportation design is perhaps the greatest example of this dilemma. Rooted near the bedrock of American society, human mobility is a seminal aspect of the quality-of-life enjoyed in the United States. It is also one of the greatest contributors to its erosion. Today, a world of users are discovering the freedom and power of the automobile, just as perennial users in the U.S. are discovering its drawbacks. “Transportation sources accounted for approximately 29 percent of total U.S. Greenhouse Gas (GHG) emissions in 2006. Transportation is the fastest-growing source of U.S. GHGs, accounting for 47 percent of the net increase in total U.S. emissions since 1990. [It] is also the largest end-use source of CO_2.[4]” (EPA) Mobility’s contribution to global warming is potentially devastating, but it is just one repercussion of automotive dependence. Other effects include dependence on foreign oil, degradation of air quality (and the health effects that result), lost productivity due to traffic congestion[5], the isolation and segregation of communities divided by highways, acute ecological disasters including the Exxon Valdez and Deep Water Horizon oil spills, the destruction of wildlife and natural

Far from a wake-up call to a fossil fuel addicted nation, the 2009 BP oil spill has already been swallowed by American doublethink. Somehow, we condemned the disaster, but not ourselves as its cause.

ecosystems, and the homogenization of the built environment as suburbs radiate further from metropolitan areas. All these are spawned by artificially deflated fuel costs[6] that continue to make automotive transportation appear inexpensive and beneficial.

The physiological effects of a population that achieves mobility through mechanization are staggering, destroying lives on personal, medical, economic and environmental levels. “Widespread adoption of multiple technological innovations in the home, workplace, and schools has reduced our daily physical activity. Similarly, the car-dependent design of our communities has made it...much harder for us to shop and do other errands entirely on foot or by bicycle.” (Benjamin 2) In short, by removing the inconveniences of daily physical labor, our products are making us fat. “Worldwide, over 1 billion adults are overweight and around 300 million are obese. The increasing global prevalence of overweight and obesity has serious implications for health, increasing the risk of type 2 diabetes, cardiovascular disease, stroke and some cancers.” (Edwards 1) The trend toward overweight and obesity in the United States is one of many consequences of a population addicted to the convenience of motorized transportation, but the consumerism that underpins it may drive far more lasting and damaging societal and psychological effects than the purely physiological. The economic and ecological costs of an increasingly obese nation are considerable because food, like transportation, is a pillar of human society with immediate connections to agriculture, transportation, housing, healthcare, economics, and the environment. The rising cost of healthcare is, in large part, the result of an increasingly obese population, and a March 2009 study estimates that the predicted 2010 increase in population adiposity (fatness) will contribute "between .4 and 1.0 gigaton of carbon dioxide equivalents per year" (Edwards 4) to global warming per year.

Massive consumption may drive psychological effects as well. With the automobile as its ultimate icon, "Consumerism is based on the assumption that the universe is a collection of dead objects. It is for this reason that depression is a regular feature in every consumer society. When humans find themselves surrounded by nothing but objects, the response is always one of loneliness, and here at the end of the second millennium, we are swamped by a vast loneliness that is soaked into every stratum of our society." (Swimme 33) This phenomenon



may have repercussions in crime, drug abuse, video game addiction, lethargy and lack of empathy within and between societies.

The automobile has been woven into the fabric of America, providing unprecedented freedom and productivity at the cost of our quality of life. "[The nation] is in its grip so securely that we can barely perceive how both the quality of mobility and the quality of life have diminished." (Kay 19) Its role at the core of our society connects it to every aspect of our lives generating repercussions systemwide. Smog, congestion, oil spills—even these effects are so commonplace today as to be regarded as facts of today's news, forgotten tomorrow. Our desperate addiction to rapid, fossil-fueled mobility is so ingrained that even green conscious consumers will fight to preserve it.

Only by understanding comprehensively a product's impact can a designer hope to reduce its negative effect, but the interconnections of the modern automobile are so many that a complete understanding of their impact may be impossible. This argues for a simpler, more comprehensible approach to human mobility.

Occam's Razor as the solution to Indra's Net

"If a thing can be done adequately by means of one, it is superfluous to do it by means of several; for we observe that nature does not employ two instruments where one suffices."

Thomas Aquinas

Human mobility is at the center of American society. It is a lynchpin that, if changed for the better, could generate positive repercussions systemwide (economically, ecologically, physiologically and psychologically). Just as the negative repercussions of a decision in Indra's Net happen logarithmically, a swing in the other direction can be achieved by reducing the scale of our products to a level appropriate to their purpose. Designers are expert at guiding users' emotions to create desire for a product by aligning the visceral, functional and, especially, reflective levels of a product to a customer's values. By replacing sales with systemic societal change as their goal—teaching customers to value simplicity, refinement and cleverness over complexity and power—designers could cultivate a desire for less destructive products. Many designers are attempting to affect positive change by treating the problem topically by appealing to the sensibility that caused the problem.

A generation of consumers is coming of age that accepts massive consumption and disposability as a way of life, from packaging, to cars, to relationships. More comfortable in a suburban world of SUVs, fast food, and cable TV, these young consumers define value as stuff per dollar. Their only experience of sustainability is through conservation—sacrifice. This abstinence model[7] for sustainability demands that consumers conserve so that the world may thrive. It is the root of the environmentalist movement and has proven a difficult pill to swallow for most consumers. An alternative, the "abundance model" for design, developed by William McDonnough accepts the stuff per dollar value scheme and calls for products that are ecologically benign or beneficial, such that we can consume at near our present level and harness natural and man-made materials and strategies ("natural and biological nutrient loops") to process waste as food for other systems. At the core of both the Abundance Model and the Abstinence Model is acceptance of consumption as a foundational premise—that quality of life is proportional to material acquisition. One demands an ascetic approach to material goods, asking consumers to abstain; the other requires a retooling of every aspect of society—that designers and producers improve. Though the outcomes of both strategies are required, neither creates desire within the consumer. A third option, the celebration of simplicity could catalyze the adoption of both.

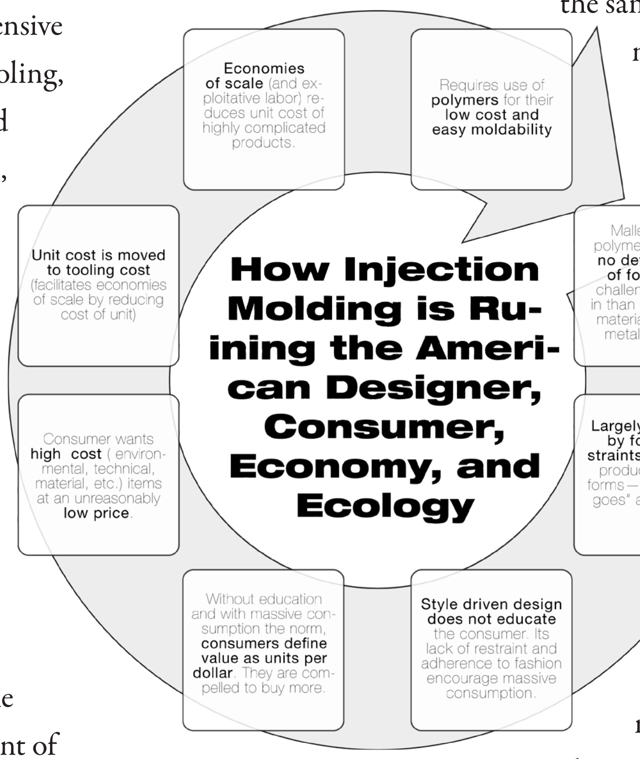
Cleverness is not held in particularly high regard in the United States as it is in other cultures. Cleverness of design or engineering replaces raw material with human ingenuity. It combines functions, simplifies inputs, and generates disproportionately beneficial outputs. Like the simple machine, it provides leverage through simplicity and ingenuity. From the perspective of Indra's Net, a simple product may be crafted not only to mitigate many of its detrimental effects but to harness its interconnections to a net positive effect, turning the interconnections of Indra's Net to its advantage. There is an elegance to this "less is more" approach that has been harnessed many times in the creative fields (in architecture, most famously) but seldom in the world of automotive design where manufacturers rely on gadgets, styling and marketing to move cars. Volkswagen is one of only a few companies to have harnessed a less is more design language to its benefit, creating the most successful car of all time. Between 1938 and 2003, 21,529,464 original Volkswagen Beetles were made. While American car manufacturers have scrambled to drive sales through planned obsolescence and advertising, the Beetle remained virtually unchanged for over half a century, achieving legendary status through simplicity, personality, and quality engineering.

One way to simplify products is to use materials with identity. Materials like steel, aluminum, leather and wood have unique idiosyncrasies that endear them to specific uses. They have a nobility that is absent from modern polymers. The flexibility of form provided by methods such as the injection-molding of plastics (and now metals) provides an aesthetic crutch to the product designer, eliminating the elegance possible through a union of form and material. In the mature field of architecture, constraints of structure, materials and reliability have historically forced this union, fostering a level of refinement seldom seen in the world of product design. A "pretty" object can be made in any material, but a beautiful object generates meaning for the user, often through this elegant combination of form and function.

"Attractiveness is a visceral-level phenomenon—the response is entirely to the surface look of an object. Beauty comes from the reflective level. Beauty looks below the surface. Beauty comes from conscious reflection and experience. It is influenced by knowledge, learning, and culture. Objects that are unattractive on the surface can give pleasure. Discordant music, for example, can be beautiful. Ugly art can be beautiful."

-Donald Norman, Emotional Design: Why we love (or hate) everyday things (87)

Any designer experienced in detail design will confirm that injection molding has its own constraints, but none will contend that they represent a fraction of the limitations of more essential materials. The crutch of injection-molded plastics reinforces a negative feed back loop between inexpensive fossil fuels, costly tooling, inelegant design, and continued economic, ecological and cultural degradation. This negative spiral can only worsen design and through it, the myriad areas in which design plays a role.



By embracing the beauty and refinement of simplicity, designers can scale back the damage they are uniquely positioned to cause, reversing this feed back loop and creating demand for better, simpler products of simpler manufacture, using fewer resources—enhancing the richness and quality of human life.

Consider the mountain bike and the dirt bike: The dirt bike is faster and easier in that it requires no pedaling, but it achieves those at the expense of noise, pollution, dependence on fossil fuels, higher initial cost and maintenance requirements, and it must be trailered to its destination. The mountain bike moves the same human around the same trails, but generates no noise or pollution; costs very little to manufacture, buy and operate; provides beneficial exercise and is powered only by food. The dirt bike drags a wake of negative repercussions, largely ignored by the user. By being limited to what can be accomplished through human effort, the mountain bike accomplishes the same task with a fraction of the impact—It is designed within an appropriate scale. The same comparison can be made between the safety razor (with its mountain of externalities) and the straight razor (a device that lasts a life time and turns an annoying chore into a pleasant and

The traditional straight razor lasts a lifetime, generates no waste beyond its manufacture, and turns an annoying chore into a pleasant ritual. Compare this to the Gillette Fusion with replacement blades at $3.75, resource intensive to manufacture and "monstrous hybrids" when disposed of. Like the mountain bike, the straight razor achieves elegance and minimal environmental effect by requiring more from the human.

skillful ritual). Consider also recreational motorboating vs. sailing, driving vs. cycling, recreational flying vs. paragliding, riflery vs. archery, gardening vs. purchasing vegetables, grinding coffee in an electric grinder vs. using a manual grinder, belonging to a gym vs. jogging outside, rototilling vs. hoeing, G.P.S. vs. a map, and movie watching vs. reading. In each case, the equipment and experience of the latter is simpler and purer, requiring more work from the human. The former relies heavily on automation and fossil fuels to simplify the work of the human, costing more, long-term in both economic and environmental terms, and ultimately degrading the human.

For the work of any given task, today's products provide the bulk of the effort,acting as the massive lever that balances the man's desires and abilities. Achieving a more appropriate balance on this metaphorical scale is the core of sustainability. With human input (skill, effort, or knowledge) on one side of the scale and human desire (comfort, convenience, etc.) on the other side, machine effort (stored fossil fuels) is the lever that allows us to achieve out desires, no matter how inappropriate, irresponsible or illogical they are.

Slow Design is the first design methodology that attempts to appropriately balance this scale using simple design and enhanced human ability

Moving a 150 lb. human from A to B is a relatively simple problem. Humans have been solving it for millenia by both biological and mechanical means. However, to move a 150 lb. human in direct, high speed, climate-controlled, leather-clad, acoustically insulated, high fashion, amply-cupholdered, multi-passenger, fun and convenient splendor is another matter.

To surmount this much larger problem (the weight on the left), using only a tiny amount of human exertion (the weight on the right—in this case, the input a driver provides in the form of steering, shifting, accelerating, braking and intention) requires a massive lever (the modern automobile). This lever allows the tiny input of the human to achieve equilibrium (mobility) with minimal input but like an unused muscle, unused ability atrophies.

A multi-billion dollar industry exists to deliver vehicles (levers) to celebrate and encourage this atrophy, allowing humans to solve large problems with less and less effort, and eco-efficient solutions allow us to do so with ever greater performance.

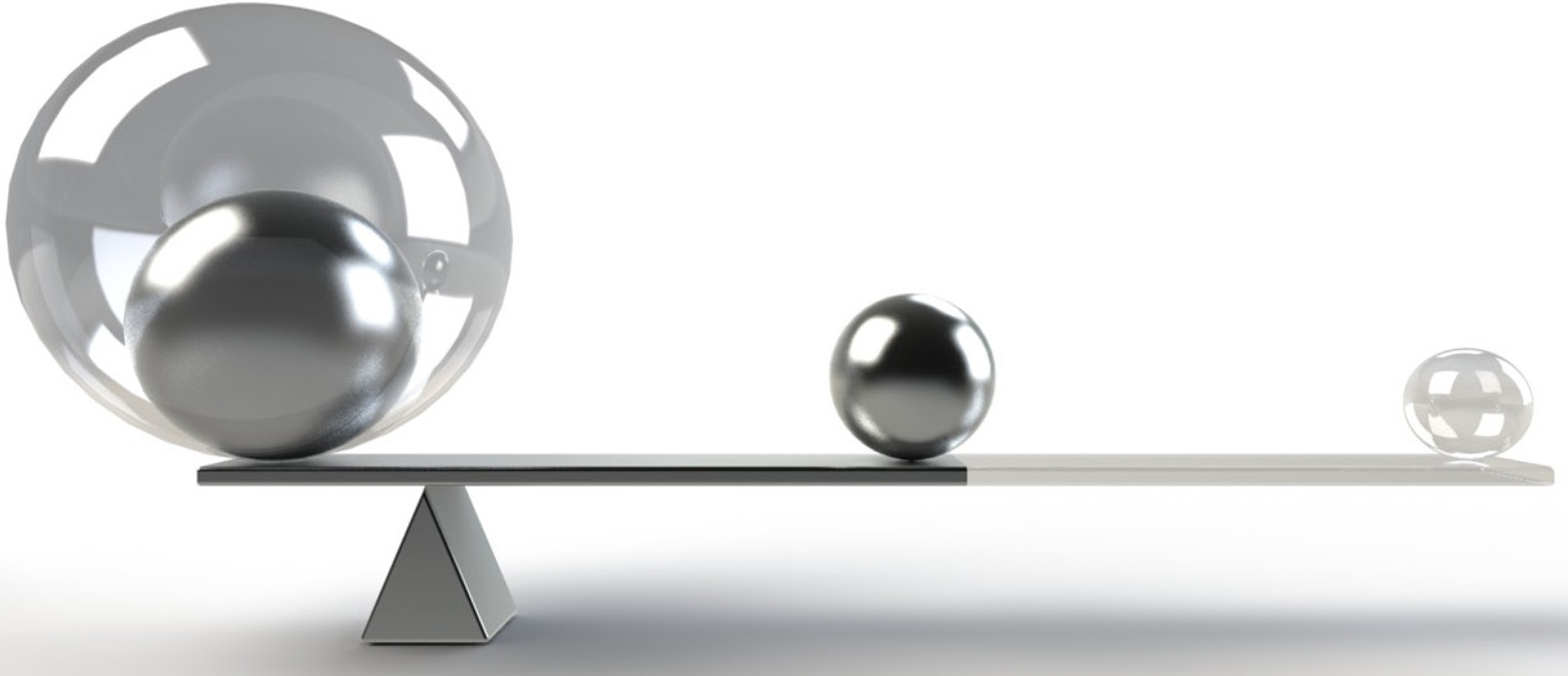
to reduce the damage of attaining human desire. What this metaphor illustrates is that the problem of generating sustainable products cannot be solved by redesigning the tool (the car, plane, building, product) but by revisiting the basic premise of the problem it is intended to solve. In the illustration at right, the weight on the left is the problem (e.g. intracity mobility). The weight on the right represents human input. The simple scale on which they balance represents the tool that allows the human to accomplish the given task—in this case, the tool is the conveyance that moves the human from A to B. If the size of the problem is reduced (by questioning the appropriateness of transportation at such exhorbitant cost) or the input of the human is increased (by requiring more from the human), a balance can be achieved using a smaller lever (less damage to ecology, economy, culture, etc.)

This celebration of machine simplicity and human ability is more than just slow design—it is *Aspirational Design*. It elevates the human being by requiring him to do more. In the process, it will enrich his life by adding color, texture, and experience in the form of new and exciting experiences, skills to master, knowledge to acquire, etc. Ultimately, by elevating and celebrating human ability, Aspirational Design creates a better human, while simultaneously reducing the

By jettisoning the basic premise of modern automotive transportation (the idea that it is appropriate to move a 150 lb. human at enormous ecological, physiological and economic cost for the sake of comfort, convenience, etc.) we can reduce the size of the problem (the weight on the left) and the length of the lever and the resources used to create and power it.

In addition, by increasing the responsibility of the human, in the form of not just directing but powering the vehicle and exercising more complicated forms of input (in terms of balance, agility, etc.), we can celenbrate and enhance human ability (e.g. fitness, agility, mastery, knowledge, etc.) The length of the lever can be further reduced, achieving equilibrium (mobility) with even less impact from a mechanical crutch.

Used constructively, by limiting human problems to those that can be solved with a smaller lever or encouraging humans to improve themselves to solve larger problems, we force human ability to increase. This is *Aspirational Design*—using the design of products to produce better humans.



environmental, social and economic costs of the machine.

Endnotes

1. "The power of holding two contradictory beliefs in one's mind simultaneously, and accepting both of them....To tell deliberate lies while genuinely believing in them, to forget any fact that has become inconvenient, and then, when it becomes necessary again, to draw it back from oblivion for just so long as it is needed, to deny the existence of objective reality and all the while to take account of the reality which one denies — all this is indispensably necessary. Even in using the word doublethink it is necessary to exercise doublethink. For by using the word one admits that one is tampering with reality; by a fresh act of doublethink one erases this knowledge; and so on indefinitely, with the lie always one leap ahead of the truth." (Orwell, 32)
2. A necessary product needs no marketing.
3. Environmentalism isn't just about saving Spotted Owls. It is about combating self-imposed human extinction.
4. "... These estimates of transportation GHGs do not include emissions from additional life cycle processes, such as the extraction and refining of fuel and the manufacture of vehicles..." (EPA)
5. "Commuters put in an average of ten forty hour work weeks behind the wheel each year." (Kay 14)
6. In 2005, the average American commuter drove "33 miles between work and home each day" (U.S. News).
7. A method proven consistently not to work in *any* field.

what is slow design?

The industrial designer of the 20th century was an amoral tool of communication, form giving, and planned obsolescence. As the profession matures into a world of problems that it created, some practitioners are attempting to apply design thinking to generate positive change. Sustainable design is one application, but as companies capitalize on green marketing, words like "green," "renewable," "organic" and "sustainable" have lost much of their meaning. As the ideals of sustainable design are usurped by marketing, many designers and a few discerning customers are looking for less corruptible means of generating positive change. This backlash can be seen in every aspect of Western life, from the renaissance of holistic medicine, to the return of urban homesteading and the rebirth of the American bicycle industry. The desire for more authentic, "Slower" ways of living represents an undercurrent of frustration against the effects of the "Attention Age."[1]

Slow design is a conscientious approach to design that serves as "an antidote to the current design paradigm" based on fashion, consumption and convenience. Still in its infancy, slow ideals are gaining traction in creative fields, fed in part by frustration with the status quo, a flagging economy that released many talented individuals into entrepreneurial pursuits, the rising cost of gasoline, increased education about global warming, the burgeoning DIY movement and the new availability of inexpensive CAD software and home prototyping equipment.

Slow Design is just the latest application of the Slow Movement that has touched fields as disparate as food, business, and sex. The Slow movement is a manifestation of a cyclical backlash of human culture against the acceleration of technology. It began at the table with Slow food, a cultural rebellion that began in 1986 as a hedonist protest against the opening of a McDonald's on the Spanish Steps in Rome. Led by Carlo Petrini, the purpose of this protest was to emphasize the debasement of culture symptomatic of globalization. Three years later, the International Slow Food Movement was created with the signing of its manifesto by delegations from over twenty countries (www.slowfoodusa.org).

Today the organization has over 83,000 members in 122 countries, and is a critical part of a 40 billion dollar organic food and drink industry (Ebrahimi). Slow foodists demand a return to a food system which celebrates authentic, healthful, and transparent food production and the pleasures of local cuisine and culture.

The popularity of Slow Food has grown immensely in the last two decades, its practitioners leading a renaissance in artisanal food production and preparation. Whether "down-shifting" for reasons of health, environmental concern, or simple pleasure, the close relationship slow food practitioners share with the source of their food illustrates, for them, the interconnected impact of their culinary choices. The rest of us, distanced from our food, are largely ignorant to those repercussions and are more likely to consume excessively. Over the last twenty years, Slow Food has fought to improve quality of life and curb ecological destruction by ending the reign of "conventional" agriculture, maintaining culture through traditional food, and educating consumers about the ramifications of their culinary habits.

"One idea that survived the middle ages, the Renaissance, and the Enlightenment to flourish into the present age is this: that humans belong to an order of being that is separate from (and higher than) the rest of the living community. This is, to my mind, the most dangerous idea extant today... Earthworms are more important to the life of this planet than humans are, and if earthworms disappear, we humans will follow very soon after. It's vital that we get it into our heads that we are members of a community and dependent on that community the same way every other member is. We cannot exist apart from it. We don't "own" that community. We aren't custodians of it... We need it, absolutely and forever; it doesn't need us."

Daniel Quinn (Ecogeek Interview October 2007)

The Arts & Crafts Movement

Over a century ago, the Arts & Crafts Movement, like Slow Design, grew out of a similar frustration with the status quo. In the late nineteenth century, a group of British artisans, disgusted by what they perceived as the "dehumanizing" effects of industrialization, began to create artifacts that recaptured the beauty, quality, and meaning of manufacturing on a human scale. By the early twentieth century, its influence had migrated to areas "as diverse as California and Budapest." (Blakesley 7) Influenced by the writings of John Ruskin[2], the founders of the Arts & Crafts Movement recognized the importance of architecture and the decorative arts in weaving the fabric of society. Their aim was to develop artifacts in which "goodness and beauty were synonymous terms."(Ashbee)

Though much of the Arts & Crafts Movements' philosophy was swallowed by the rapid growth of the American economy following the first world war, several of its central tenets remain in the worlds of art and architecture. The idea of "honesty of form" was adopted by future artists and architects and popularized by those of the Bauhaus and Modernism, including Louis Sullivan who famously stated "form ever follows function." Aesthetically, the Arts and Crafts Movement condemned the onrush of eclecticism – the haphazard application of unrelated historical styles to contemporary structures. It also demanded that objects display the process and material by which they were fabricated and that the creator of an object be instrumental in every aspect of its design and manufacture—the antithesis of industrialized manufacturing, in which the division of labor is instrumental.

The celebration of handicraft became central to the ideals of the movement (and the primary contributor to its downfall). The added value of the handmade imbued the products of the Arts and Crafts Movement with exceedingly high quality and correspondingly high cost. (Though many practitioners *did* embrace some machine labor to relieve the monotony of mindless work, freeing craftsmen for the mindful, human work.) The products of the Arts & Crafts movement, though inspired by and designed to celebrate the role of the working craftsman, became the exclusive property of the wealthy industrialists and gentry of the early 20th century. The movement met its end because it was unable to adapt to the financial constraints of a post war economy and a growing middle class. Its products, exquisitely produced and executed by master craftsmen, were unable to compete in a sea of inexpensive but reasonably functioning goods. In the words of C R Ashbee, "We have made of a great social movement, a narrow and tiresome little aristocracy working with great skill for the very rich." (Naylor 9)

Slow Design can benefit from an understanding of the obstacles faced over a century ago by the artisans of that period. Today, amidst a sea of perfect, impossibly identical, machine-made parts, "Handmade" still means quality. However, the complexity of modern products all but precludes that type of investment, with the cost of tooling driving the need for high volume sales. Working on a small, slow scale can avoid the standardization required of mass production, but rarely without sacrificing credibility and market success. Like the Arts & Crafts Movement, challenging the premise of massive scale without becoming diluted or marginalized will be the greatest obstacle to the future of Slow Design.

In its infancy, Slow Design is already struggling to find that balance between message and marketability. Steeped in the onanist world of conceptual art, slow projects such as *Human Chair* by Ruiz de Azúa and *Grown Stool* by Christopher Cattle are clever and communicative, but incapable of translating the Slow idea into a serious movement. The future of Slow Design will be tenuous until it begins to turn soft ideologies

into marketable products.

To become a serious movement, Slow Design must be neither a nostalgic return to preindustrial craft nor a regurgitation of the puling and easily marginalized tactics of the environmental movement. It must strike a balance between slow ideals and an objective, real world understanding of product design and manufacturing. In *Slow Theory,* Alastair Faud-Luke offers a set of design guidelines that may provide the direction for a successful turn from mass consumption. His writing encourages designers to refocus the role of design on the enhancement of human *well being*. Like any standards, these guidelines will be railed against by those who prefer the safety of the status quo, but as the complexity of Life Cycle Analysis and the mental exploration of Indra's Net reveal, the designer's role is too powerful to remain unguided. Adoption of these principles may enable a designer to achieve the *tempo giusto* or "right speed" for design.

(Endnotes)

1 The term associated with the current era of waste, contradiction and instant gratification.

2 In particular, The Seven Lamps of Architecture (1849) and The Stones of Venice (1851–53)

The Slow Food Manifesto

Our century, which began and has developed under the insignia of industrial civilization, first invented the machine and then took it as its life model.

We are enslaved by speed and have all succumbed to the same insidious virus: Fast Life, which disrupts our habits, pervades the privacy of our homes and forces us to eat Fast Foods.

To be worthy of the name, Homo Sapiens should rid himself of speed before it reduces him to a species in danger of extinction.

A firm defense of quiet material pleasure is the only way to oppose the universal folly of Fast Life.

May suitable doses of guaranteed sensual pleasure and slow, long-lasting enjoyment preserve us from the contagion of the multitude who mistake frenzy for efficiency.

Our defense should begin at the table with Slow Food.

Let us rediscover the flavors and savors of regional cooking and banish the degrading effects of Fast Food.

In the name of productivity, Fast Life has changed our way of being and threatens our environment and our landscapes. So Slow Food is now the only truly progressive answer.

That is what real culture is all about: developing taste rather than demeaning it. And what better way to set about this than an international exchange of experiences, knowledge, projects?

Slow Food guarantees a better future.

Faud-Luke’s Guidelines for a Slow Designer

- *Satisfy real needs rather than transient fashionable or market driven needs.*
- *Reduce resource flows and environmental pollution by minimizing the ecological footprint of products/service products.*
- *Harness solar income—sun, wind, water or sea power and renewable materials.*
- *Enable separation of components of products/service products at the end-of-life in order to encourage recycling, reuse and remanufacturing.*
- *Exclude the use of substances toxic or hazardous to human and other forms of life at all stages of the product life cycle.*
- *Engender maximum benefits of well-being to the intended audience.*
- *Educate the client and the user by encouraging sustainable literacy and graphicacy.*
- *Exclude innovation lethargy by re-examining original assumptions behind existing products.*
- *Dematerialize products into service products wherever there is proven benefit in terms of individual, social and/or environmental well-beingEnsure physically, culturally, emotionally, mentally and spiritually durable products.*
- *Maximize products benefits to sociocultural communities.*
- *Encourage modularity: to permit sequential purchases as needs and funds permit; to facilitate repair/reuse; to improve functionality.*
- *Foster debate and challenge the status quo surrounding existing products.*
- *Publish sustainable designs in the public domain for everyone’s benefit, especially those designs which commerce will not manufacture.*
- *Promote Design for Sustainability as an opportunity not a threat to the status quo.*

slow transportation?

In the U.S., the automotive paradigm continues to poison American society and Americans. To systemically cure the repercussions of modern land-based mobility will require the rethinking of basic premises and a break from this paradigm. Many alternatives exist, from hybrid cars to the infamous Segway, but most are built on the same foundations: 1. A one-size-fits-all approach to design, and 2. Inappropriate scale. With only one exception, these alternatives fail to meet the challenge of Indra's Net.

The Swiss Army Approach

The demands of terrestrial mobility exist across a wide and non-indexed spectrum: from short distance, intracity errands; to medium distance, intercity commutes; to transcontinental or intercontinental journeys (to say nothing of recreational applications). As in other applications, different jobs cannot always be done by the same tool. Despite the dizzying array of options available in the modern automobile (power windows or manual; manual transmission or automatic; leather or fabric; sunroof; moonroof; convertible; number of cup holders; tape, CD, MP3, iPod jack; power seats; heated seats; vented seats; antilock brakes; air bags; auxiliary sun shades; power locks; traction control; four wheel drive; all-wheel drive, etc.) the idea of an automobile exists within a relatively narrow bandwidth. From the Smart Fortwo to the Hummer H3, a car is still a car. Although many cars are designed with a special purpose in mind (e.g. the pickup truck), they also serve double and triple duty as grocery-getters, long-distance tourers, weekend cruisers, and kid haulers, conflicting purposes that dilute their capacity to serve their primary function. The remedial development of crossover vehicles (those cars that do nothing well, but many things poorly) are the icon of this phenomenon. Their aesthetics and function form a hodgepodge of conflicting messages and inferior performance, a phenomenon that customers notice and react to. "The Aztek is the only car that I can remember that people would walk by and actually point and laugh at you when you were driving it," recalls Jake Fisher, senior automotive engineer at Consumer Reports. (The car he refers to, the Pontiac Aztec, was a crossover with such compromised function and aesthetics that it earned a place in Forbe's Ten Legendary Car Flops alongside such icons as the infamous Yugo.)

This Swiss army approach to transportation design is necessary due to the high cost to the consumer of buying and maintaining a vehicle as large and complex as the modern automobile, but as long as the United States refuses to adopt mass transit as part of its quiver of mobility solutions, it remains largely up to the consumer to provide his own mobility platform. For most consumers, a quiver of uncompromised, purpose-built vehicles is financially or spatially unmanageable. Only by lowering the size and cost of these vehicles could customers afford to own and operate a quiver of appropriately designed vehicles, the right tool for each of the jobs of mobility—short, intracity trips to the grocery; a long distance commute; or a weekend trip to another city.

Scale

Not all modern vehicles subscribe to the one-size-fits-all approach to mobility. There have been countless attempts to create specialized vehicles to equip the mobility quiver. These are the fringe species that populate the ecotones—the area "where two ecosystems meet, ... a small strip of terrain that conforms strictly to neither system" (Hawken 51)—of the transportation ecology. "Should one of the ecosystems change suddenly, devastated by disease, perhaps, ... these edge species will provide the means by which the environment will establish a new ecosystem." (Hawken 51) Our current transportation paradigm is an ecosystem—a monoculture of automotive dependence showing the symptoms of an underlying disease.

Specialized alternatives to the automobile are everywhere, each adapted to

a special niche in the transportation environment. Though these alternatives avoid the one-size-fits-all approach to mobility, many fall victim to another trap in the search for an automotive alternative. Like the automobile, they are built on a scale that is inappropriate for their purpose.

The Segway is, without doubt, the best example of an inappropriately scaled and misguided solution to intra-city transportation. Conceived in the vacuum of an engineering boys club, the Segway was designed as an alternative for short automobile trips. The Segway i2 weighs 105 lbs., has a top speed of 12.5 mph, a range of 24 mi. and a price tag of $6K. It is slower than a bicycle but faster than walking, and provides none of the storage capacity or weather protection of an automobile. Far from an alternative to the

The Segway i2

- 80 lbs.
- $7,000
- 12 mph
- 12 mile range
- replaces walking

automobile, it is a faster, less sustainable alternative to walking, an activity that many Americans could use much, much more of. Though a jewel of engineering technology, the Segway was designed without regard for the potential needs of its user, nor for the context or implications of its use. It exemplifies the disproportionate application of technology to simple problems that plagues much of the consumer product landscape.

The average American driver drives less than 32 miles/day and does so *alone*. In this frequent scenario[1] the Toyota Prius moves a 150 lb. human with the application of 3042 lbs. of steel (a ratio of 20 units of car to one unit of human cargo).[2]

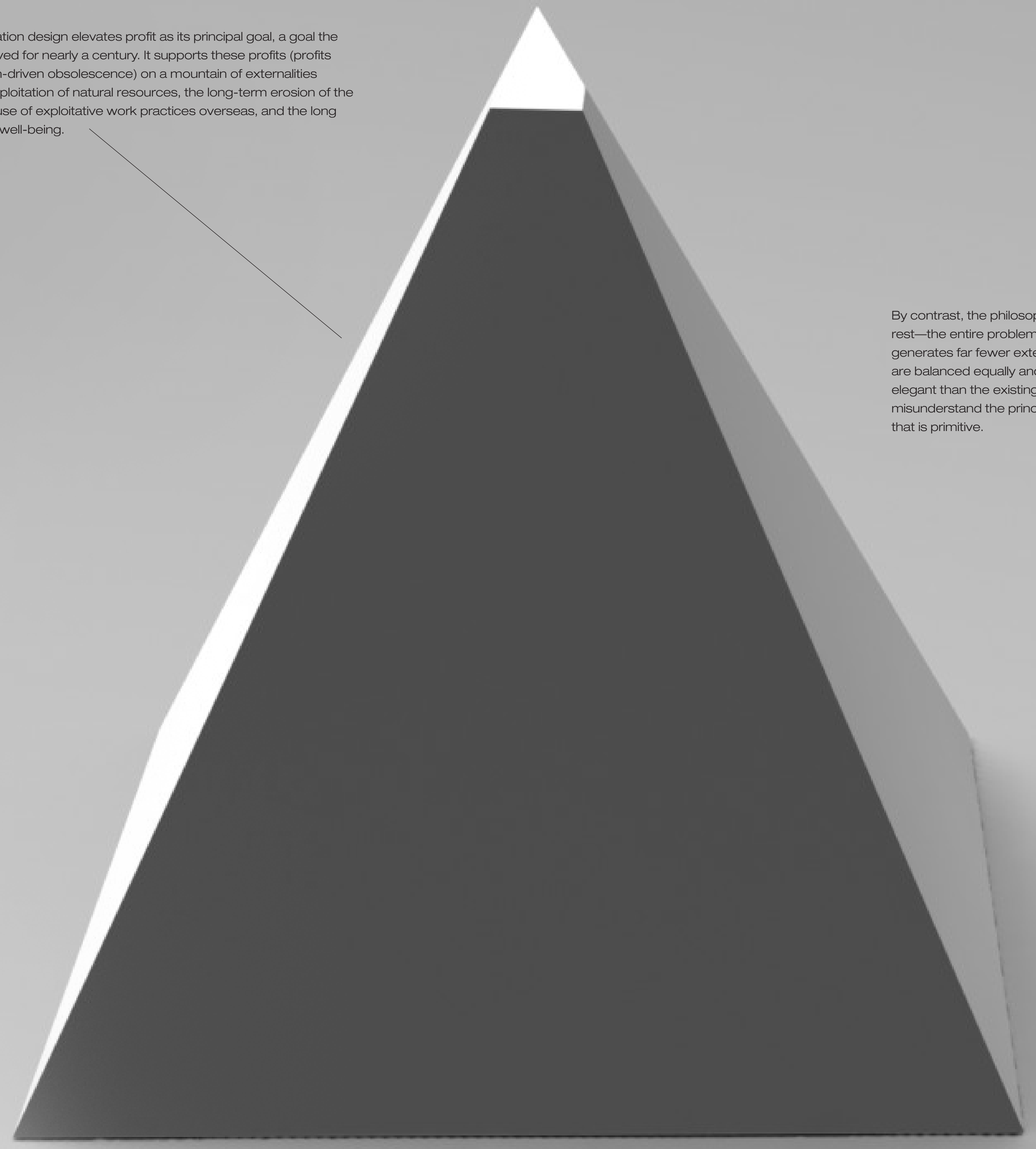
A *slow* approach to the problem of American terrestrial transportation would apply the principles of *purpose-built* and *appropriately scaled* vehicles to create a holistically designed and functioning *network* of mobility solutions—a transportation quiver—incorporating both public and privately owned and operated vehicles, each optimally designed for a unique purpose. Like the systems of veins and capillaries that deliver nutrients in the human body (and other natural systems), the human transportation network would be composed of a similar network of mobility solutions.

Within this network would be an array of federally funded high speed rail pathways (veinous

& arterial trunks) for regional excursions, state and citywide mass transit systems (subways, trolleys, light rail) for short and medium distance commutes (veins, arteries), and shared vehicle systems for cargo transportation. Solutions for the "last mile" and for intracity travel under 32 miles (most of the daily travel undertaken by an average, working American) would include a quiver of purpose-built, small-scale vehicles (capillaries). These conveyances would be inexpensive to own and operate and designed to appropriately align their purpose with their technical and ecological footprints.

By targeting a smaller segment of Indra's Net for each mobility solution, rather than applying a one-size-fits-all approach, designers could more comprehensively consider and anticipate the consequences of these individual solutions. This *deliberate* approach to design might mitigate the reverberations of automotive dependence, positively affecting American communities, the environment, and the health and well-being of individuals. It could provide the balance or *tempo giusto* (the "right speed") for American intracity mobility.

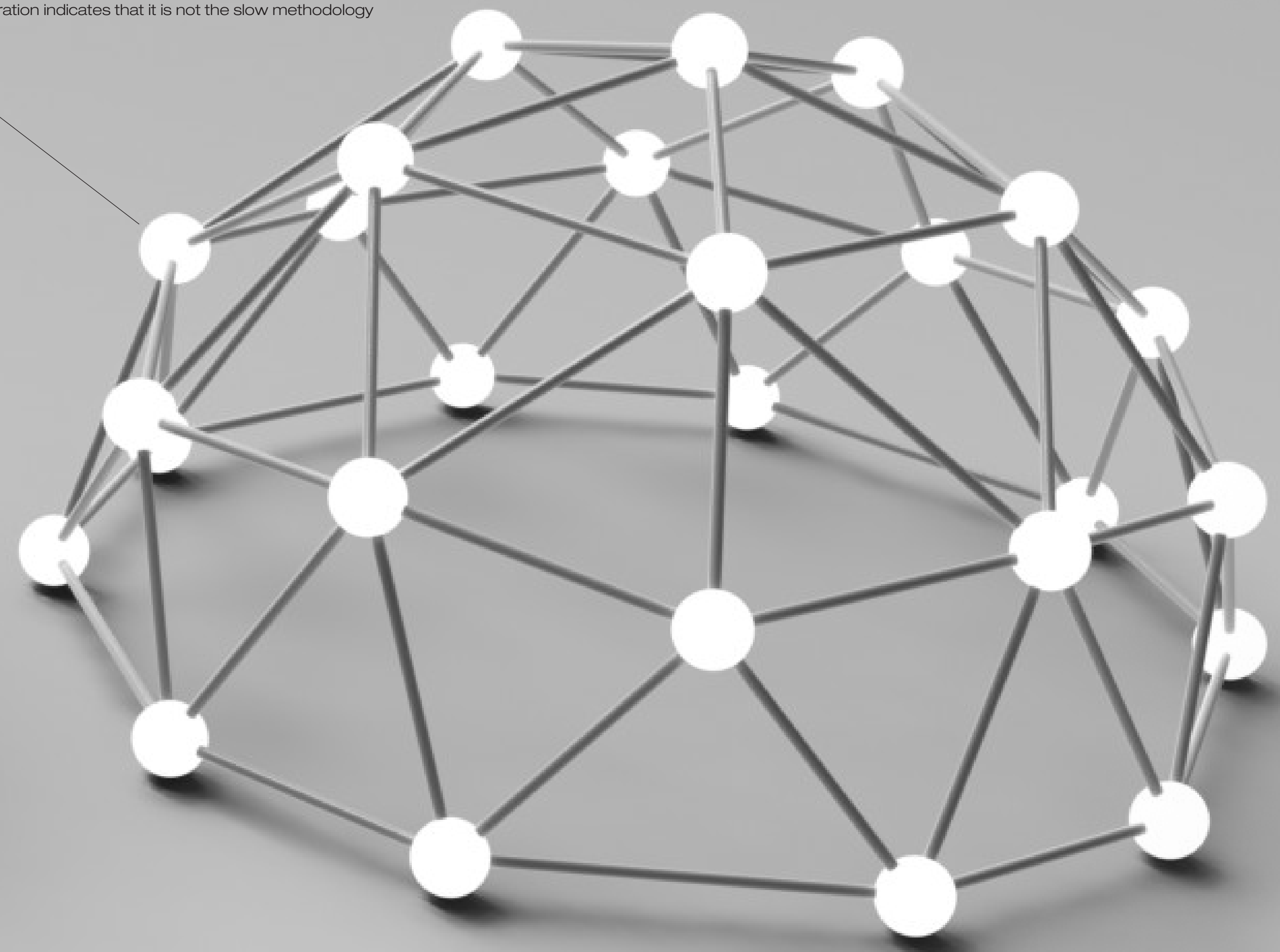
The existing "architecture" of transportation design elevates profit as its principal goal, a goal the major American automakers had achieved for nearly a century. It supports these profits (profits driven by high volume sales and fashion-driven obsolescence) on a mountain of externalities including: ecological destruction, the exploitation of natural resources, the long-term erosion of the American economy and skill base, the use of exploitative work practices overseas, and the long term degradation of human health and well-being.



"The Slow philosophy can be summed up in a single word: balance. Be fast when it makes sense to be fast, and be slow when slowness is called for. Seek to live at what musicians call the tempo giusto – the right speed."

-Carl Honoré

By contrast, the philosophical "architecture" of Slow Transportation elevates no one goal above the rest—the entire problem is considered holistically, resulting in a "structure" that is self buttressing and generates far fewer externalities. Needs such as sustainability, profit, efficiency, beauty, and equity are balanced equally and treated holistically. The resulting methodology is lighter, smarter and more elegant than the existing automotive paradigm. Viewed as a "return to the primitive" by those who misunderstand the principles of slow design, this illustration indicates that it is not the slow methodology that is primitive.



Success Through Mediocrity

The focus of this project is to keep the greater system in mind, while illustrating a single cog in the larger machine—that of intracity mobility. This project focuses on the trips that account for the majority of daily human travel—those medium-range, solo commutes and errands that form the majority of daily American transportation needs.

Designers and engineers have continuously proven themselves capable of producing automotive alternatives for this area of transportation, but few provide *appropriate* solutions—those that solve the problem at the acute level as well as in the greater context of the problem. Guided by postmodern amorality and confused by the myriad voices of scientists, marketers, consumers and politicians, few designers are willing to question the fundamental assumptions of the transportation paradigm. The vehicles which dominate our transportation landscape are the product of the vacuity of the philosophies on which they were built, resulting in the continued application of aesthetic novelty, planned obsolescence, and the use of marketing to generate artificial demand for vapid, unnecessary products.

To create appropriate solutions to intracity mobility requires a philosophy that challenges the core tenets of conventional design thinking: so-called "user centered design," economies of scale, producer unaccountability, and problem solving.

User Centered Design | Marketing

"The iterative method is design by compromise, by committee, and by consensus. This guarantees a result that is safe and effective, but invariably dull. If you want a successful product, test and revise. If you want a great product, one that can change the world, let it be driven by someone with a clear vision. ... It is the only path to greatness." (Norman 98)

Donald Norman

To create a new transportation paradigm, the first impulse of many designers is to seek consumer "insights." This is a mistake, for it is the safety of marketing and "user centered" design that is leading the charge toward mediocrity. In this scenario, *marketeers* ask the consumer what he wants while simultaneously crafting the ads that tell him what he wants. This self-congratulatory cycle does much to drive the profits of marketing firms, but little to drive innovation. Instead, it inseminates the market with safe, harmless products, the tools for the stagnation and homogenization of culture and humanity. To be effective, design must challenge paradigms rather than bowing to them. Designers innovate. Consumers, in large part, do not.

"In the mid-1990s, then-General Motors Corp. Chairman John G. Smale decided to bring the world's biggest automaker a dose of the give-the-people-what-they-want ethic that had animated Smale's old company, Procter & Gamble Co. And what the people wanted was sexy, edgy and a bit off-key; in short, a head-turner. General Motors' culture took over from there. Design would be by committee, the focus groups extensive. And production would have to stick to a tight budget, with all that sex appeal packed onto an existing minivan platform. The result rolled off the assembly line in 2000: the Pontiac Aztek, considered by many to be one of the ugliest cars produced in decades and a flop from Day One.

The Aztek represented all that is wrong with GM's design process, that official said. The concept car actually did something few GM designs do: arrive before a trend—this time, the crossover SUV that combines the attributes of a truck and a passenger car. And GM had high hopes to sell 50,000 to 70,000 Azteks a year, establishing Pontiac on the cutting edge.

Then came production, the executive said. The penny-pinchers demanded that costs be kept low by putting the concept car on an existing minivan platform. That destroyed the original proportions and produced the vehicle's bizarre, pushed-up back end. But the designers kept telling themselves it was good enough. "By the time it was done, it came out as this horrible, least-common-denominator vehicle where everyone said, 'How could you put that on the road?'" the official said.

Sales never reached the 30,000 level needed to make money on the Aztek, so it abruptly went out of production last year. The tongue-in-cheek hosts of National Public Radio's "Car Talk" named it the ugliest car of 2005. "It looks the way Montezuma's revenge feels," one listener quipped."

Jeff Atwood

"If I'd asked my customers what they wanted, they'd have said a faster horse."
- Henry Ford

Economies of Scale

The capital expense of tooling creates a tendency toward conservative design by making design a high stakes endeavor. With $100K of tooling on the line, the stakes are high if a product should fail in the marketplace. The resulting climate of caution is the soul of user centered design. By jettisoning the use of high tooling cost materials and processes (e.g. molded polymers, cast metals, etc.) and focusing on products that can be *fabricated* rather than *manufactured*, the financial stakes of design concepts can be lowered, paving the way for more nimble, courageous, and less democratic design. This will also mean a turn away from high volume sales of single, replicated objects and toward a more diverse network of independent producers and regionally adapted solutions. The result could be less waste, more diversity, increased economic competition and a stabler economy.

Problem Solving

Conventional design thinking is an inherently negative process. Focused on problem solving, it generally begins with a problem and creates a product to eliminate that problem, often removing one more task from the responsibility of the user. A positive design methodology would not focus on eliminating inconveniences; It would aim to celebrate and enhance *experiences*.

The automobile has contributed to an American population that is unhappy, unhealthy, and unskilled. This is because modern automobiles are fundamentally *antihuman*. The *complete* needs of the human seem to be the least considered aspect of a modern automobile which insulates us from the experience of mobility, reducing it to the chore of going from A to B. It replaces the joy of *movement itself* with DVD players, mobile phones and other distractions, placating the user rather than elevating his experience.

Nothing positive can come from lowering the bar of human endeavor nor from eliminating human experience. Doing so simply *creates worse humans* by reducing their physical involvement, abilities, and enjoyment. A positive design methodology celebrates the human by celebrating the mobility that only humans enjoy. Mobility is not a problem to be solved or an experience to be insulated from; It should be celebrated and cultivated through the application of a more positive and courageous design path and fewer technological crutches.

"If standard of living is your major objective, quality of life almost never improves, but if quality of life is your number one objective, your standard of living almost always improves."

Zig Ziglar

Crowdsourcing & Accountability

"Internet forums are famous for their lack of civility, but more distressing is how rarely they seem to produce meaningful discussions."

Michael Rogers

Crowdsourcing is expected to be one of the next big movements in Industrial Design. It is the term applied to design driven by the input of a crowd of amateurs, rather than that of a paid expert in the field. Major consumer products companies like Procter & Gamble have long relied on quantitative, rather than qualitative means to provide the data to create safe, market-acceptable products. In 2000, "In seeing that the company's most successful products were a result of collaboration between different divisions" Procter & Gamble's Larry Huston, Vice President of Research and Development "figured that even more cross-pollination would be a good

The Rally Fighter is the first crowd-sourced automobile. "Designed" (drawn) by Sangho Kim, this car was "co-developed" by over 160 individual contributors.

thing.... P&G had set a goal of increasing the number of innovations acquired from outside its walls from 15 percent to 50 percent. Six years later, critical components of more than 35 percent of the company's initiatives were generated outside P&G." In 2006, he said "R&D productivity is up 60 percent, and the stock has returned to five-year highs." Using collaboration and cross pollination to foster new creativity within an insular organization is both necessary and effective. Crowdsourcing, however, takes the idea to a new level, made possible by the increased connectivity of the internet. The crowdsourcing method harnesses the collective efforts of an inexpensive sea of amateurs to replace the work of a small, dedicated body of experts. It is the idea that if two heads are better than one, a million heads are better than two—or like the old joke: "if you provide an infinite number of monkeys with typewriters one of them will eventually come up with a masterpiece" (Flintoff 1) The concern is, if the rest of the monkeys' work is all we read, how will we recognize a masterpiece?

Web 2.0 is the facilitator and the progenitor of the crowdsourcing phenomenon. It is our new, interactive generation of internet behavior, filled with content generated by a global network of amateur users rather than that from a few, credible sources. On the internet, this methodology has had the beneficent effect of democratizing the creative fields, giving a voice and an opportunity to a world of users who would otherwise never be heard and elevating the work of the few talented naturals. The question, however, is whether the overall quality of information is being lessened by a large body of inept contributors. The evidence suggests that it is, manifested by the "endless digital forest of mediocrity: uninformed political commentary, unseemly home videos, embarrassingly amateurish music, unreadable poems, essays and novels." (Flintoff 1) Wikipedia alone, the icon of the wisdom-of-crowds methodology that is rapidly replacing curated encyclopedias like Britannica, has over 1.8 million articles (Flintoff 1) but "is full of mistakes, half truths and misunderstandings." (Flintoff 1)

In artistic fields, the social benefits of democratization may outweigh the degradation of the body of work, but where the quality of the work is paramount, this homogenization can be disastrous. Furthermore, the stirring of the work of the credible into the stew of equivocal information may degrade the work of the expert while disproportionately shouldering him (her) with the responsibility of propping up the overall quality of information at his own expense.

Even product designers are using quantitative, rather than qualitative thought to drive product design. The web 2.0 methodology is being applied to every field, including product and (terrifyingly) transportation design. At Local Motors, the wisdom of the crowd is being harnessed as an antidote to the stagnation of the "Big Three." Local Motors is "a next generation American car company" that uses a "proprietary open source design community"[3] to combine the input of thousands of designers worldwide, to develop vehicles for local, discrete applications. The need for an alternative to the foot-dragging stagnation of the Big Three is obvious, and Local Motors has identified the problem of *scale* as the root of the problem, but crowdsourcing seems to "throw the baby out with the bath water." It swings too far in the opposite direction—to inept and fragmented design—a weak assault on a powerfully entrenched incumbent that may do more to harm than help the struggle against the automotive paradigm. The inelegance of this shotgun approach to design implies its underlying weakness.

"What defines the best minds is their ability to go beyond the 'wisdom' of the crowd and mainstream opinion."

Andrew Keen

Another aspect to the web 2.0 phenomenon is anonymity and the lack of accountability that it creates. Andrew Keen argues "The most

corrosive thing of today's Internet is anonymity. That's what's creating such an uncivil world. It's a pre-social contract place. It's a state of nature. We're not behaving ourselves properly on it, very often because we don't reveal who we are. ...So one beginning, one place to start for all of us is to recognize that we don't need to be anonymous on the Internet. We can reveal who we are. And having revealed who we are, I think the conversation will be more mature, more responsible, and more fruitful for everybody." (Keen) In web 2.0 and its product design derivatives, who is accountable for the flaws of a product's design? Like the internet, the firewall of the corporation protects the individual from the inept and possibly harmful repercussions of his design decisions. Now the onus is on the consumer, who is not an expert, to evaluate the safety, performance, reliability, and ergonomics of a product, relieving the producer of this responsibility.

"According to the Better Business Bureau's Gary Almond, if you buy a defective product, you know who's to blame? You are, for not doing more research."

Cash Peters (American Public Radio's Marketplace, May 10th, 2010)

What is the effect on the overall quality of the artifacts of design and of the designers who produce them? It invests the producer in the ignorance of the consumer rather than the quality of his product, for the more willing the consumer is to accept the inferior, the less a producer has to spend to develop a quality product. Who is responsible in this situation? The producer who is creating inferior products at the behest of market demand, or the consumer who is demanding more of what he sees on the market and in ads? For example, the Big Three continue to claim (truthfully) that the market *demands* SUVs while simultaneously pouring money into the marketing of... SUVs. They ask consumers what they want while simultaneously *telling* consumers what they *should* want through advertising. Crowdsourcing is the inevitable evolution of "user centered"[4] design—an attempt to eliminate the middle man and go straight to the mob for product solutions.

Crowdsourcing may lessen the short term cost of innovation, but the long term cost of lost expertise and lowered standards will outstrip these savings. "The idea that content on the web is 'free' is mistaken: the hidden cost may be the demise of old media and entire art forms on which the free content depends." (Keen) In Indra's net, where all things are connected, degradation of this kind in the field of information as well as product design will be both catastrophic and self-accelerating.

The Segway P.U.M.A., an attempt to inject usability into the Segway platform through a series of functional add-ons that still miss the point.

Philosophy for Slow Transportation Design

Like everything in Indra's Net, the philosophies mentioned above are intertwined. They are all part of a single, greater mindset that is poisoning our society. This larger condition has no single name, but its effects are everywhere, evident in the dwindling quality (not length) of American lives. Obesity, type 2 diabetes, hypertension, smog, traffic congestion, McDonald's, large scale salmonella poisonings, Wal-Mart, strip malls and oil spills—These are a few of the discrete symptoms that appear on occasion, like tumors to indicate the presence of a deep and underlying cancer. Philosophies and ideals like user centered design, economies of scale and crowdsourcing are all part of, not solutions to, the problem; they cannot be harnessed to produce a beneficial and appropriate system for intracity mobility nor for any other purpose other than the long term degradation of human quality of life. As the fossil record of sustainable mobility has shown (and will show) with attempts that include the Segway, the Segway P.U.M.A. and many others, the problems of today will not be solved by the ideas that created them.

Slow Design attempts a more targeted, thoughtful approach to product design, jettisoning the "wisdom" of crowds, economies of scale and the safety of a lack of accountability. Applied to transportation, the slow philosophy would produce a vehicle with the following characteristics:

1. It would combat the trend toward obesity and poor physiological and psychological health by exploiting natural, human energy and creating a positive, engaged commuter experience.

2. To reinforce diversified, local economies, a slow vehicle would be designed to eliminate the capital expense of tooling, relying on cleverness of design (rather than economies of scale) to generate desire and profit.

3. A slow vehicle would empower its human user, leveraging design thinking to provide utility outputs that exceed its material inputs.

4. The design of a slow vehicle would educate the consumer through obviousness of function and adaptive design. It would foster curiosity and the desire to adapt it to the individual aesthetic, functional or reflective desires of its user.

5. A slow vehicle would be designed, tested, marketed and sold by an accountable party—a company or individual that is responsible for the repercussions of its actions.

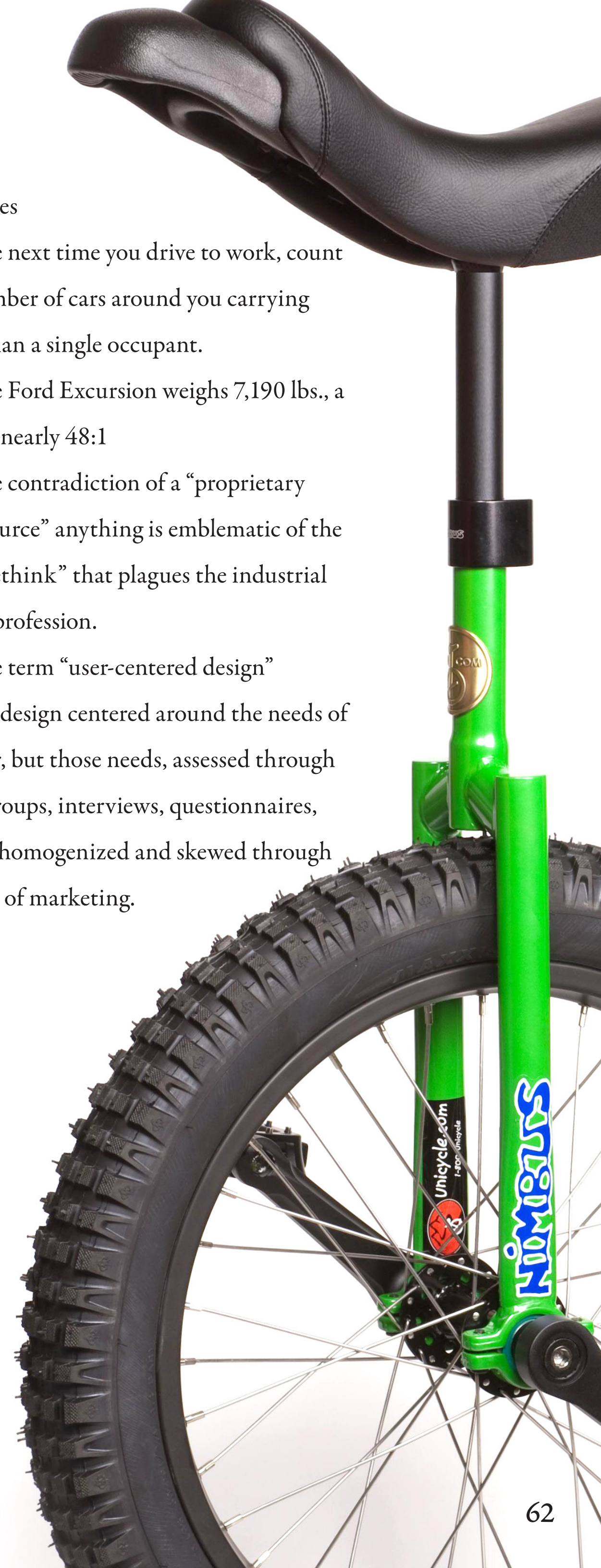
Endnotes

1 The next time you drive to work, count the number of cars around you carrying more than a single occupant.

2 The Ford Excursion weighs 7,190 lbs., a ratio of nearly 48:1

3 The contradiction of a "proprietary open source" anything is emblematic of the "doublethink" that plagues the industrial design profession.

4 The term "user-centered design" implies design centered around the needs of the user, but those needs, assessed through focus groups, interviews, questionnaires, etc. are homogenized and skewed through the lens of marketing.



the noblest invention

There is already a vehicle that embodies many of the ideals of the slow philosophy. Called "the noblest invention," the bicycle is the purest, greenest, and most efficient transportation device ever conceived. It is designed for disassembly, requires only food for power, provides valuable exercise and is made almost entirely of recyclable technical nutrients.[1] The bicycle is truly a slow method of transportation (though not always in both meanings of the word). It is empowering, healthful, and its function is obvious. In its simplest form, the fixed gear bicycle is the very embodiment of Occam's razor.

When compared to the automobile, however, the bicycle falls far short in the areas of speed, safety, storage and accoutrements. This gap, usually filled through the heavy application of fossil fuels and over-design, represents a giant area of opportunity for the development of a device that balances the elegant simplicity of the bicycle with the performance of the automobile. Tempered by the principle of slow design, such a device would offer a truly sustainable alternative for short range automotive travel.

The "Safety"

The simple mechanisms and disproportionate functionality of the bicycle has provided fertile ground for amateur and professional inventors since the unveiling of the first Draisine in the early 19th century. Some of its earliest descendants—the majestic "hi-wheelers" of the Victorian period, were recognizable as the modern bicycle's ancestor, but their simple, clunky drive train was cumbersome. It had yet to provide the *mechanical advantage* that would launch the bicycle as the most popular, efficient and elegant vehicle in history—the *safety* bicycle (so named due to the high riding attitude and unstable nature of its predecessor, the *ordinary*)[2]. This simple combination of elemental machines is the embodiment of everything that the *slow* methodology represents. Its purity, simplicity, and elegance is the perfect union of art and engineering—the baseline to which product designers should, but do not, aspire.

Today, when someone mentions the word "bicycle," the "safety" is what springs to mind. This "noblest invention" has existed in a recognizable form since 1885 when John Kemp Starley's Rover, a chain-driven[3] "safety" bicycle "overtook all other cycles on the road" (Herlihy 251). Since then, the simplicity and affordability of the bicycle has provided fertile ground for constant experimentation, contributing directly to the emerging automotive, motorcycle, and aircraft industries[4]. Within the framework of the bicycle itself, though thousands of iterations and refinements have been attempted[5], the modern bicycle has experienced only nuanced change since the last days of the 1890's, the so-called *Golden Age of Bicycles*. Though modern, upright bicycles have evolved to become lighter, stiffer, stronger, easier to use and more efficient, no casual cyclist could identify any lasting *revolutionary* change since the invention of derailleurs and pneumatic tires in the late 19th century.

Despite exponential advances in technology, this victorian era conveyance is ridden in nearly every corner of the world and in most parts, far more than in the U.S. where the boom era of cycling gave way to the motorcycle and automobile shortly after the onset of the industrial age.

"Even as the public eagerly awaited affordable automobiles, it rightly regarded the safety bicycle as one of the great technical and social contributions of the Victorian Age. And although the humble bicycle would never again rule the road as it had in the last quarter of the the nineteenth century, it offered new and compelling opportunities for technical and commercial development."

- David Herlihy, Bicycle

The rapid rise of the automobile cast a long shadow over the development of the bicycle in the U.S., and modern American cities are built around its advance. Except for occasional increases, particularly surrounding historical war-time suspensions of automobile production, American demand for utilitarian (commuter) bikes pales compared to that of other Western countries. "Recent figures show that they [Americans] make less than 1 percent of all urban trips by bicycle, compared with European rates ranging from 5 percent in Italy to 30 percent in the Netherlands." (Herlihy 340) And developing nations like India and China still rely heavily on a bicycle-based transportation infrastructure. China's bicycle fleet alone represents "a third of the world's total", a figure that, in 1990, "approached a billion bicycles."

Though occasional flare-ups of interest in utilitarian cycling have occurred, the American love of the automobile (and the fact that our cities cater specifically to that love) has left the American cycling scene dominated almost entirely by recreational and/or fitness bicycles—toys

The Velocar

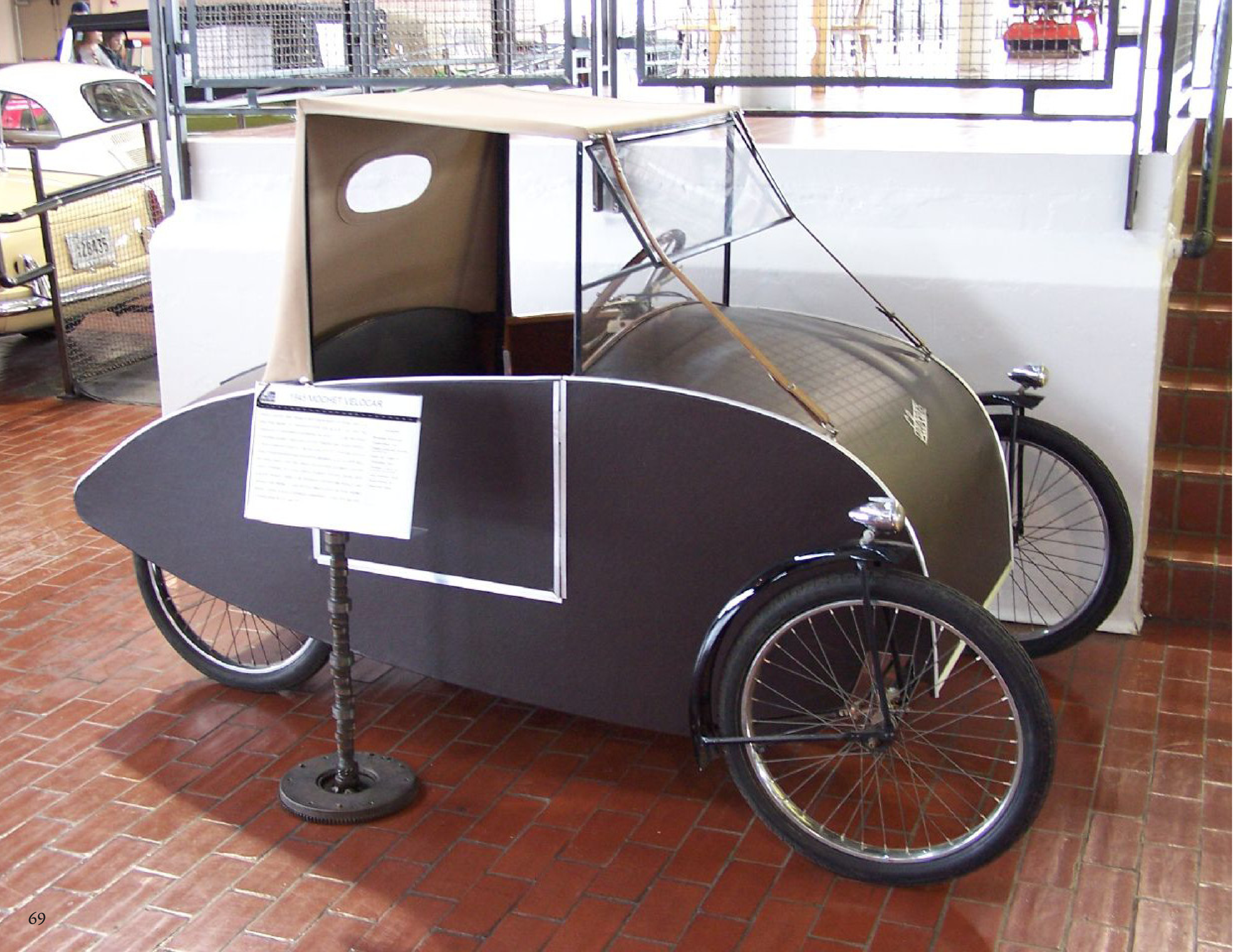
The gas shortages and Environmental Movement of the 1970s sparked one such resurgence in utilitarian cycling, and it was during this time that the recumbent bike (a cycle ridden in a semi-reclining position), one of the few *truly* revolutionary departures from the (now) conventional bicycle, made its most recent and lasting comeback.

Because of its low stance and the semi-reclining position of its rider, the recumbent bike is much more aerodynamic than the upright, conventional bicycle, and aerodynamics, not weight, is the critical factor to bicycle speed. "On a flat road, aerodynamic drag is by far the greatest barrier to a cyclist's speed, accounting for 70 to 90 percent of the resistance felt when pedaling. The only greater obstacle is climbing up a hill" (http://www.exploratorium.edu} As such, the smaller wind profile of the recumbent can provide speeds "significantly faster than a conventional bicycle, with drag reduced by as much as 50 percent." (Herlihy 409)

The recumbent also puts the user in a far more powerful attitude, ergonomically, providing a seat back against which to more efficiently transmit muscle power to his/her pedals. An upright cyclist can generate no more force against his pedals than his arms have to keep him attached to the bike.

Through all these advantages, the recumbent appears to be the superior conveyance. (A faired recumbent bicycle even holds the current record of 81 mph for a land-based human-powered vehicle.) Despite this evidence, the recumbent bicycle has received little acceptance from the cycling mainstream.

With near religious zeal, conventional bicycle advocates accuse recumbents of being "slow climbers" (the 81 mph record was set on flat land), heavy, expensive and poorly maneuverable. After writing about the speed advantages of the recumbent bicycle, David V. Herlihy goes on to write "Even proponents, however, admit that the most advanced racing recumbents, which place the cyclist's back just inches off the ground, are not practical for everyday use." He, like many upright cyclists ignores the fact that conventional *racing* bicycles are equally inappropriate for the same purpose. He continues " it appears unlikely that recumbents of any style will win road supremacy, at least in the near future. Besides being more expensive[6], the stretched-out models require more storage space than conventional bicycles, a significant drawback for cramped urbanites. Recumbents are also more difficult to maneuver in traffic, and their superior speed on the open road does not offer great advantage for short hauls in the city. But even if recumbents do not replace



the conventional bicycle as a utilitarian vehicle, they could conceivably gain a much larger share of the recreational market. After all, their superior speed allows the tourist to cover more ground with less effort."

The same criticisms lodged against the recumbent as a bicycle also make it perfect as a human-powered commuter. This is because, though it may be superior in many ways from a performance standpoint, the recumbent bicycle was not originally designed for racing. Conceived as a low cost alternative to the early automobile, Charles Mochet designed the Velocar as a four-wheeled, social tandem (riders sat side-by-side). His son George created the first two-wheeled version and, perhaps to the detriment of this new class of vehicles, adapted it for racing use. On July 15th, 1933, amateur racer Francis Faure shattered the one-hour distance record held by Oscar Egg, covering 27.9 miles in one hour.

Faure so devastated the existing record that "five years would pass before a racer on an 'ordinary' racing bike was able to reach an average of 28 mph." (Fehlau 10) Soon after, the recumbent bicycle was excluded from all official races of the UCI (Union Cycliste Internationale) then the governing body of continental bicycle racing.

Had the original *Velocar* not been set to compete in governed bicycle racing, recumbent cycles may have retained their original purpose, evolving to the same level of performance that the diamond frame upright bike enjoys today. Instead, recumbent riders doggedly pursued the standards of a racing tradition that didn't want them. In the years since that initial race, and particularly since the founding of the International Human Powered Vehicle Association (IHPVA) in the 1970s, riders created their own categories and racing clubs, adopting the same developmental path as their conventional cousins.

A photographic illustration showing the frontal wind profile of different rider configurations on an upright and recumbent bike.

What of the *Velocar's* original purpose, to provide a low cost alternative to the automobile?

The standard model *Velocar* incorporated many innovations and accessories that made it ideal for transportation use. It had a practical 22" seat height, a universal joint to provide simple, responsive steering, a simple two speed transmission, high bottom bracket (for a smaller wind profile), dual fenders, and a luggage rack. Updated with modern manufacturing and materials, this nonagenarian design would, from a functional standpoint, likely prove superior to its conventional counterparts. Compared to a car, it would provide several benefits, including: less pollution, less noise, low weight, low operating costs, increased community, and beneficial exercise. It's disadvantages would include diminished speed; reduced comfort, safety[7], and storage capacity; and of course, it has to be pedaled. What would a modern Velocar look like?

The Velomobile

The word "velomobile" is a play on the word "automobile" and describes a cross between a bicycle and a car. Virtually unheard of in the United States, velomobiles fill the gap between bicycle and car by combining a stable tricycle frame with an aerodynamic fairing to add speed, storage, and weather protection to the efficiency and low cost of a human-powered drive train.

Velomobiles are ridden and manufactured primarily in the Netherlands and Germany[8], where a surprising number of manufacturers exist. Models sell for as little as $4K and as much as $25K and range from the practical but heavy *Leitra* to the elegant *Quest*. Adapted with a mechanical assist, these devices could catalyze many American commuters to abandon their cars and commute by velomobile, possibly as a bridge to even lighter (ecologically and physically) methods of transportation, such as the bicycle.

Competitive Analysis

As a light and efficient class of vehicles, the velomobile seemed a perfect area in which to innovate toward a sustainable mobility alternative. In preparation for the design of such a vehicle, I undertook a competitive analysis in 2008 to study the characteristics, advantages and disadvantages of this small group of competitors. The goal was to uncover the reasons for the limited acceptance of velomobiles in the U.S. and to reveal any product opportunity gaps left unfilled by existing products. Below is a list of competitors including the characteristics that, in part, define their designs.

This list includes most, if not all, practical velomobiles available from a manufacturer. It does not include the array of homebuilt velomobiles, nor does it include the faired models designed for breaking speed records. In this list there are only two velomobiles that come with a built in electric assist. There is also only one dual occupant vehicle—the Twike. (Due to its much larger size and weight, beefier scooter components, and dual occupancy, the Twike may not fall within this line of vehicles. It may simply serve as a bookend describing the outer limit of the velomobile class.)

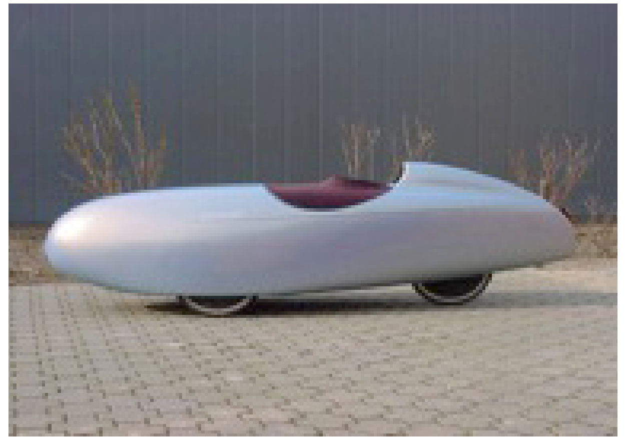
Name: Aerorider
Company: Aerorider
Base Price: $9,284*
Dealers: Belgium, New Zealand, Netherlands, South Korea
Occupancy: 1 driver
Format: Three-wheel Tad-pole
Steering: Dual Lever
Material: Fiberglass
Luggage Capacity: 120L
Assist: Standard
Top Speed (assist): 30mph
Range on batteries: 12-50 miles*
Add-ons: NiMH batteries
Weight: 132 lbs. w/o batteries
Wheelbase: 50 in

Name: WAW
Company: Fietser
Base Price: $8,987*
Dealers: Canada, Germany, Netherlands, Denmark
Occupancy: 1 driver
Format: Three-wheel Tadpole
Steering: Dual Lever
Material: Kevlar
Luggage Capacity: Large
Assist: Aftermarket
Add-ons: BionX Electric Assist
Weight: 53 - 77 lbs.
Wheelbase: 51 in.
Track Width: 29.5 in.

Name: Sorcerer
Company: TriSled
Base Price: ?
Dealers: Manufacturer
Occupancy: 1 driver
Format: Three-wheel Tadpole
Steering:
Material: Fiberglass
Luggage Capacity: 60L
Assist: N/A
Add-ons: N/A
Weight: 57 lbs.
Wheelbase: 41 in.
Track Width: 24.4 in.

Name: Stormy Weather
Company: Lightfoot Cycles
Base Price: $6,500 - 7,000
Dealers: Canada, Montana
Occupancy: 1 driver
Format: Three-wheel Delta
Luggage Capacity: 140L
Assist: Aftermarket
Add-ons: Electric Assist, Hitch, Tandem Conversion
Weight: 75 lbs.
Wheelbase: 67 in.
Track Width:

Name: Mango
Company: Go-Mango
Base Price:
Dealers: Netherlands, Germany, Canada
Occupancy: 1 driver
Format: Three-wheel Tadpole
Luggage Capacity: Large
Assist: Aftermarket
Add-ons: Fabric Roof or Racing Top
Weight: 70.5 lbs. incl. battery for lights
Wheelbase: 50.4 in.



Name: Quest
Company: Velomobiel
Base Price: $8,803*
Dealers: Netherlands, Germany, Belgium
Occupancy: 1 driver
Format: Three-wheel Tadpole
Steering: Center Tiller
Material: Fiberglass
Luggage Capacity: Large
Assist: Aftermarket
Add-ons: Fabric Roof or Racing Top
Weight: 75 lbs. incl. battery for lights
Wheelbase: 48 in.

Name: Leitra
Company: Leitra
Base Price:
Dealers: ?
Occupancy: 1 driver
Format: Three-wheel Tadpole
Steering: Dual Lever
Material: FiberglassLuggage Capacity: 100L
Assist: Aftermarket
Add-ons: Built to specifications
Weight: 64 lbs.
Wheelbase: 35 in.
Track Width:

Name: Leiba Classis (X-Stream available 04.08)
Company: Leiba
Base Price: $7,248*
Dealers: Germany
Occupancy: 1 driver
Format: Three-wheel Tadpole
Steering: Center Tiller
Material: Fiberglass Monocoque
Luggage Capacity: Large
Assist: Aftermarket
Add-ons: Rohloff, Upholstery, Aero wheel covers
Weight: 77 lbs.
Wheelbase: 47 in.
Track Width: 31.5 in.

Name: Aurora
Company: Cambie Cycles (manufactured by Nimbus Kayaks)
Base Price: $6,500 canadian*
Dealers: British Columbia, CA
Occupancy: 1 driver
Format: Three-wheel Delta
Steering: Underseat
Material: Kevlar or Graphite/Vectran Monocoque Luggage Capacity: 120L
Assist: Aftermarket
Add-ons: Roof
Weight: 79.3 lbs.
Wheelbase: 63 in
Track Width: 31 in

Name: Alleweder A5 (A6 available soon)
Company: Alligt & Lohmeyer
Base Price: $5,615*
Dealers: Netherlands, Belgium, & US
Occupancy: 1 driver
Format: Tadpole
Steering: Center Tiller
Material: Aluminum
Luggage Capacity: 40L with lock
Assist: Aftermarket
Add-ons: Rohloff Hub
Weight: 70.5 lbs.

Name: Versatile
Company: Flevobike
Base Price: $11,485*
Dealers: ?
Occupancy: 1 driver
Format: Tadpole Trike
Steering: Dual Lever
Material: Twintex (recyclable)
Luggage Capacity: Large
Assist: Aftermarket
Add-ons: Trailer, Roof
Weight: 87 lbs.
Wheelbase: 49 in
Track Width: 29 in

Name: Butterfly
Company: Birkenstock Bicycles
Base Price: $29,761
Dealers: From manufacturer (only two made)
Occupancy: 1 driver
Format: Tadpole Trike
Steering: Dual Lever
Material: Composite
Luggage Capacity: 55L
Assist: Possibly Aftermarket
Weight: 75 lbs.
Wheelbase: 53 in
Track Width: 33.5 in

Name: Go-One3
Company: Beyss
Base Price: 10,342.92*
Dealers: Belgium, Switzerland, US
Occupancy: 1 driver
Format: Three-wheel Tadpole
Steering: Dual Lever
Material: Carbon/FiberglassLuggage
Capacity: 25-30L (divided)
Assist: After Market
Add-ons: Electric assist, panniers, lights, turn signals, Rohloff Hub, soft top... etc.
Weight: 66 lbs.
Wheelbase: 53 in
Track Width: 28 in

Name: Twike
Company: FineMobile
Base Price: $27,500*
Dealers: ?
Occupancy: 2 drivers
Format: Three-wheel Delta
Steering: Center Tiller
Material: Fiberglass
Luggage Capacity: Large
Assist: Standard
Top Speed w/ batteries: 53mph
Range on batteries: 80 miles
Add-ons: Heat, Upholstery

A few observations are:

1. The average unassisted velomobile weighs 78lbs.
2. 78% of velomobiles use a tadpole configuration (2 steering wheels in front, one in back).
3. 64% of the competition uses some form of canopy to decrease wind resistance and provide weather protection.
4. Less than 1% of the competitive models offer an on-the-fly conversion between enclosed and open top configurations. The rest are either open top or the user must find a place to stash his removable canopy.
5. All existing velomobiles are made of monstrous hybrids—composites that cannot be broken down into biological or technical nutrients.
6. The average price of an unassisted, single occupant velomobile is $10,638. (Without the inclusion of the *Butterfly*, the average is $8,247.)

The velomobile community is a niche within a niche (recumbent riders) within a niche (cyclists). Despite this, there are more than a dozen velomobile models on the market today. Why, then, are they viturally absent from U.S. streets? And what steps can be taken to make them more palatable to U.S. consumers?

A highly visible object, a velomobile designed for the U.S. market cold be a billboard for sustainable principles and a less-is-more approach to urban mobility. Instead, current velomobiles today are icons of the flaws that debase the sustainable design movement.

This brief competitive analysis reveals several areas for velomobile improvement:

1. All currently produced velomobiles are made of composite materials like fiberglass or carbon fiber—composites that form non-recyclable, non-biodegradable monstrous hybrids. A body designed for disassembly and made from reclaimable or recyclable technical or biological nutrients would greatly improve the sustainability of the velomobile's construction and disposal.
2. Though many are made of high performance composites, most velomobiles are surprisingly heavy—a problem for a purely human-powered vehicle. The use of lighter materials would improve the performance and range of the vehicle.
3. Though velomobiles should encourage new ridership, the challenge of pedaling a heavier bicycle often seems to outweigh the benefits. (The data shows that this is not the case, but the perception remains.) Many manufacturers adapt aftermarket kits to velomobile use, but the results are often poor. An integrated assist system would enable a range appropriate to an automotive replacement.
4. The use of composite bodies necessitates a capital investment in fiberglass molds. This type of manufacturing is more appropriate to products of high volume and infrequent change. Unlike the automobile, topographical and meteorological variability greatly effects the use of HPVs. A vehicle (and business model) aligned with this variability could be more sustainable and profitable.
5. Many velomobiles do not include a storage area. The ones that do often provide only a small trunk. A large, versatile storage area could enhance the usability of the vehicle.
6. Because of their low volumes and expensive fabrication method, velomobiles are often quite expensive to buy. Aligning the manufacturing of the body with the scale at which velomobiles are sold could help build demand for these vehicles by reducing their purchase price.

Most of the opportunities uncovered by this brief analysis point to the need for a modular, adaptable body made of separable technical or biological nutrients. This skin will need to retain the aerodynamic and weather protection properties of a composite body but with less weight—physically, ecologically and economically. Other opportunities include the integration of an assist kit and the need to lightweight the entire vehicle. Opportunities for light-weighting include the development of a lighter, more efficient drive train (tadpole trikes can use over 14' of steel bicycle chain and a series of idler pulleys, each of which produce mechanical drag) and the use of lighter materials for non structural components (like the outer skin of the vehicle which just has to provide rain protection and streamlining). A flatbed storage area would provide ample and versatile storage for an array of parcels.

Endnotes

1 This is not true of all bicycles. Many newer, performance models are made in non-reclaimable "monstrous hybrids" like carbon fiber, and several combine carbon components with metal frames.

2 Mark Twain famously suggested during the era of the Penny-farthing "Learn to ride a bicycle. You will not regret it if you live."

3 Previous bicycles, like the famous "Penny-farthing" had used a direct drive system harnessed directly to the front, steering wheel.

4 Henry Ford was a former bicycle mechanic, as were, famously, Orville and Wilbur Wright

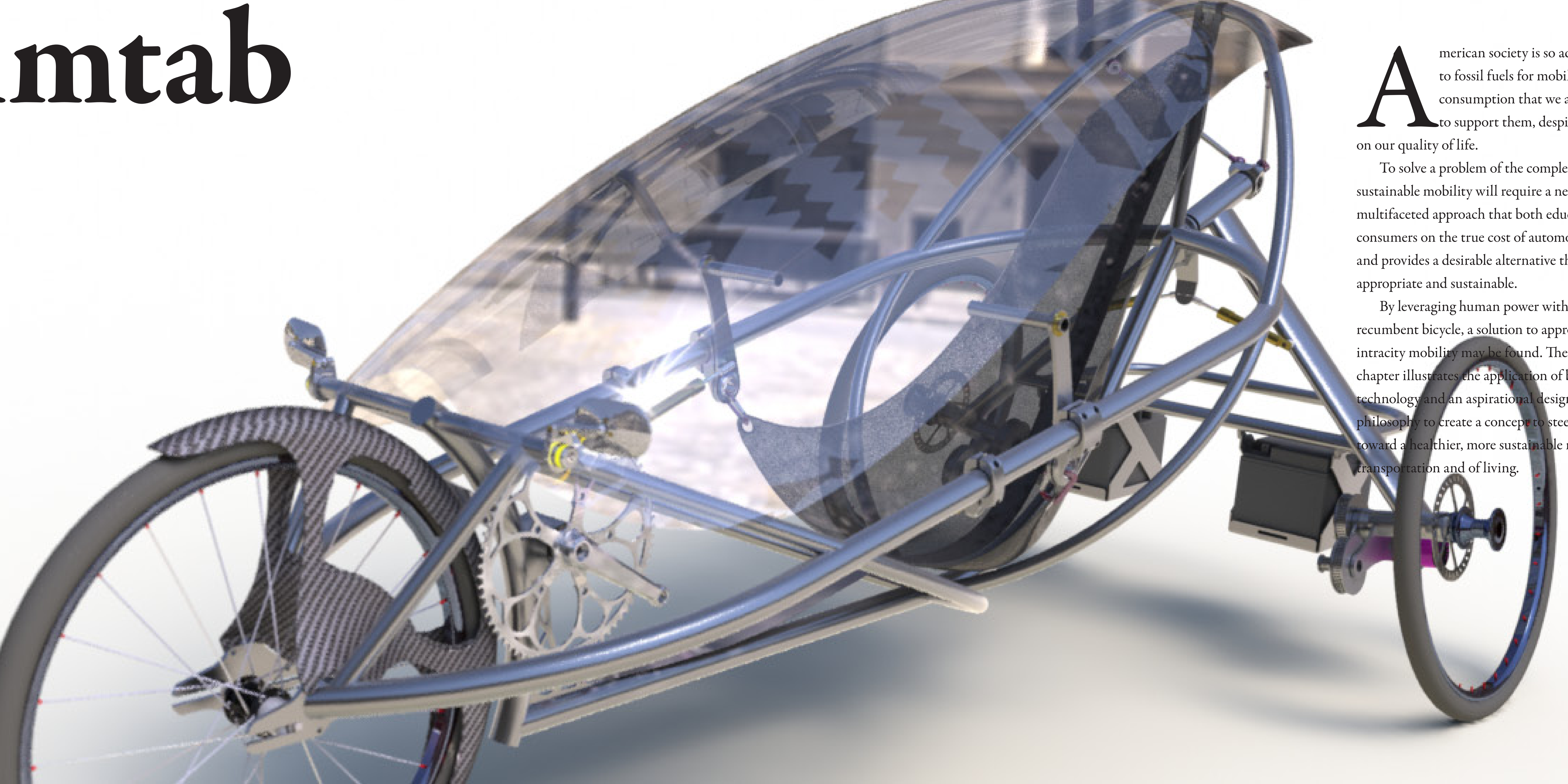
5 These include Albert Pope's chainless, shaft-drive bicycle, a concept that has been tried several times, to little success, before and since. The most recent installments are the products of Dynamic Bicycles.

6 The list price of the Orbea Orca 7900, an upright carbon fiber road bike is $6,714

7 Although, it would only be less safe than a car if surrounded by cars. Today, the only way to be safer is to be bigger. What if we designed cars to be of comparable size across the board?

8 There is one American manufacturer slated to begin production in 2010.

the trimtab

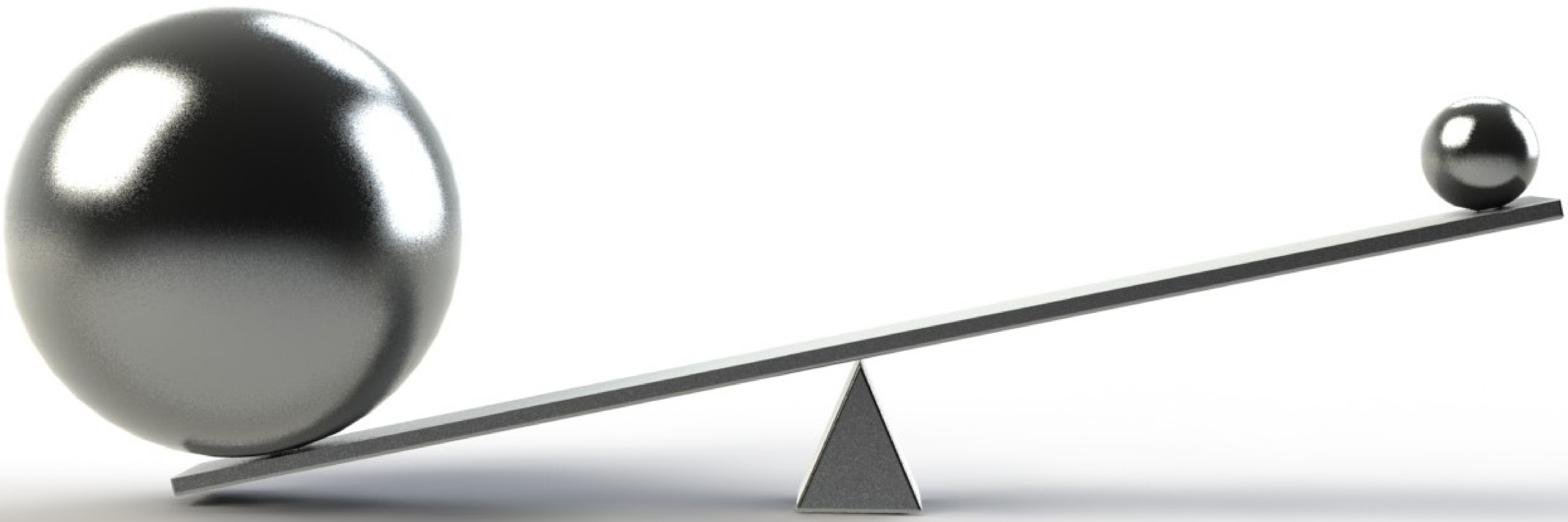


American society is so addicted to fossil fuels for mobility and consumption that we actively fight to support them, despite their toll on our quality of life.

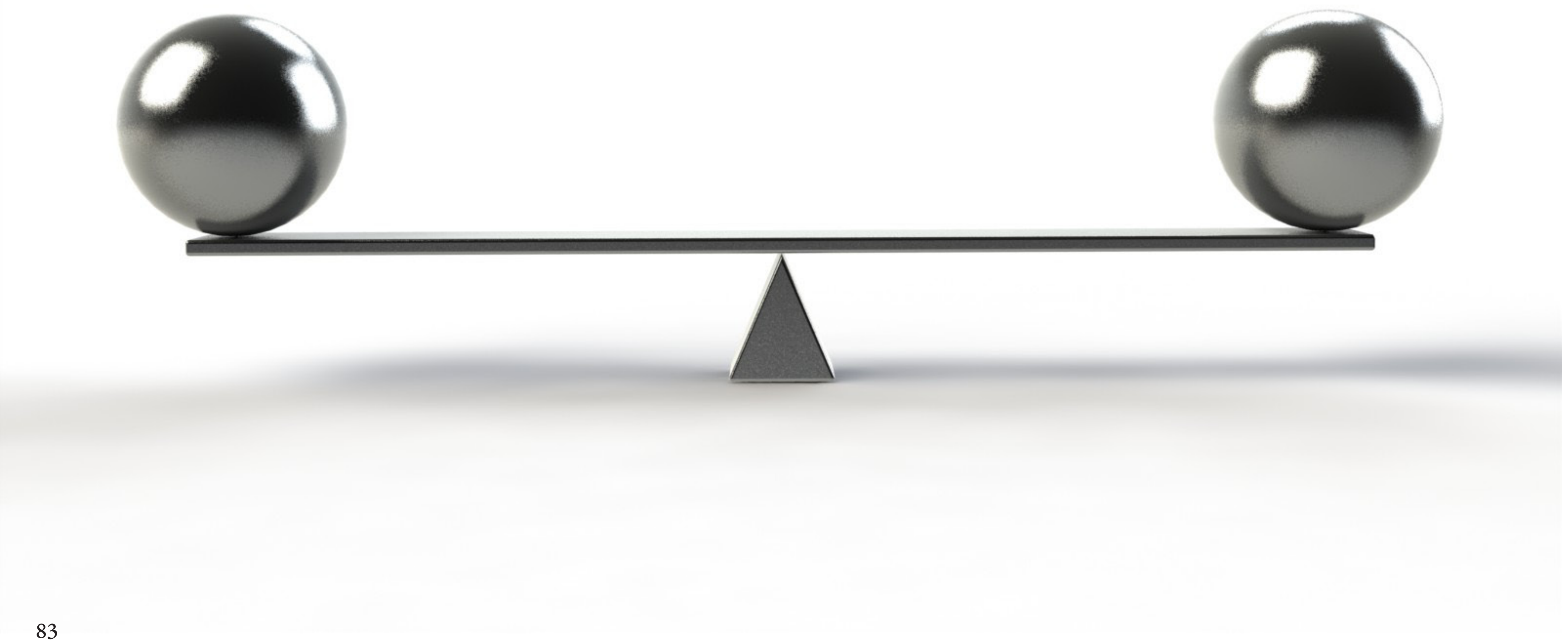
To solve a problem of the complexity of sustainable mobility will require a networked, multifaceted approach that both eductates consumers on the true cost of automotive mobility and provides a desirable alternative that is simpler, appropriate and sustainable.

By leveraging human power with the recumbent bicycle, a solution to appropriate intracity mobility may be found. The following chapter illustrates the application of bicycle technology and an aspirational design philosophy to create a concept to steer humans toward a healthier, more sustainable method of transportation and of living.

Problem Statement



To design a human-powered vehicle, for transportation, that overcomes the obstacles that prevent conventional bicycles from being adopted by a sedentary population.



Trimtab 3X3

The Trimtab 3X3 is the first vehicle model to be produced by the Revolution Cycle Company, but it is far from ideal; it is a necessary compromise. The complexity of the transportation problem requires more than a single, product solution. An ideal solution would be purely human-powered[2] and part of a larger network of diverse mobility platforms. The missing component, however, is a better human. Until a human is ready to make the transition to purely human powered mobility, the ideal solution will have to wait. In the meantime, the Trimtab 3X3 represents a catalyst toward the creation of that better human. Like its namesake, Trimtab is designed to facilitate a faster transition toward a sustainable mobility future built around the intertwined needs of transportation, human healthfulness and quality-of-life. Described below are the characteristics of the Trimtab 3X3 in the context of the constraints around which it was designed: the functional needs of its target market, the geographical challenges of its area, the financial needs of the business, and the need to integrate these into a sustainable whole.

The Target Market

Trimtab is designed for the average American between 30 and 59 years old who commutes to a full time job. In 2005, this commuter drove an average of 33 miles between work and home each day" (U.S. News) and spent approximately 48 minutes driving between home and work. The time spent at work and commuting leaves him little time to cook and enjoy a meal with his family, let alone get the hour of daily exercise recommended by the Surgeon General. He often eats convenient but unhealthy meals on the way to and from work, and is now approximately 40 lbs. overweight. His resulting lack of energy and physique is frustrating both his children, with whom he is often too tired to play and his wife, who never imagined herself married to a fat man. His diet and lifestyle have drastically increased his risk for Type 2 diabetes and heart disease.

The Concept

Trimtab is a vehicle designed to fill the functional gap between the bicycle and the car. Trimtab is intended to act as a catalyst by aiding commuters who would consider cycling as a means of transportation, but are not fit or motivated enough to do so. Designed as "Slow" transportation, the Trimtab is intended to provide maximum functional "leverage" with minimal environmental affect. It achieves this at a product level through minimization of materials, design for modularity and disassembly, light weighting, using fuel storage that can be charged renewably, and harnessing human power. On a system level, Trimtab approaches sustainability by creating better, more sustainable humans through fitness, education and empowerment.

To appeal to a market that is currently unable or unwilling to abandon the automobile for intracity travel, this concept addresses four main roadblocks to bicycle travel identified by users: speed,storage, weather protection, and exertion. Though the following paragraphs are organized by the problems they solve, the solution presented represents a new approach to intracity mobility that is more than the sum of the problems it solves. The concept was designed not to build on those problems but on the corporeal experience—the exhilaration, empowerment, and authenticity—of cycling, adding to it the benefits of appropriate design. Through the Slow Design methodology, Trimtab benefits and *improves* its user, community, and environment by providing appropriate mobility. Ultimately, it is intended to transition a demographic of overweight, complacent commuters into fit, active, discerning and empowered members of the community.

The Trimtab is, fundamentally, a riff on the velomobile, a class of vehicles that is perfect for this application for several reasons:

The velomobile is uniquely positioned exactly between a car and a bicycle with a historical attribute (its origin) that lends reflective value. Velomobiles are almost exclusively single occupant vehicles, making them more appropriate for the vast majority of commuter trips.
Because it is essentially an enhanced bicycle, the velomobile is not yet plagued by the oversight that governs automobiles, scooters, and motorcycles, making it inexpensive (and less annoying) to park, insure, license and operate.
The market for velomobiles in the United States is wide open, with only a few European models (and exactly one American version) available. The market remains small because velomobiles, to date, have been poorly designed for the needs of the average American commuter, providing a unique product opportunity gap.

Speed

The average cyclist can generate 200 W of power on a conventional bicycle, or about ¼ horsepower and travel between 10 and 30 miles per hour. (Wilson) To maintain a safe speed, a vehicle designed for intracity travel must be capable of at least 25 mph, continuously, for mobility on urban streets. Trimtab uses two methods for achieving the necessary speed for intracity mobility, aerodynamics and stored energy.

"Mathematically, drag created by air resistance

The Track Bicycle

Simple, clean, human powered. The track bicycle is the purest form of assisted transporation.

The Velomobile

An unassisted recumbent trike coupled with an aerodynamic shell to create a low impact automotive alternative.

The Electric Bicycle

Combining the efficiency of human power with an electric assist, the electric bike adds a small amount of complexity and carbon to achieve huge usability benefits.

The Electric Scooter

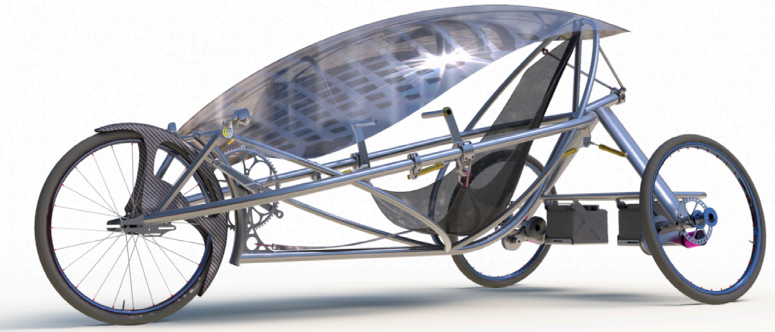
No human power, but the simple drivetrain and light weight of modern electric scooters offer a viable errand running alternative to automotive transportation.

The Smart Fortwo

The best of the automotive genus, the Smart Fortwo is the simplest modern car produced today. It uses a simple internal combustion engine and smart design to deliver safe, reliable two occupant transportation within the automotive format.

The Lowracer Recumbent

Low profile, fast and purely human powered. The lowracer harnesses the enhanced aerodynamics and biody mechanics of a recumbent to generate higher speeds from the same amount of human energy.



The Trimtab 3X3

The Trimtab falls somewhere between the car and the bicycle, It combines the efficiency, light weight, single occupancy and aerodynamics of a recumbent bicycle; the shelter and enhanced aerodynamics of a velomobile; and the electric assist of an e-bike to deliver near the performance of an automobile but at a much lower, less impactful scale.

The Twike

The twike offers two passenger transportation, shelter and storage. The large carbon footprint of its fiberglass body, scooter components and Lithium Polymer batteries is partially offset by a human-assisted hybrid drivetrain.

The Segway

The Segway combines extremely complex technology, heavy weight, and a high price tag to accomplish less than that of the average bicycle. It provides low speeds, no shelter, no storage, and cannot be operated on the street or sidewalk.`

increases as the velocity squared. However, the power or energy expenditure to overcome resistance during cycling increases as the velocity cubed. Thus, as velocity increases, an exponentially greater level of power must be produced in order to attain that speed." (Seifert 50) At any speed greater than 20 mph, a cyclist can expend over 80% of his energy to overcome his own wind resistance. (Wilson 126)

A tandem bicycle combines improved aerodynamics with additional horsepower to achieve a 10% improvement over a single rider bicycle. " Tandems have 50% less wind resistance than two single bicycles. ... tandem riders use 20% less power per rider than two separate cyclists when cycling at the same velocity. In essence, the stoker (rear position) is drafting off of the captain (front position) while contributing to power output and adding minimally, if at all, to air resistance." (Seifert 50)

The Trimtab harnesses the same idea—reducing drag and adding power—to achieve speeds greater than the average bicycle and closer to those of cars traveling in urban areas. Its design reduces drag by incorporating aerodynamic features, including a stretched nylon fairing, aerodynamic canopy and a recumbent cycling position. Additional power comes from a pair of rear-mounted assist motors providing 4400 W of high torque power for under 70 lbs. of additional weight. (Compare this to a tandem at 200 W for 150 lbs.) The higher speeds possible through this arrangement allows the Trimtab to keep up in traffic, providing greater speed, safety, convenience and versatility.

Storage

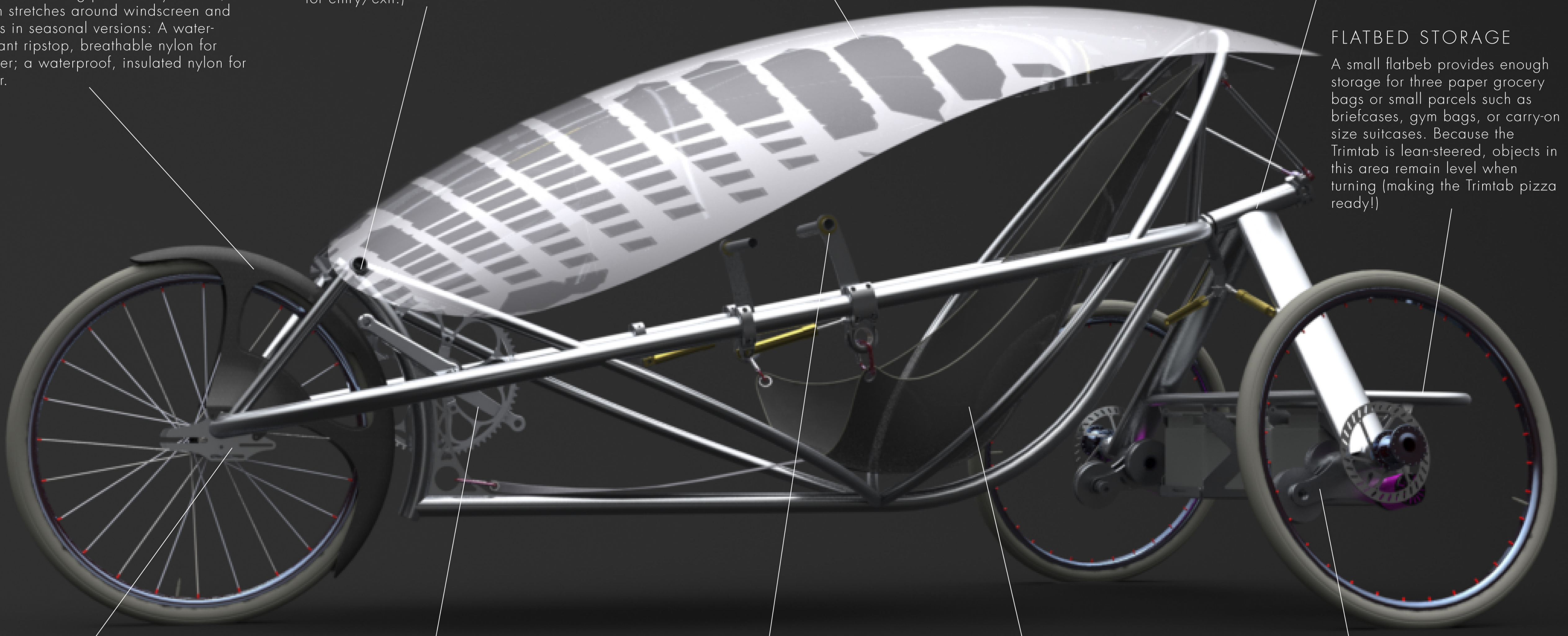
The inability to haul more than the smallest loads

$$P = gmV_g\,(K_1{+}s) + K_2 \times V_a^2\, V_g$$

"Where P is in watts, g is Earth's gravity, V_g is ground speed (m/s), m is bike/rider mass in kg, s is the grade (m/m), and V_a is the rider's speed through the air (m/s). K_1 is a lumped constant for all frictional losses (tires, bearings, chain), and is generally reported with a value of 0.0053. K_2 is a lumped constant for aerodynamic drag and is generally reported with a value of 0.185 kg/m."

- Wikipedia, Bicycle Dynamics

on conventional bicycles is another roadblock to their adoption by the American commuter. Most commuters carry a purse, briefcase, backpack or coffee with them on the way to work, but most bicycles require panniers or a backpack to accommodate such cargo. Specialized accessories,



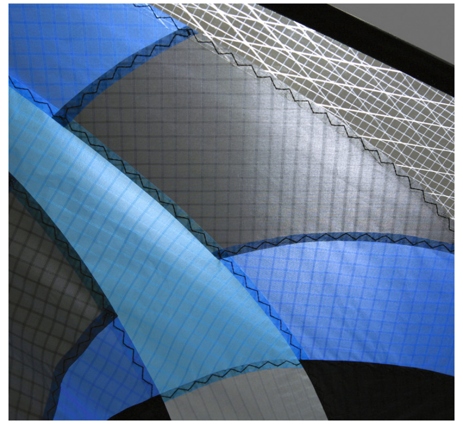
including trailers and racks, are required to haul loads of greater volume (e.g. groceries).

Trimtab incorporates a flatbed storage area that is large enough for three paper grocery bags, a briefcase or laptop bag, a small backpack, or similar load. Its position on the rear, non-leaning portion of the vehicle means that the load is not subject to tipping as on a conventional bicycle rack or single wheeled trailer (e.g. B.O.B. trailers). This allows users to haul open top loads, heavier loads, and even pizza!

Shelter

One of the most oft-cited excuses for not traveling by bicycle is that of weather protection. Precipitation can transform a pleasant ride into a wet, miserable ordeal. Competitive velomobiles use composite hard-shelled bodies and acrylic canopies for rain protection and aerodynamics. Built of rigid composites, it is often difficult to adapt these vehicles to changing daily and seasonal weather. In the summer, they become rolling greenhouses, slow cooking their users to inefficiency and exhaustion because "the heat-removal capacity of air surrounding a working human is a key factor in the duration of his effort." (Wilson 118) In the winter, their thin skins and open bottoms provide little in the way of insulation.

Trimtab overcomes the hurdle of rain protection with an aircraft style canopy, providing unhindered visibility and partial rain protection. To overcome the issue of seasonal and daily weather changes, Trimtab uses a unique, adaptable skin system inspired by single layer camping tents. These skins are stitched from two separate pieces (top and bottom) and can be stretched tight over the body to form an aerodynamic and protective barrier between the user and the elements: For the summer, a lightly colored, ripstop nylon reflects heat and provides breathability. For the winter, a sewn covering of Therm-a-rest®-style insulated air pads will provide a thin, light, insulated air gap to retain body heat and repel wind. Seating will be fabricated in a similar manner: mesh for the summer to keep the user's back cool, and inflatable pads for winter insulation.



Exertion

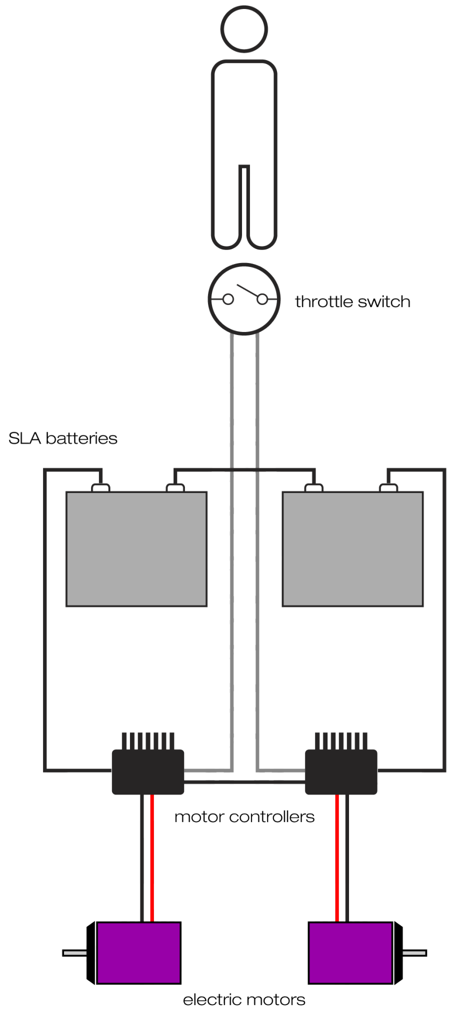
There is a sort of stiction (or static friction—the friction between two objects that are not moving relative to each other) that prevents humans from engaging in new behavior. In human powered transportation, the largest source of friction (that which prevents a user from cycling) is the fact that bicycles must be pedaled—they require *exertion* from the user. However, the exertion they require is also the biggest potential benefit to an increasingly obese market and nation.

In physics, once the initial, often very high, force of overcoming static friction is supplied, the amount of force required to *sustain* movement is relatively low. Unfortunately, many would-be commuters last only a few days before the initial shock of physical activity—exhaustion, sore backs, and sweaty rides—drives them back to their cars. Trimtab's integrated electric assist system facilitates the transition to healthy, zero impact bike commuting by providing much of that initial force, allowing the user to pedal as much as they can handle initially, to overcome the friction of a sedentary lifestyle. As the user gains fitness and confidence, the amount of effort required to sustain his newly athletic behavior will decrease, and he can reduce his reliance on the mechanical assist system.

The typical commute is never one-dimensional, affected, as are all things, by its context. A commuter with an early meeting may want to take it easy, avoiding a sweaty morning at the office; out for a weekend, the same commuter may want a serious workout or to race with friends. The adaptability of an integrated assist system allows the user to tailor his level of exertion to that which is appropriate to his situation, rather than forcing him into a one-size-fits-all approach to mobility.

The selection of an electircal powerplant was a difficult and frustrating decision due to the many environmental, economic and performance drawbacks of electrical energy storage systems. Many alternatives were considered, including: fossil fuel and pneumatic stored energy and hydraulic regeneration. This system is a compromise—think of it as a placeholder. At this time, it is simply the best technology for the job and provides the trimtab effect of steering commuters toward the ideal solution—pure human power.

Electrical Stored Energy

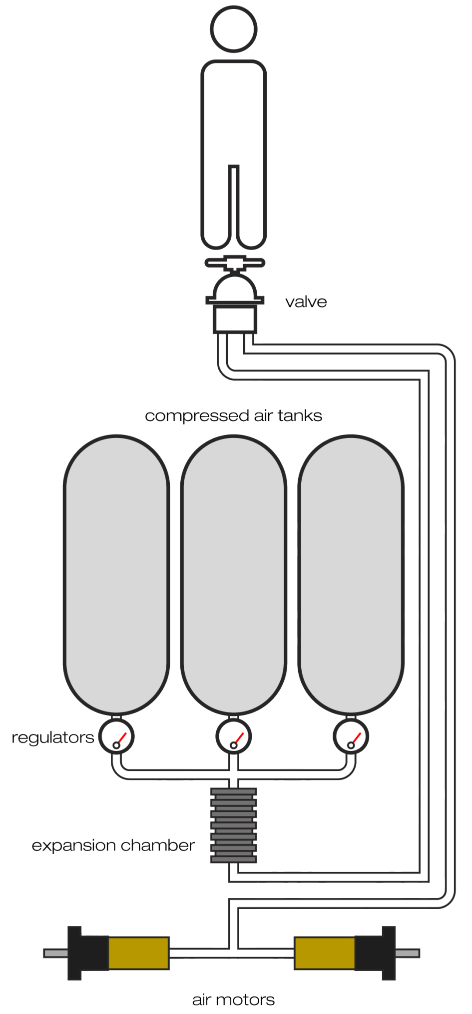


This system uses SLA (Sealed Lead Acid) batteries to power a pair of 3hp electric m otors. Despite their low power to weight ration, SLAs were selected for their low cost and recyclability.

This system is simple, adaptable and uses technology that is readily available and developing rapidly. A host of manufacturers now produce lightweight motors and programmable controllers that include regenerative braking, ramped acceleration, and rapid charging.

The weight (60 lbs.) and environmental impact of the batteries is staggering. However, this system presents the best compromise of cost, range, efficiency and ease of development.

Pneumatic Stored Energy

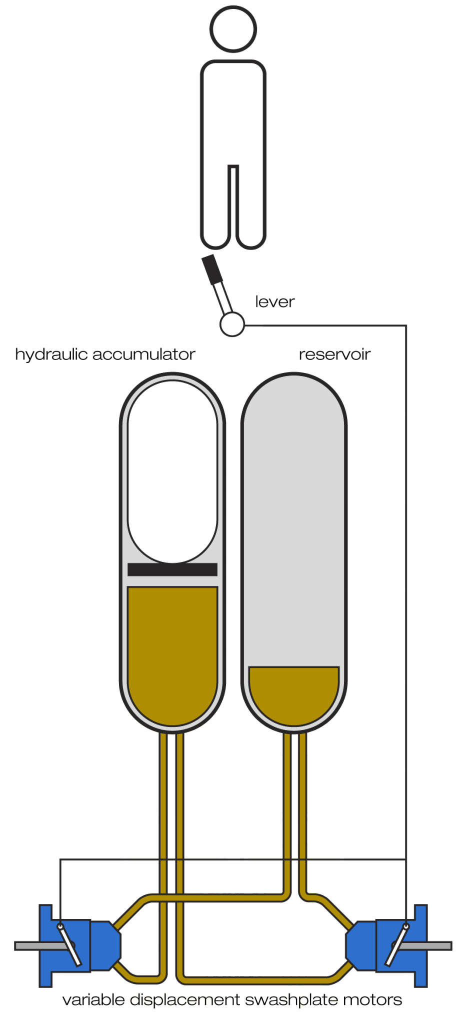


This system uses a series of high pressure (5000 PSI), fiber-wrapped compressed air tanks to power dual air motors. A handlebar mounted valve controls flow to the motors.

This system is extremely simple and uses a virtually non-disposable mechanical battery.

Compressed air was abandoned for several reasons. The inefficiency of available air motors (10- 30 CFM) and the small size of the vehicle necessitates the use of high pressure air tanks. These still provide only a very short run time, and present an explosion hazard if ruptured. Also, the enormous energy loss of compressing and releasing atmospheric air makes it an exceptionally inefficient battery. (Liquid CO2 or nitrogen could replace compressed air for a longer run time but with similar probelms of storage efficiency and explosion hazard.)

Hydraulic Regenerative



This is the most exciting system that was considered and is the only system that is not powered by grid energy. Instead, it acts as a mechanical battery for storing human energy. A user can charge an accumulator rapidly (while braking) or gradually (on a long flat), to be deployed when needed (on a hill). The key to this system is a pair of variable displacement swashplate hydraulic motors that provide propulsion, braking and energy storage.

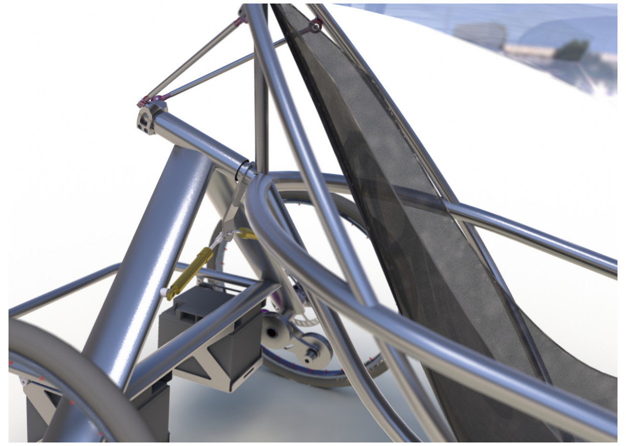
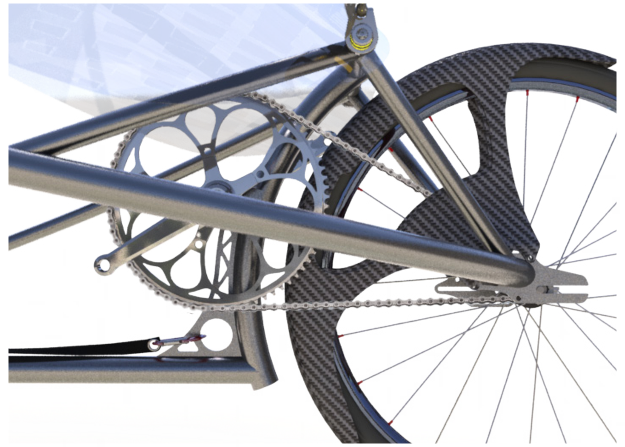
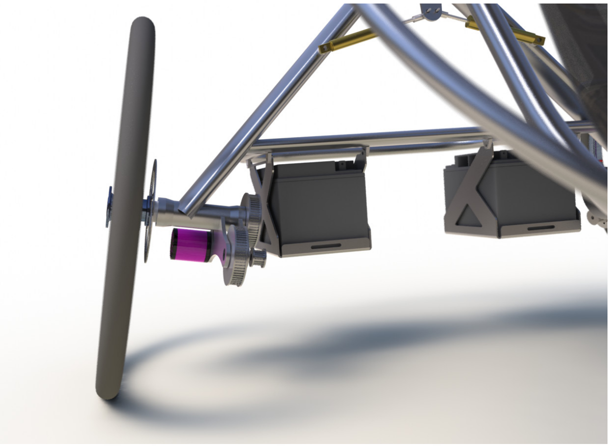
The benefits of this system are that it can be lightweight, completely self-contained, simple, mechanical and purely human-powered.

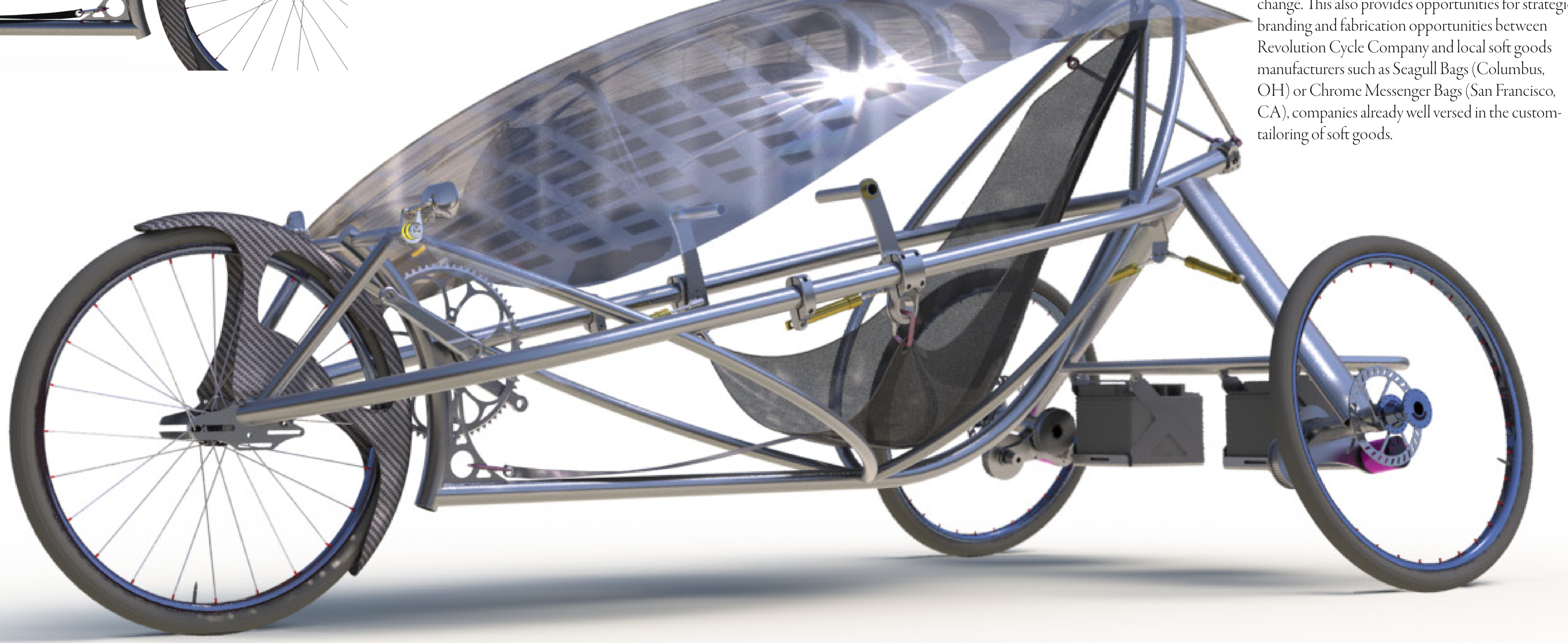
This system is untenable for this version of the Trimtab because components cannot be purchased to fit a vehicle of this small size. With further development ($), a motor and accumulator could be developed that would suit this purpose.

Integration & Additional Benefits

Like Indra's Net, every aspect of the Trimtab is intertwined, a condition made possible by the simplicity—the scale—at which Trimtab was designed, providing maximum functional leverage to the *target user*[3] while minimizing the negative affect of the transportation paradigm. This integration is evident in the way that every aspect of the design buttresses and is buttressed by other aspects of the design, at the component and/or functional level:

1. An acrylic windscreen provides aerodynamics and weather protection and is affixed to the body by a 1" diameter accessory bar (around which it pivots for ingress/egress). This bar is the same diameter as most bicycle handlebars and the perfect place to mount headlights, mirrors (which retain the windscreen), turn signals, horns and other accessories.
2. The same mechanism that delivers the full body experience of lean-steering also enables the use of a simple, FWD (front wheel drive) assembly, lightening the vehicle, simplifying and improving the efficiency of the drivetrain, and enabling the use of dual rear assist motors for 3X3 traction and power.
3. Cambered wheels enable and are enabled by the integrated hub/axles and assist motors of the rear drivetrain, providing cornering stability and wheel strength for relatively light weight (compared to that of a differential).
4. Secured to the frame by a thread-on freewheel, the integrated hub/axles provide stiff, lightweight power transmission from motors to wheels through a hollow aluminum shaft rather than the splined hub and heavy steel shaft of a conventional adult tricycle.
5. Interchangeable skins and seating mean that the components most likely to change are the cheapest and easiest to customize: colors and fabric types can be changed like clothing to adapt the skins and seating seasonally and to the customer's taste while minimizing the cost and ecological impact of that change. This also provides opportunities for strategic branding and fabrication opportunities between Revolution Cycle Company and local soft goods manufacturers such as Seagull Bags (Columbus, OH) or Chrome Messenger Bags (San Francisco, CA), companies already well versed in the custom-tailoring of soft goods.

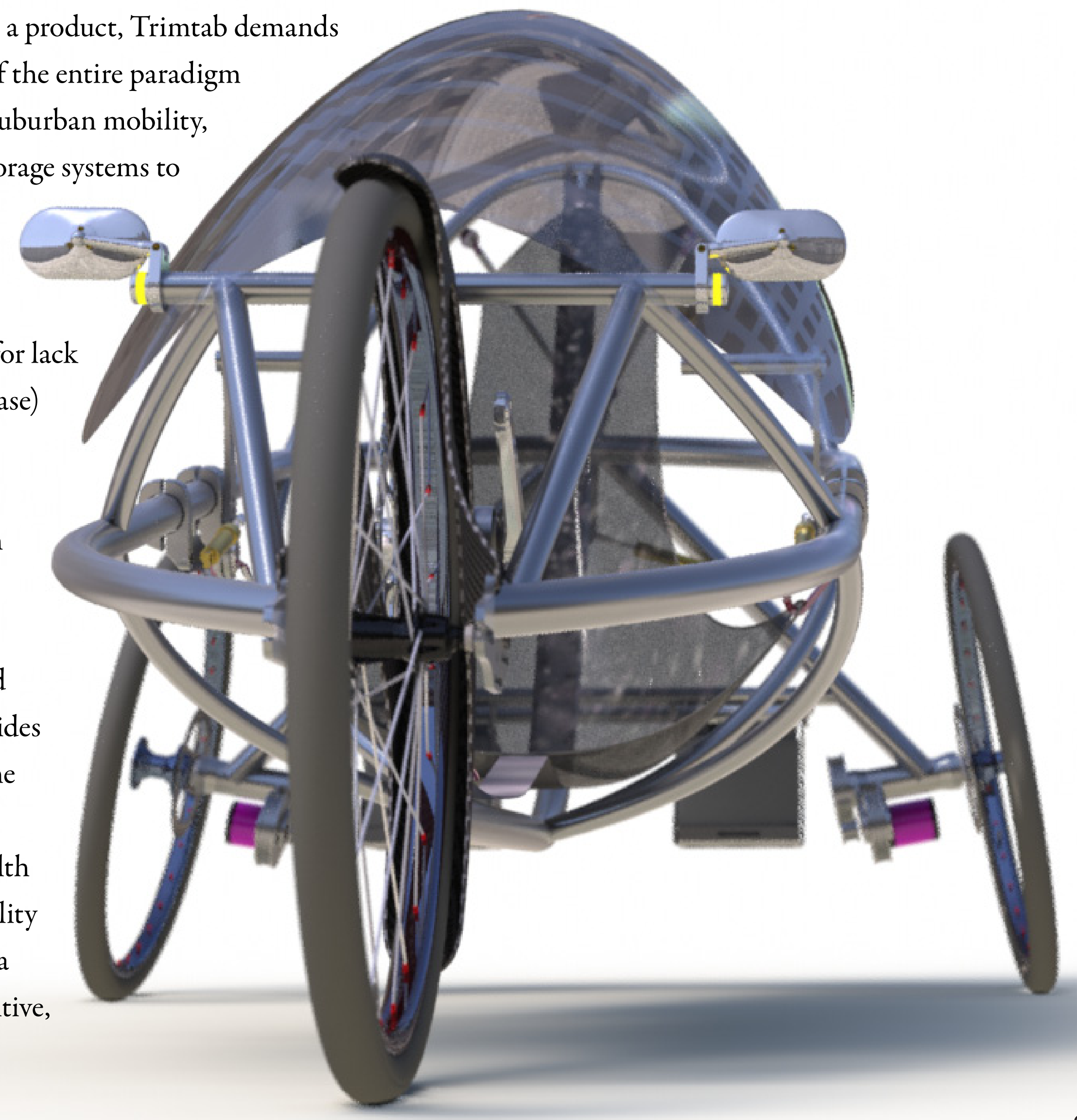






An additional benefit of the increased size, structure, visibility and speed of this vehicle is the added safety to be derived from those characteristics. Even with its tubular aluminum frame, roll bar and canopy, however, the Trimtab will never be as safe as a car, nor is it intended to be. A vehicle can have a dozen or a million airbags, but in the end, mass wins. To manufacture a safe car today means to make a vehicle that is heavier than anything else on the road. In the spirit of slow transportation and of challenging premises, this design will not kowtow to the actions of a few inept and morally corrupt corporations and their designers. To challenge paradigms involves some measure of risk. At some point the cost of fossil fuels, congestion and other factors will force consumers and producers to quit the vehicle size arms race. In the meantime, it will take courageous design and courageous consumers to begi n the process of disarmament, taking a stand—through their purchases—to halt further escalation.

Unlike the traditional product of transportation design, the *idea* of the Trimtab is more than a restyled velomobile. Physically, it is the artifact of a holistic, aspirational view of transportation design—a tightly knit, self-supportive, and empowering structure of components and functions—elegance. Environmentally, the Trimtab's limited scale of influence (particularly the purely human-powered version to come) means that its repercussions can be anticipated and consciously crafted not just to reduce its impact, but to provide a positive benefit to society and the world. Philosophically, it is a catalyst for the change required in transportation design and in our cultural view of mobility.

More than a product, Trimtab demands a rethinking of the entire paradigm of urban and suburban mobility, from power storage systems to the structure of cities. It asks that we "slow down" (for lack of a better phrase) and consider the impact of designing with blinders, in a complex and interconnected world. It provides a stepping stone on the path to simplicity, health and sustainability and intimates a vision of a positive, appropriate, and intelligent direction for design and mobility.



Slow Design = Local Design

Just as the physical implementation of slow design is a diversified, networked web of integrated constraints and solutions, its geographical implementation is also networked and diversified. Slow design cannot happen by a centralized, one-size-fits-all approach to geography and the constraints derived thereof. A vehicle designed for San Francisco (hills) would appear quite different from one intended for use in Phoenix (heat) or Minneapolis (snow). Each locality provides its own unique challenges, but with its hilly terrain, manic climate, and conservative population, Cincinnati, OH may be the worst place in America to launch such a vehicle. If one's purpose, however, is to create a rigorous concept, there can be no better proving ground.

When launched, Revolution Cycle Company will be built around *design for location*. Though units will be sold nationwide upon request, a unique breed will be adapted to every geographical market Revolution actively pursues: for San Francisco, perhaps a minimally insulated, 1X3 with a broad gearing range; for Minneapolis, a studded-tired, tightly insulated, 3X3; for Phoenix, a breathable, white, nylon-skinned two wheeler with fast gearing.

This variability is impossible for a company built around a vehicle using conventional velomobile or automobile construction. The cost of tooling for mass production precludes this type of regional adaptation but, in the spirit of slow transportation, Trimtab is designed around a reduction of tooling. It uses a welded frame, sewn fabric skins and modular bicycle parts to facilitate adaptability both within individual models and within the product line.

A Slow Business

The design complexity of many products, cars in particular, focuses entirely on the product, relying on the homogenization of the built environment, the user, and the community to accommodate their inflexibility. Nearly everywhere a modern car is expected to operate requires a standardized system of roadways, highways and traffic controls. Even the reclamation and recycling of automobiles happens only as a result of their prevalence, inadvertently spawning an ecosystem of scavenger industries that profit from externalities of the automotive paradigm. The simplicity of a slow product allows designers to consciously craft these effects, abandoning the idea of externalities and weaving them into a comprehensive strategy for sustainability. These effects include the way a product is marketed, manufactured, distributed and reclaimed, as well as its repercussions on the user, the community and the world. Rather than minimizing negative "externalities" as modern automobile manufacturers do[4], a slow product attempts to harness externalities as positive elements of its design.

To a designer, the marketing, sale and service of a product is often considered an externality—the job of the marketing or business development department. Like all else, if integrated into the design (a much easier task at a small scale), a slow business model becomes an integral buttress for (and of) the argument[5] for a product's design.

A concept is an argument, and like any good argument, it requires proper support. The most elegant support for a design "argument" should, like these flying buttresses, be integral to the design.

One example of integrating a product's non-product attributes into both the design and the design philosophy of the product is the way that The Revolution Cycle Company plans to harness its business model to manage the environmental cost of its products' manufacture, including the impact of Trimtab's SLA (sealed lead acid) batteries. Trimtab's physical design already reduces its environmental footprint through lower impact materials and fabrication, modular construction, stored energy from potentially renewable sources, and the use of human power to combat the costly trend toward obesity.

To decrease the environmental cost of the electrical assist portion of the vehicle and to incentivize users to transition to purely human powered mobility, Revolution will offer the Trimtab 3X3 with a unique buying option: Customers will be able to buy the electric-assisted model (Trimtab 3X3) for $3k (projected) plus a $1k deposit and a monthly fee of $10 to "lease" the electric-assist package.

The Trimtab 1X3 (the portion of the Trimtab 3X3 that the customer actually *owns*) will be profitable at a $3k price point (a price that will generate slight profit for the Trimtab 3X3 that incorporates electric assist). The $1k deposit held by Revolution to insure the return of the electric assist package will be invested toward the long-term growth of the company. The company will profit, in part, by the dividends on those investments.

In time, the customer will gain fitness and confidence and come to rely less on electric assist and more on his own muscles,. At some point, the electric assisted Trimtab will begin to feel bulky and unnecessary—like entry-level equipment to a performance athlete. At this point, the customer can return the modular, electric-assisted rear portion of the vehicle, leaving him a Trimtab 1X3.

The Trimtab 1X3 will retain much of the Trimtab 3X3, including flatbed storage, seasonally adaptable skins, lean steering, and its role as the lightest, leanest velomobile on the market.

Meanwhile, Revolution Cycle Company will refurbish the returned rear of the Trimtab, (recycling the SLA batteries, if needed) and prepare it for lease to another customer.

The newly improved customer (a better human) will be left fitter, more confident, more attractive, at less medical risk for long term disease, and with $1000 back in his pocket. (The $10 monthly payment is an inconsequential amount intended not as a primary revenue stream but as a monthly reminder and incentive to wean the user off of stored energy.)

Endnotes

1 Doublethink is a concept described by George Orwell in his dystopian novel, 1984 "The power of holding two contradictory beliefs in one's mind simultaneously, and accepting both of them....To tell deliberate lies while genuinely believing in them, to forget any fact that has become inconvenient, and then, when it becomes necessary again, to draw it back from oblivion for just so long as it is needed, to deny the existence of objective reality and all the while to take account of the reality which one denies — all this is indispensably necessary. Even in using the word doublethink it is necessary to exercise doublethink. For by using the word one admits that one is tampering with reality; by a fresh act of doublethink one erases this knowledge; and so on indefinitely, with the lie always one leap ahead of the truth." (Orwell 32)

2 Rev. 2.0!

3 For a fitter, more active user, a more optimal solution is possible, setting the stage for the development of future Trimtabs.

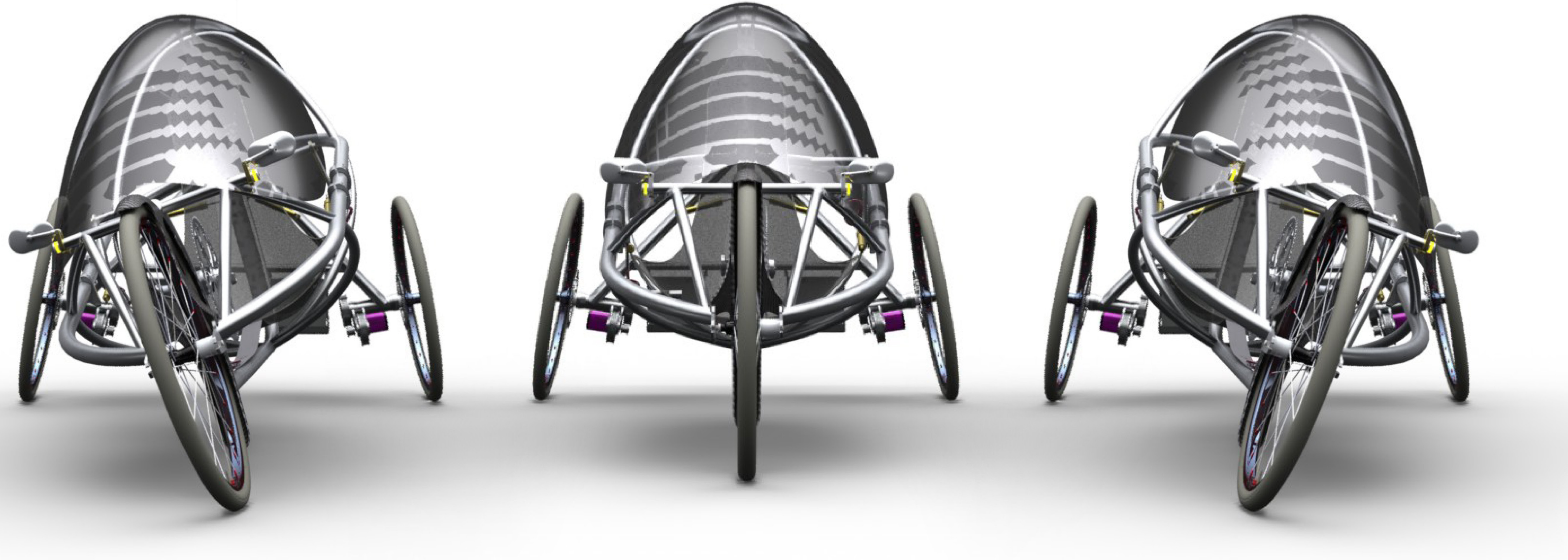
4 By facilitating scavenger businesses, improving fuel economy, or reducing toxic materials

5 In a world of finite resources and a "free" market, every product is an argument for the resources it requires to manufacture it and for those that must be traded to attain it.

Customer returns the modular, electric-assisted rear portion of his Trimtab 3X3 to his local Revolution Cycle Company hub.

Customer receives a new unassisted rear Trimtab section and is refunded the $1000 deposit he paid to lease the electric assist package.

the prototype



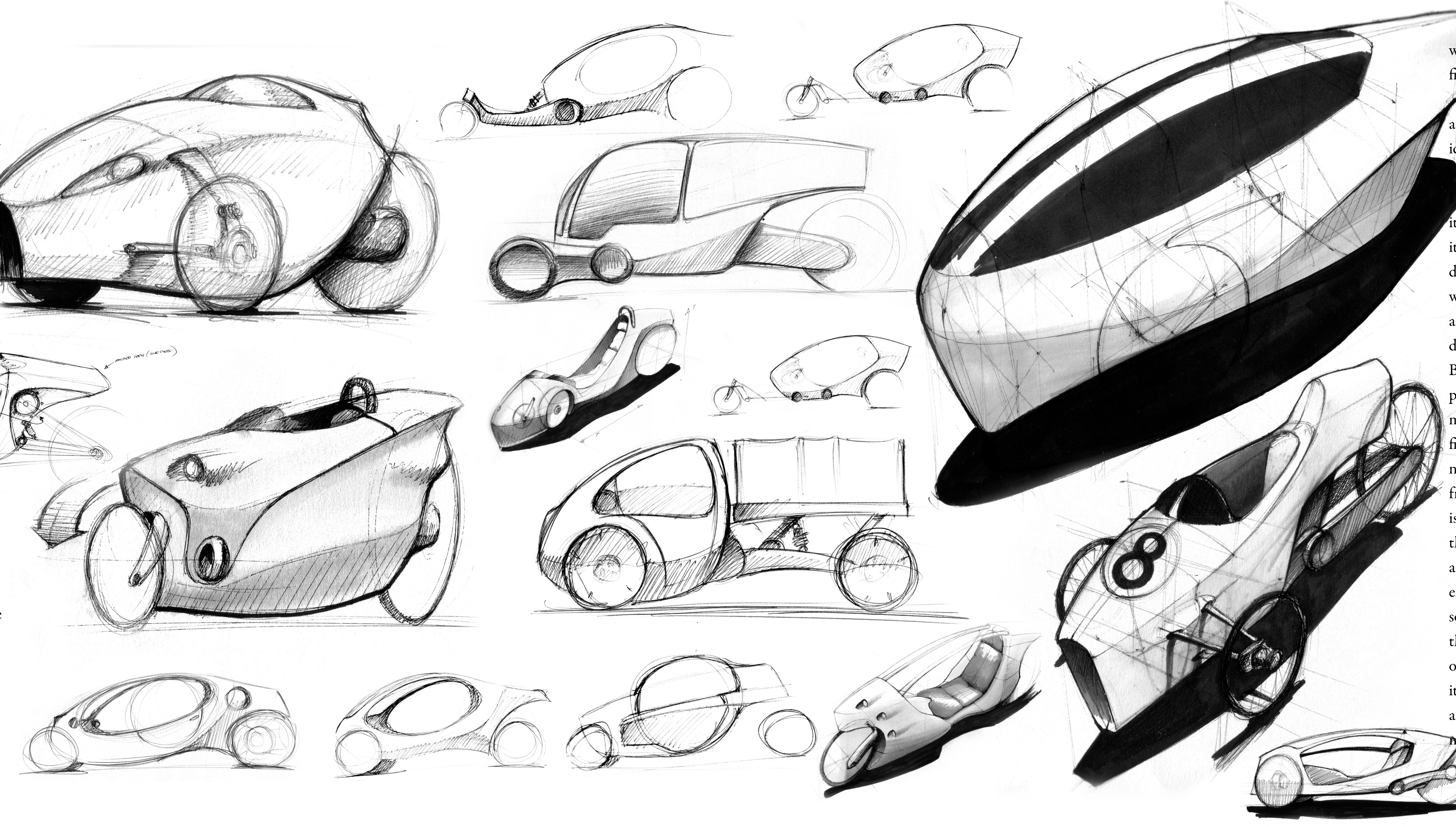
Design that doesn't work is fine art, and transportation and product designers everywhere have been disguising fine art as design for as long as the profession has existed by ignoring constraints, styling for the sake of styling and creating concepts ignorant of reality. With the power the design profession now weilds, to design *products* in such a way is not only incompetent—it is irresponsible.

In light of this, I determined that the only way to judge the Trimtab's success was to build a prototype and test it. This would determine the effectiveness of design solutions and pave the way for future development by both myself and the HPV (human powered vehicle) community. In the spring of 2010, a prototype of Trimtab's latest incarnation was started with help from Stress Engineering Services, Inc. in Mason, OH. At the time of this writing, the prototype is nearly complete. This chapter provides a survey of its evolution from initial concept sketch to prototype.

First Ideas

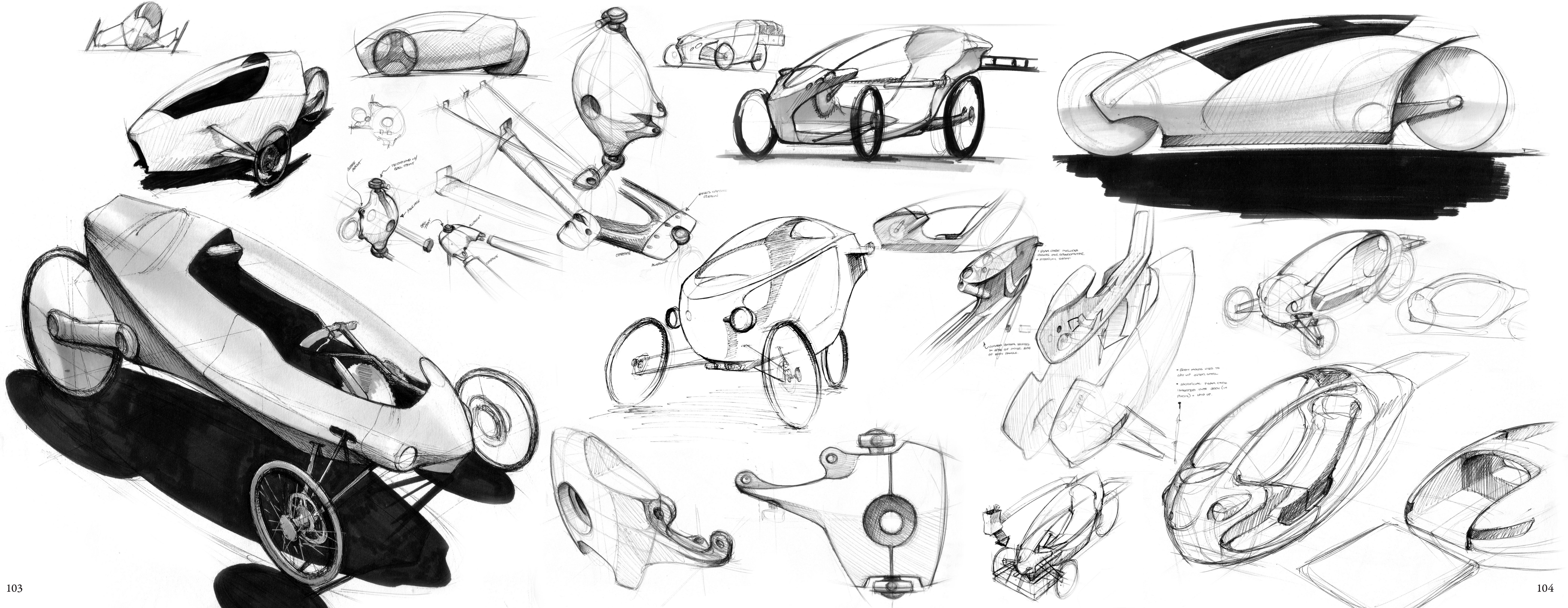
As in the typical design process, before a final concept was selected for development, a series of concepts were considered. The Trimtab took many forms during its initial development—in CAD and on paper. An early sketchbook contained descriptions of suspension systems, body designs, accessories and many other details. Many of these sketches are captured here. These reflect an ongoing conversation about the nature of slow transporation, the *real* needs of the consumer, the implementation of sustainable materials and fabrication methods, and the best integration of these elements.

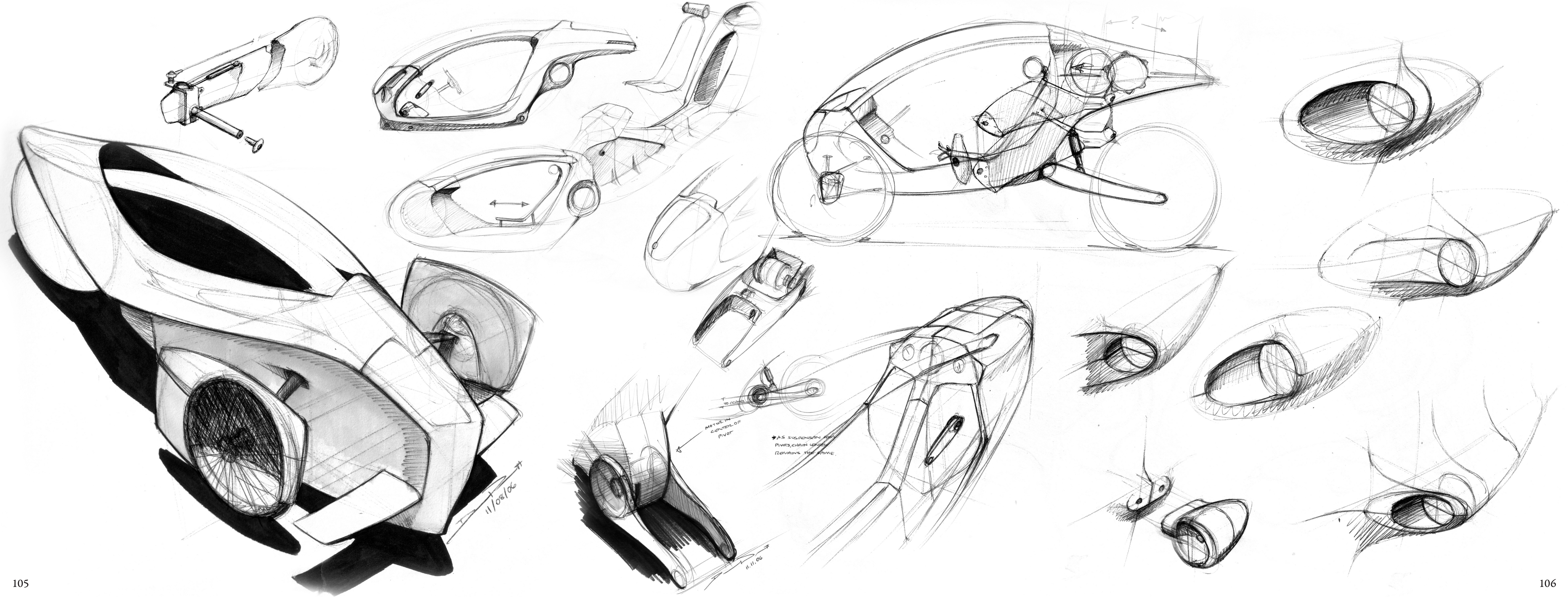
During the Trimtab's initial concept development, I was focused on the use of a composite monocoque shell to integrate frame and shelter into a single, lightweight unit. This is the current state-of-the-art in velomobile construction, as it is in high performance vehicles from aircraft to F-1 race cars to sail boats. To eliminate the monstrous hybrid of highly toxic technical nutrients that make up most monocoque shells—carbon fiber, fiberglass, etc.—I explored the use of a UV-cured bio-resin and a number of biodegradeable but high performance woven fabrics, including hemp, silk, jute fiber, wool, PLA, and others. Many of these composites

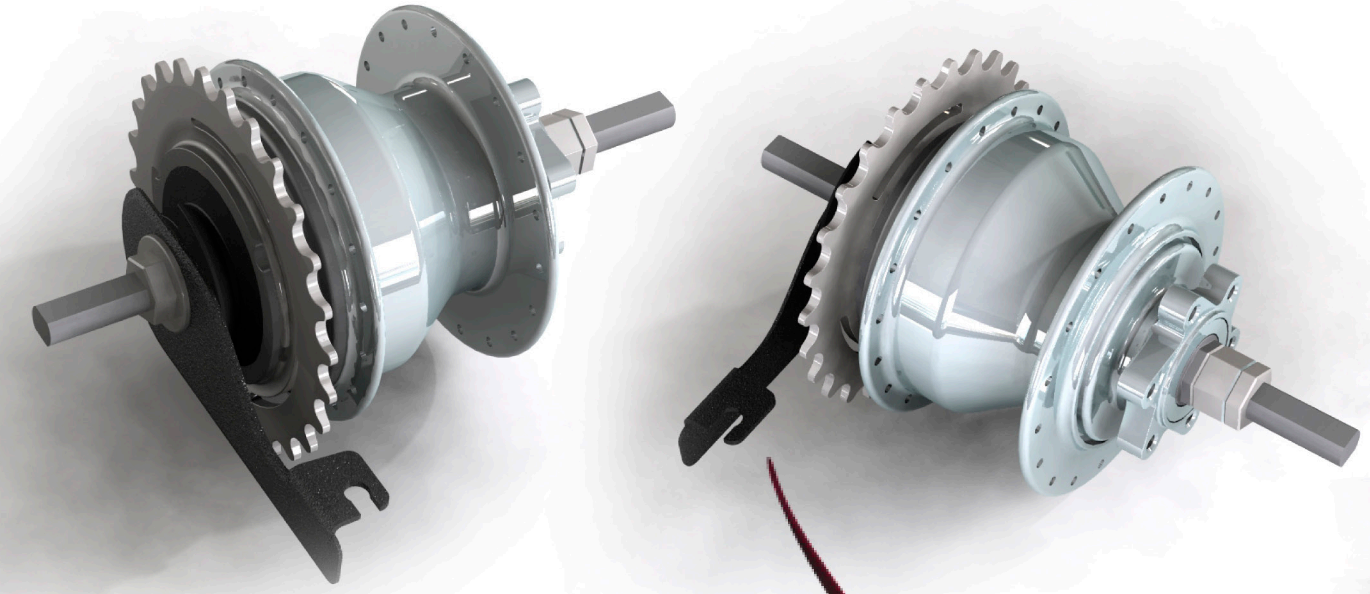
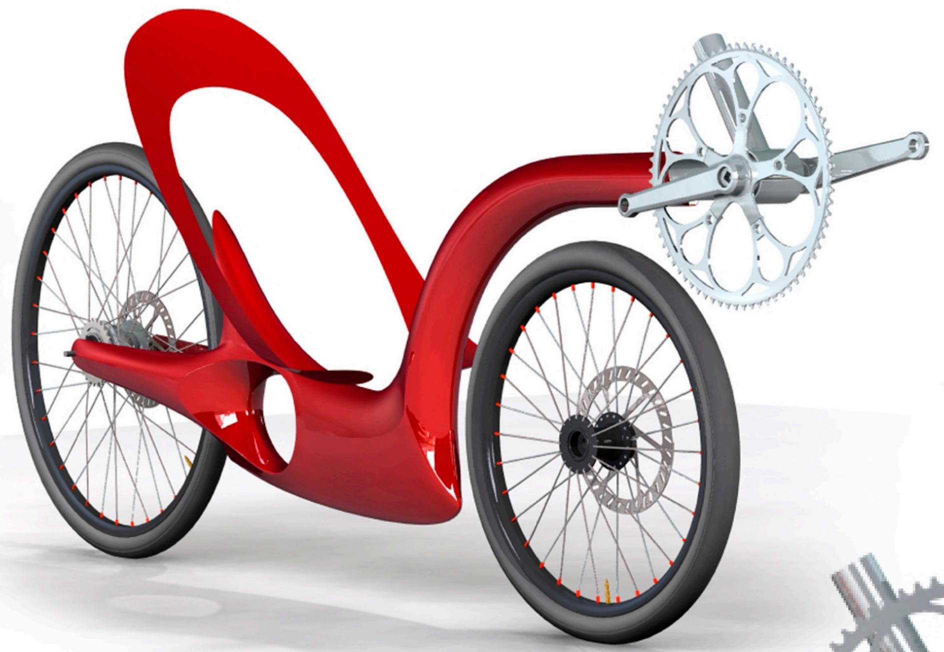


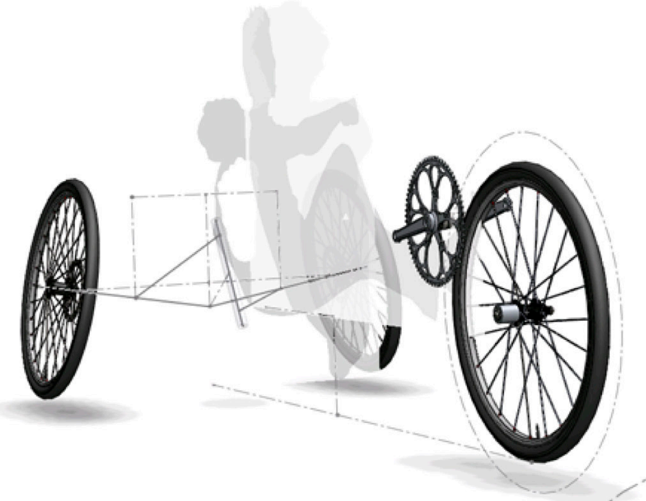
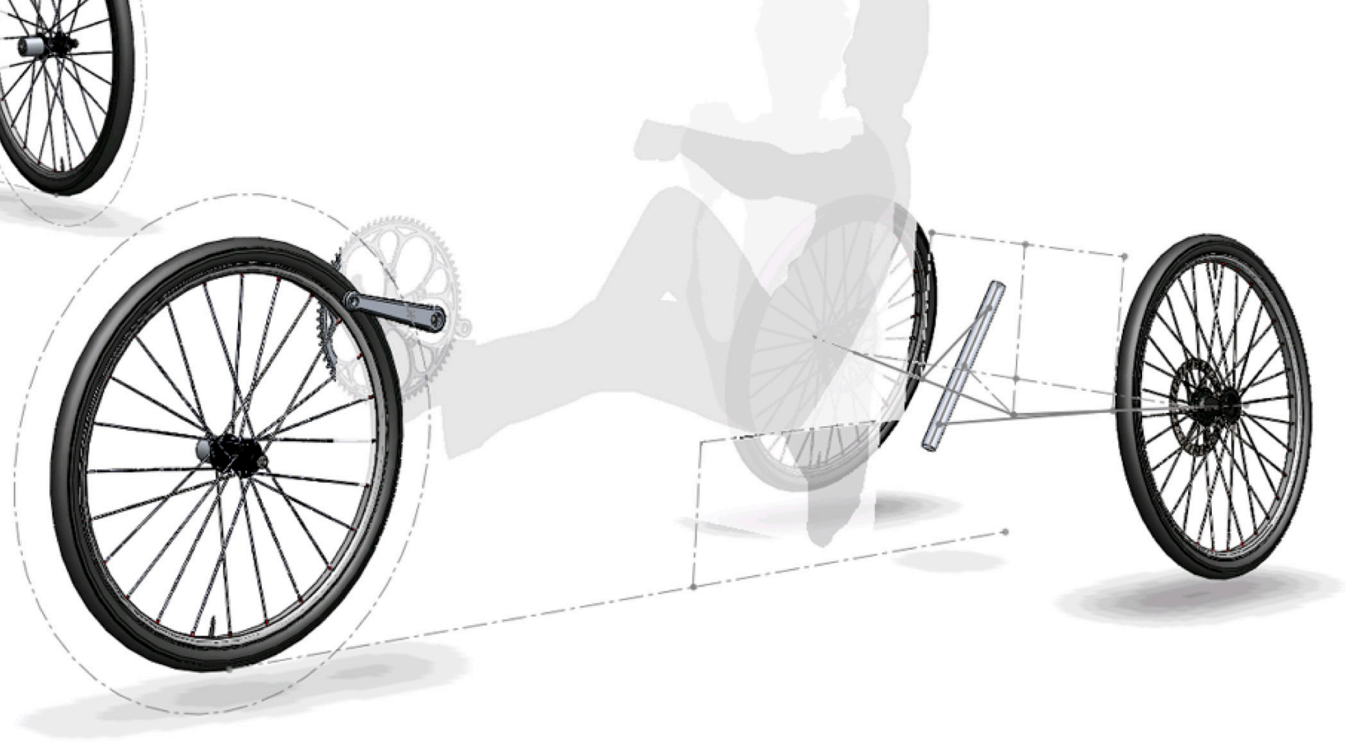
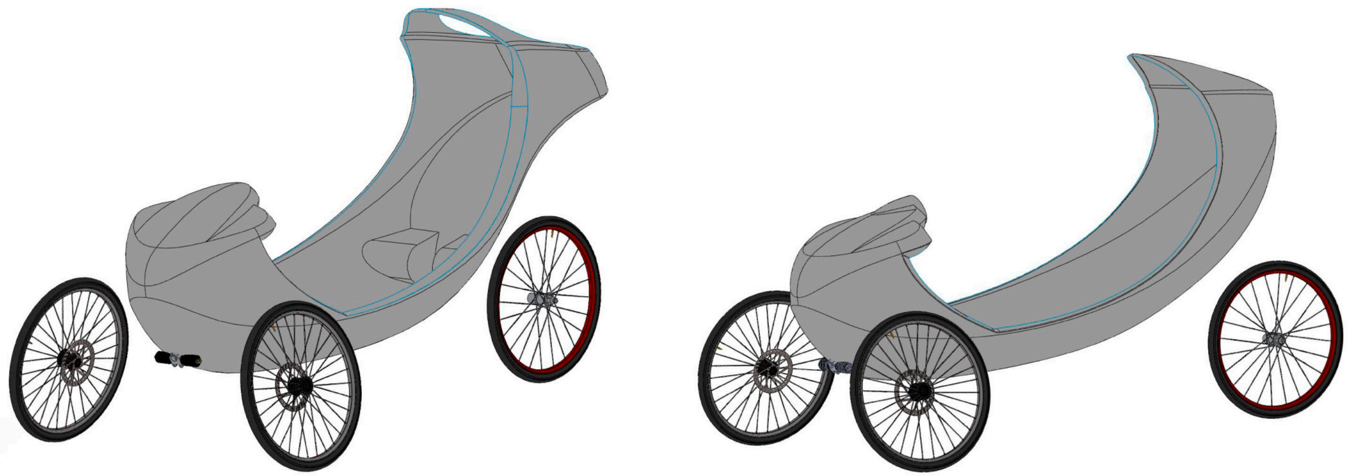
would produce strength similar to that of modern fiberglass shells.

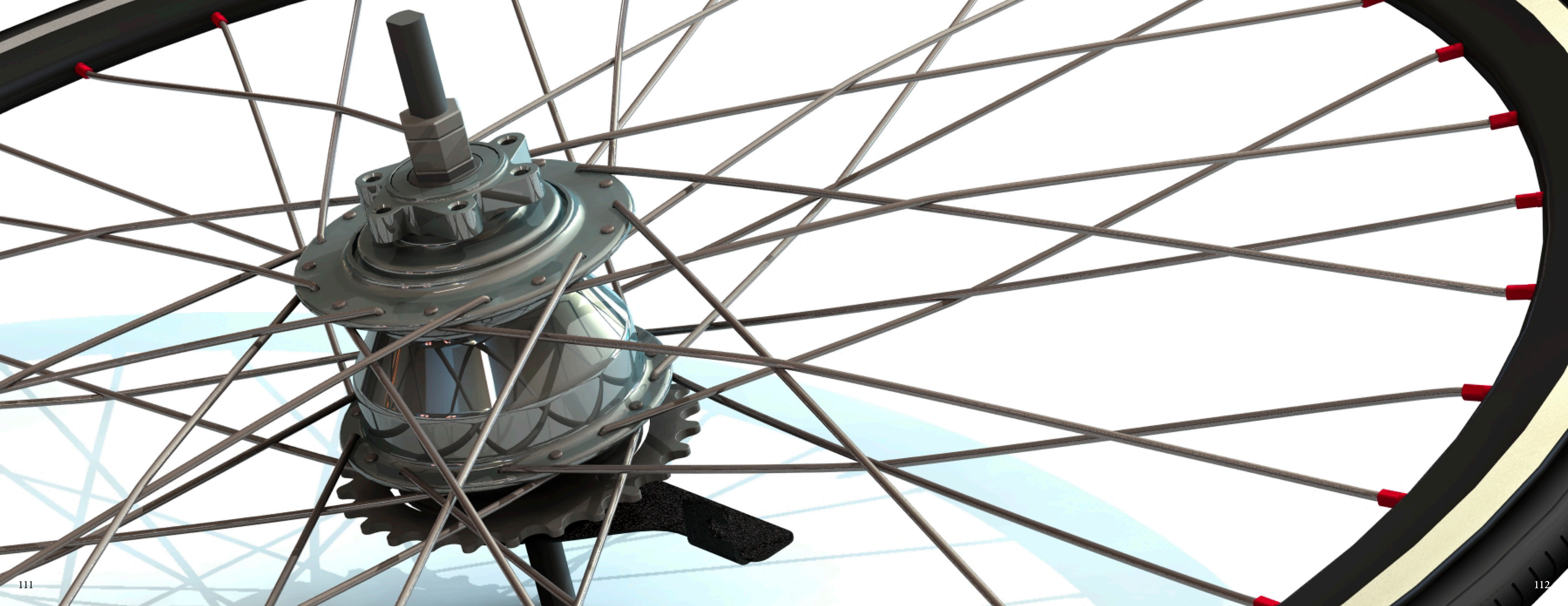
After exploring a number of concepts on paper and in Solidworks, I eventually abandoned the idea of a purely fabric composite shell because it seemed to contradict the "determinacy of form" observed in "slow" products. That is, the form itself has very few constraints imposed upon it by its material and manufacturing. This has been the direction of product design for the last centuryin which amorphous materials (such as polymers) and advanced molding techniques have virtually freed designers of the form contraints of their material. By contrast, the forms of most pre-industrial products, or those made from non-synthetic materials such as leather, wood, stone, natural fibers and, to some extent even metals, were necessarily dictated by the "grain" of the materials from which they were made. In these objects, there is an inherent integration that is unattainable through less determinate materiasl. There is an almost spiritual quality to these materials that enhances their reflective value. At the risk of sounding melodramatic, it is as if the the "soul" of the material is expressed in its forming. Reflecting on the beauty of this type of object, I realized that it was impossible to achieve this level of beauty and integration without selecting a more "soulful" material.




11/08/06
MOTOR IN CENTER OF PIVOT
TO CRANKS
*AS SUSPENSION ARM PIVOTS, CHAIN LENGTH REMAINS THE SAME.
11.11.06

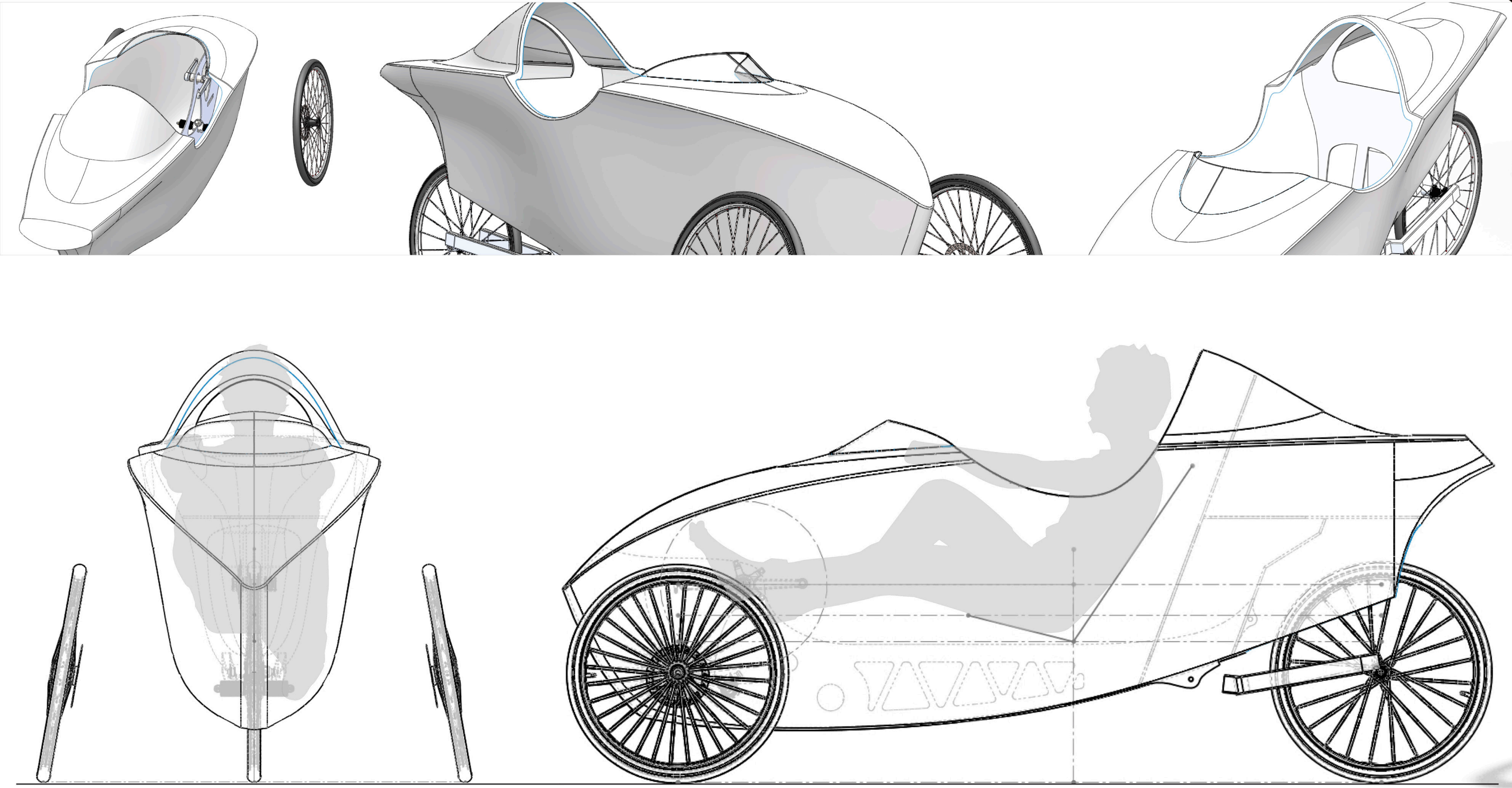


The Arts & Crafts Trap

In the summer of 2009, it occured to me that an aerodynamic form for a terrestrial vehicle could be very similar to that of a vehicle made for aquatic use. They are just two forms moving through two liquids of different densities. The hull of a sailboat is designed to cut through the water without creating a lot of turbulence in its wake. My vehicle should do the same only through air.

I began to see the sailboat hull as an appropriate analogue for form of the Trimtab and found that methods of small watercraft construction, in addition to being a fusion of form and material, would lend themselves perfectly to the consruction of such a vehicle while also referencing a long tradition of craftsmanship. Moreover, sailboats of this size and similar construction were available on the market within the price range I had targeted in my initial direction.

Based on this new direction, I began a prototype using the strip-planking method of small watercaft. It was constructed of hand-stripped redwood to be laminated in a UV (solar) cured biodegradable resin and tri-axially woven silk fabric. The design was a three wheeled tadpole trike with an open, convertible top with tonneau



cover, formula one style suspension, and a locking interior storage compartment.

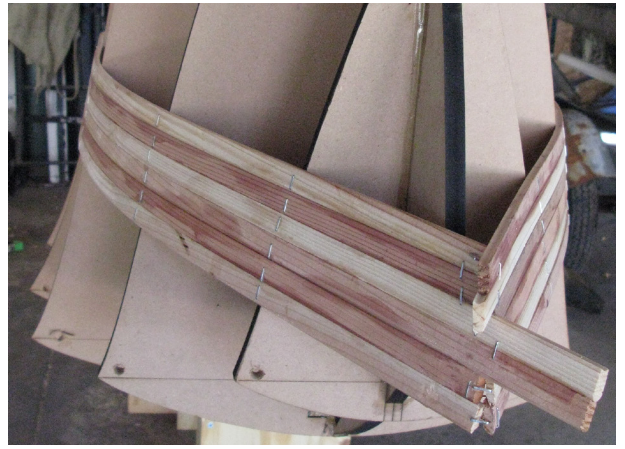
The fabrication process included a midnight drive to West Virginia to buy a tanning bed for curing the bioresin, a plan to create a 48” loom for weaving silk composite fabric, the milling of hundreds of 1/4” cove and bead redwood strips, and days of hand-stripping a wooden shell. It was after several weeks that I realized that the hundreds of hours required to produce such a craft in this handmade fashion would, like the products of the Arts & Crafts Movement, make it affordable only to the hyper rich. The idea and prototype were mothballed in search of a physically, economically, and environmentally “lighter” alternative.

I believe that this vehicle, if supplied in a pre-cut kit, like the sailboat kits of the 1970s and today, could be a viable product for a customer with the will to build it themselves. In a kit format: the enormous cost of labor would be absorbed by the end user, becoming a “labor of love”; the ecological footprint of shipping such a vehicle would be reduced to that of shipping a half pallet of flat, pre-cut parts; the wood could be harvested and supplied locally through a partnership with a network of lumber yards; the resin could be sun-cured on site; and the user would intimately know every inch of his vehicle.



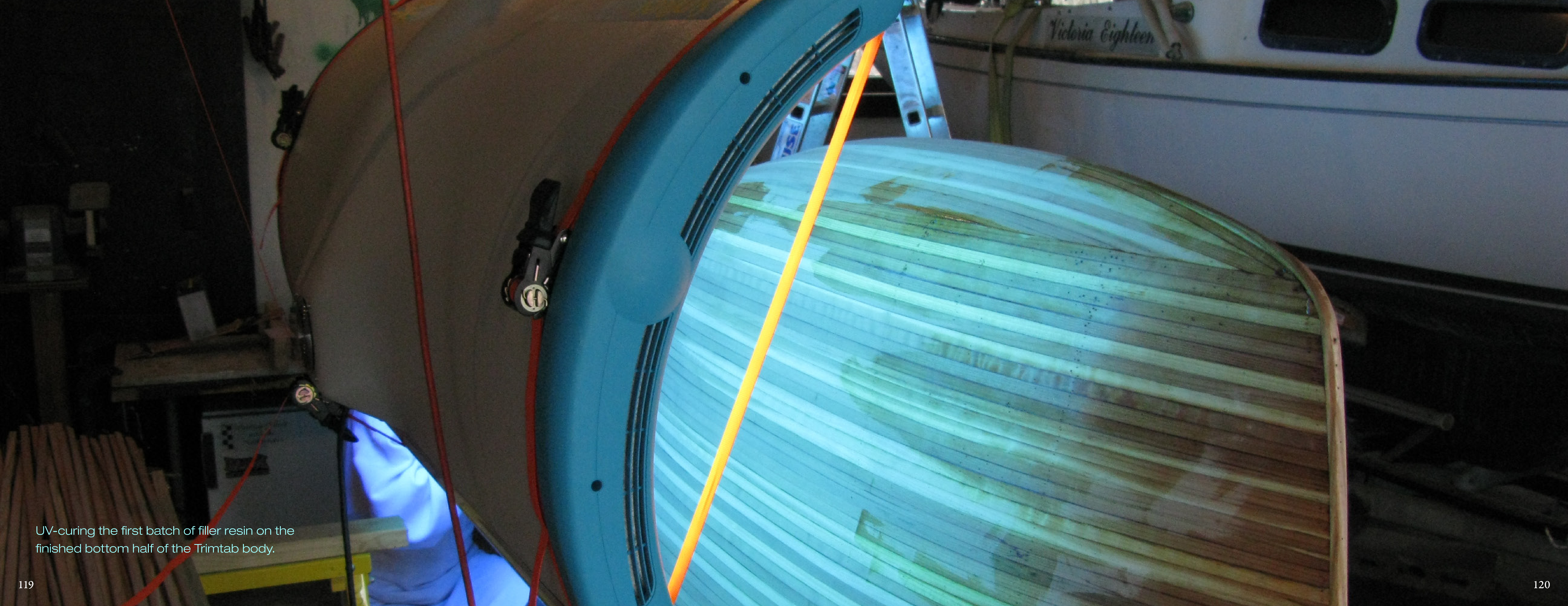








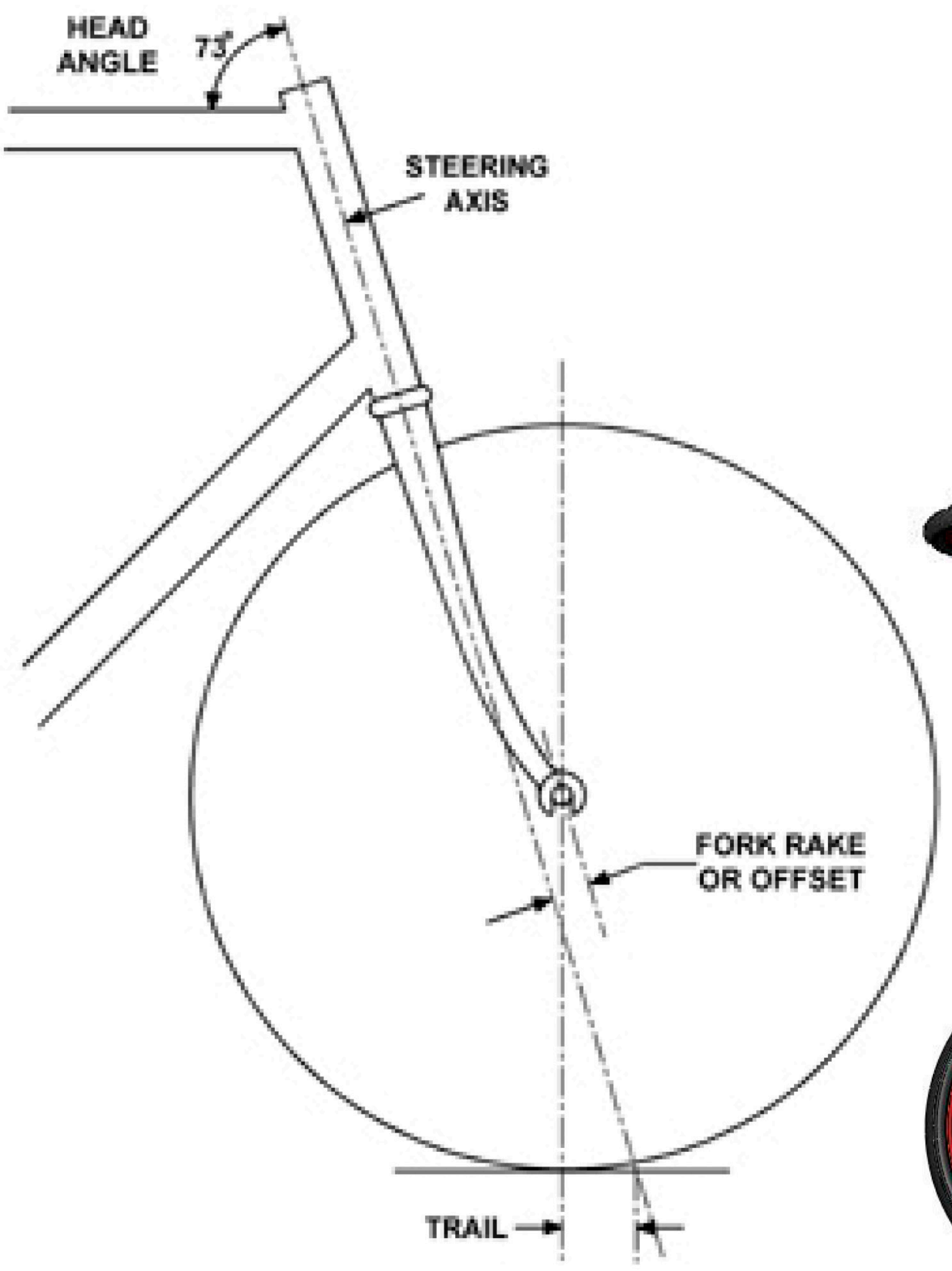
UV-curing the first batch of filler resin on the finished bottom half of the Trimtab body.

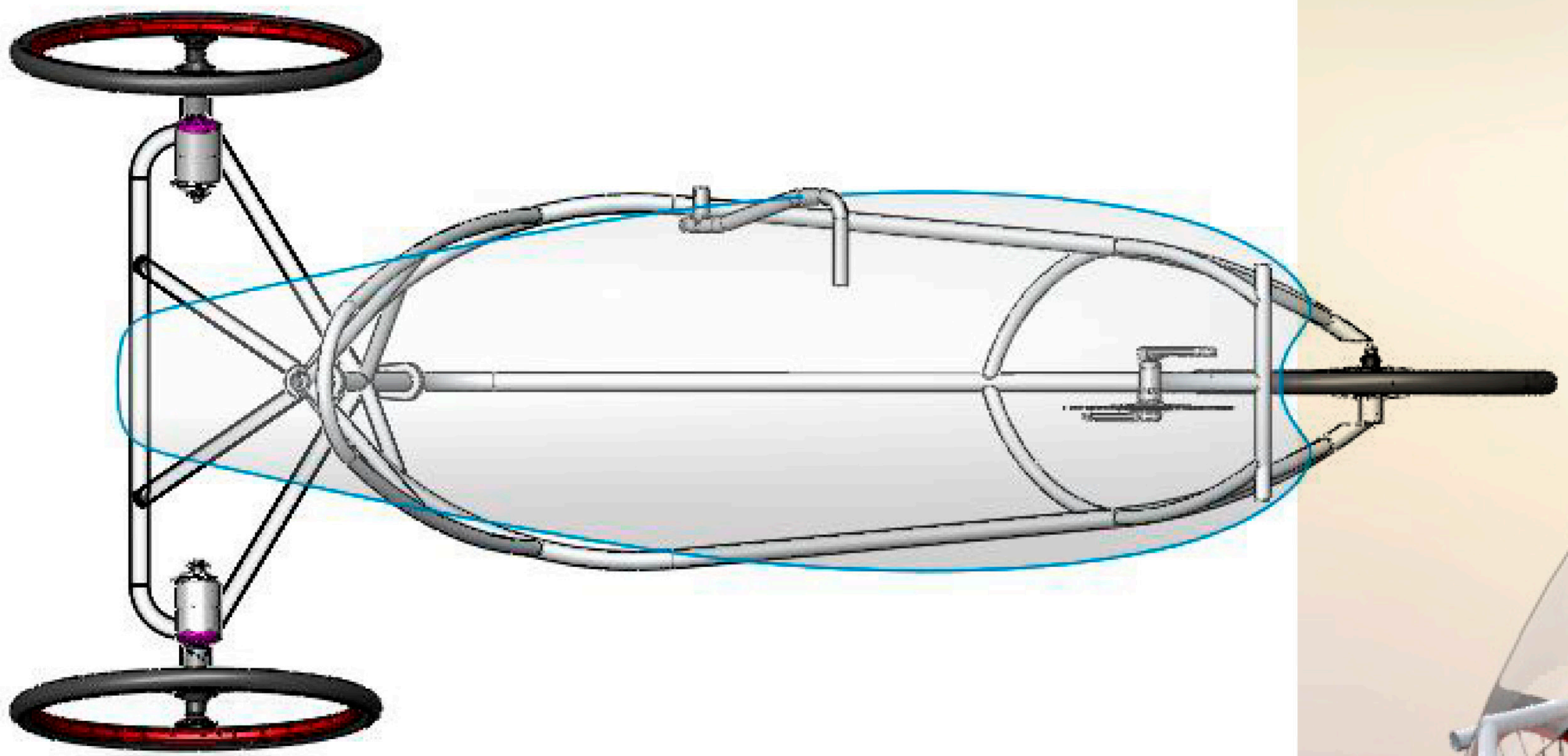
Open Source & Negative Trail

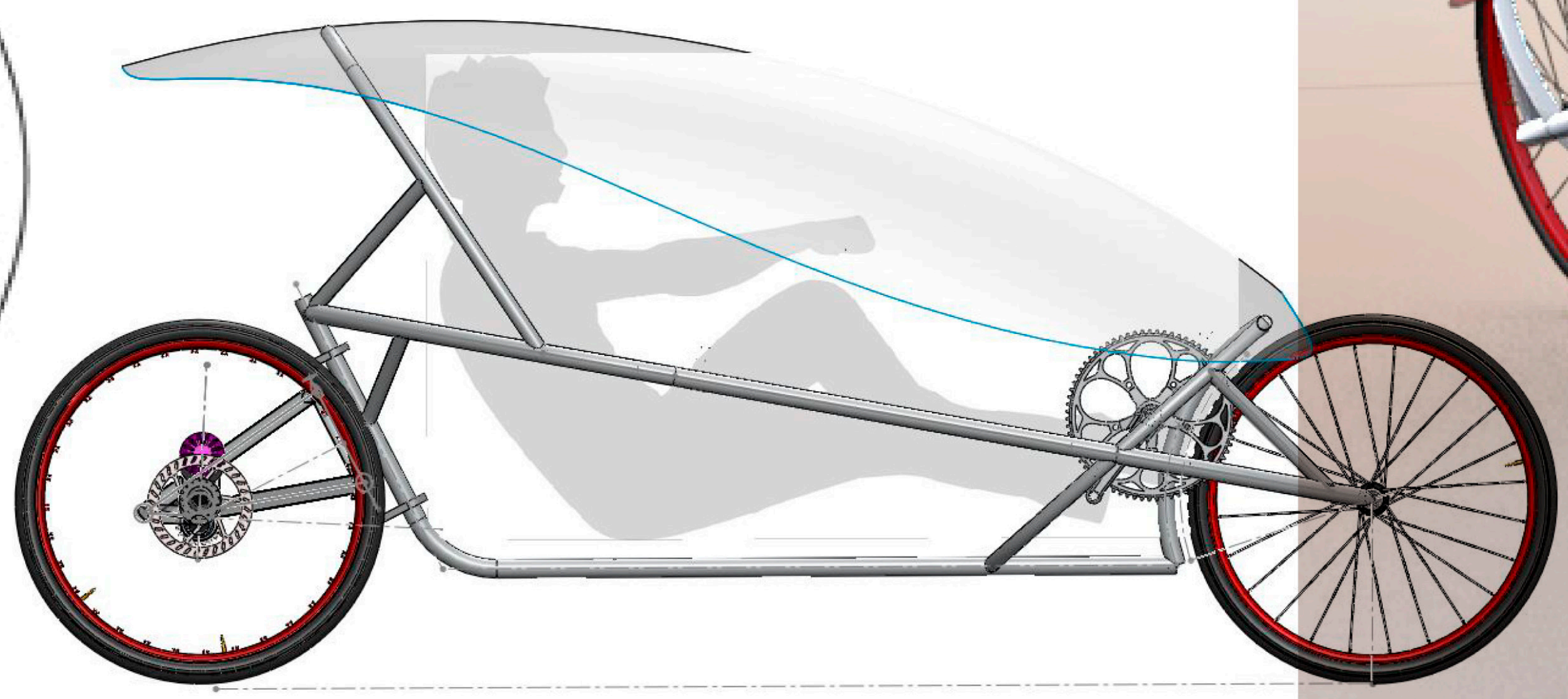
"Trail, or caster, is the horizontal distance from where the steering axis intersects the ground to where the front wheel touches the ground." (Wikipedia.org) Despite all the dogma surrounding positive trail in the world of bicycle design, the idea of negative trail was captivating for a number of reasons. First, it meant that the drivetrain of the device could be simplified by using a non-steering front wheel, eliminating the 14 feet of steel roller chain, idlers pulleys and drag inherent to most rear wheel drive (RWD) recumbents. Second, it provided the possibility for a more exciting and intuitive full body steering motion. Third, the use of extreme negative trail was pioneered by a man named Jürgen Mages who has been developing it in an open source manner since 2003 (though his *Airbike,* another "center-steered" recumbent was created in 1996). His Python recumbent is the result, an open source, international bike design project that incorporates input from a wiki on the subject. This open source methodology seemed to align nicely with the collaborative spirit of both the Arts & Crafts Movement and modern principles of design thinking and Slow Design.

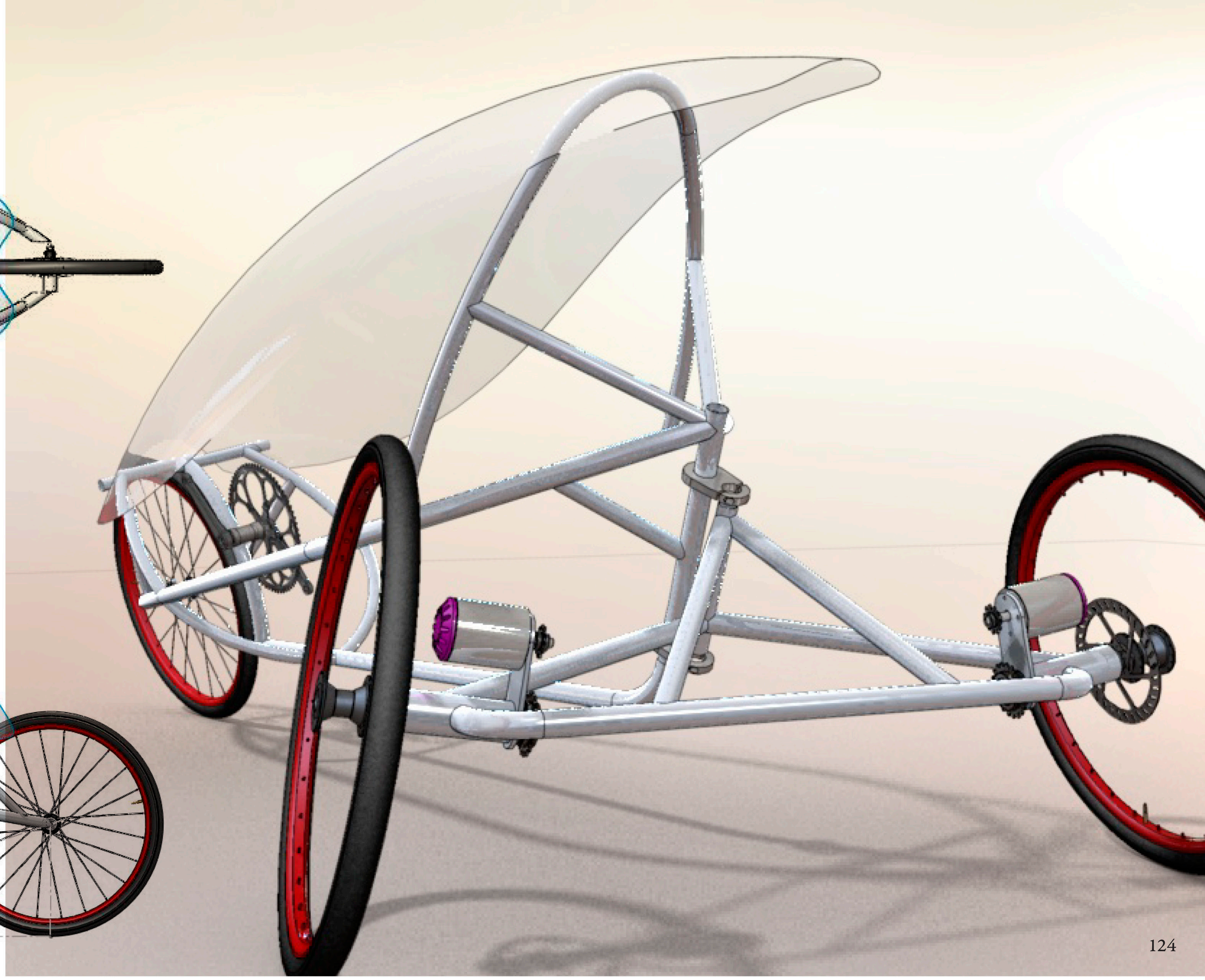
After creating a Solidworks model of a new Trimtab in lightweight welded aluminum tubing, a potentially closed-loop technical nutrient, I requested feedback from the on-line community at the Python wiki (http://en.openbike.org/wiki/Main_Page). I was concerned with the stability of a Python style tricycle at high speeds. After receiving no response, I built and tested a crudely welded prototypemade from MIG welded tubes of old bicycle frames. A classmate and I tested the unit on the commons at the College of Design, Architecture, Art and Planning (DAAP). While it was fun to ride, our test rides revealed two things: the frame geometry was incredibly unstable at all but the slowest speeds, and every user who rode it attempted to control the vehicle with their hands as well as their bodies (the prototype was intended to be solely lean-steered like a Python Lowracer), indicating a strong but unannounced desire for at least auxiliary hand controls.

After experimenting further, I realized that the patchwork of extra mechanisms that would be required to make a negative trail vehicle stable at high speed would eliminate any potential weight savings and invalidate the simplicity of the design. This concept too was abandoned, and I believe that the Python low racer will remain a cycling novelty if, indeed, it remains at all.


HEAD ANGLE
73°
STEERING AXIS
FORK RAKE OR OFFSET
TRAIL





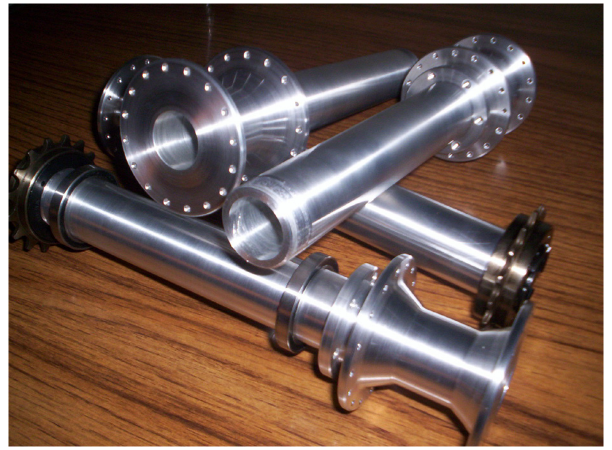


TRIMTAB 3X3

The design for the Trimtab 3X3 prototype was influenced by the work of Greg Kolodziejzyk who built, for a trans Canadian speed record attempt, a faired, three wheeled, lean-steered, FWD (front wheel drive) recumbent called the Trans Canadian Rocket. His frame geometry used a high, shallow head tube and an assisted lean-steering system that I thought might be adapted to great advantage for this design.

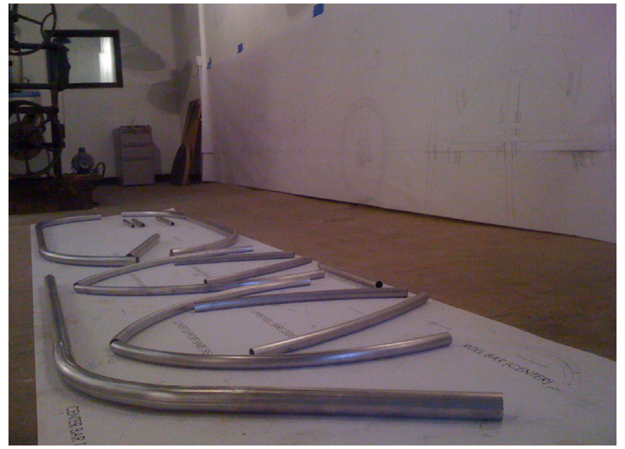
The benefits of this system were many: A simple, clean FWD drivetrain eliminating the 10+ feet of steel roller chain carried by many recumbents and routed through a series of energy-robbing idlers and tubes; an intuitive lean-induced steering motion; the ability to power all three wheels for 3X3 traction; and a convenient place to mount a flatbed for versatile rear storage. This pivot location opened the door for the rest of the design, including the integrated hollow axle wheel hub and drivetrain that allows for cambered rear wheels and provides efficient transfer of power from the motors to the rear wheels, eliminating the cost of a differential and CV assemblies.

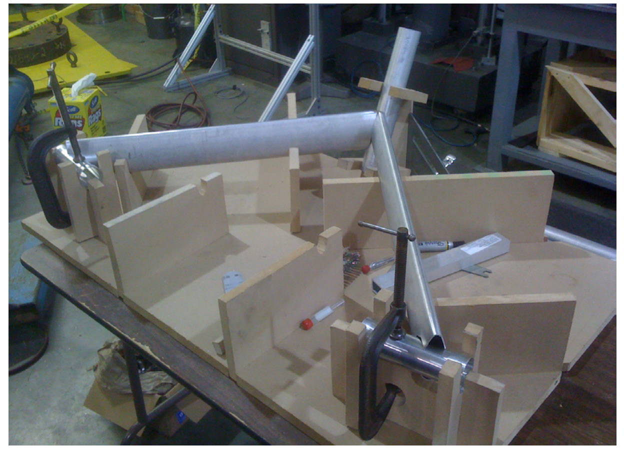
The frame was welded at Stress Engineering Services (SES) under the guidance of the SES staff who donated hours of effort and their invaluable expertise to help produce this prototype.

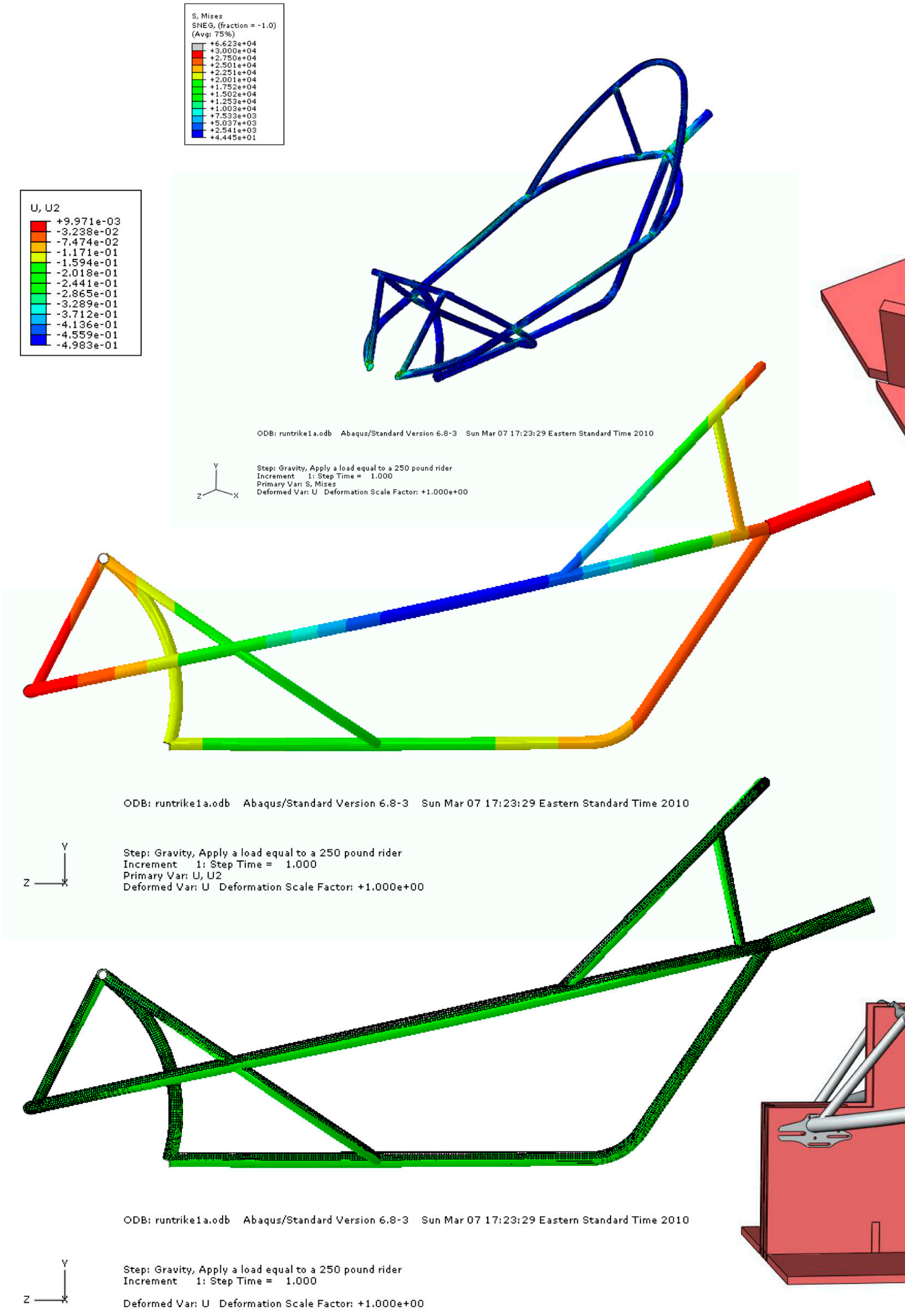


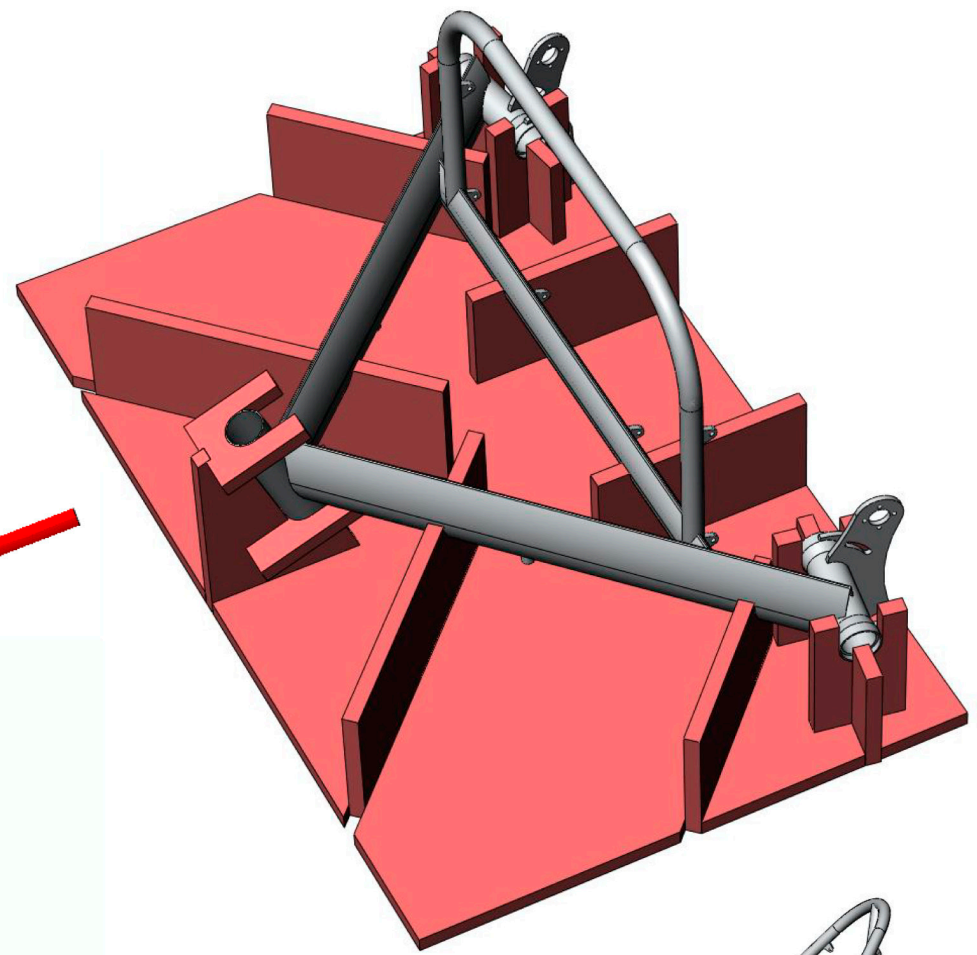


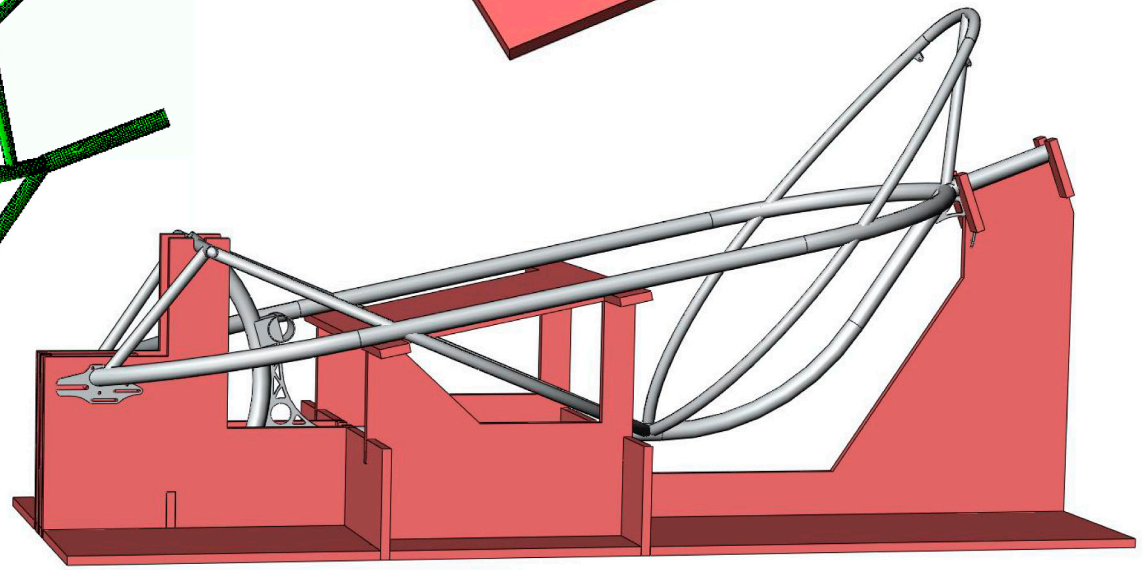





U, U2
+9.971e-03
-3.238e-02
-7.474e-02
-1.171e-01
-1.594e-01
-2.018e-01
-2.441e-01
-2.865e-01
-3.289e-01
-3.712e-01
-4.136e-01
-4.559e-01
-4.983e-01
ODB: runtrike1a.odb Abaqus/Standard Version 6.8-3 Sun Mar 07 17:23:29 Eastern Standard Time 2010
Step: Gravity, Apply a load equal to a 250 pound rider
Increment 1: Step Time = 1.000
Primary Var: U, U2
Deformed Var: U Deformation Scale Factor: +1.000e+00
ODB: runtrike1a.odb Abaqus/Standard Version 6.8-3 Sun Mar 07 17:23:29 Eastern Standard Time 2010
Step: Gravity, Apply a load equal to a 250 pound rider
Increment 1: Step Time = 1.000
Deformed Var: U Deformation Scale Factor: +1.000e+00





conclusion

The cry to "slow down" is likely a cyclical one. Just as the Arts and Crafts Movement was a response to the acceleration of culture and technology during the industrial revolution, the Slow Movement is a response to a similar acceleration and likely to fizzle just as fast. Like other short-lived movements of its kind, it is a defined only by what it *is not*—it cannot exist without the status quo.

However, the sentiment that underpins the Slow Design movement is spreading in a way that was not possible at the beginning of the 20th century. Drowning in a sea of mediocre products and 24/7 marketing, consumers and designers alike are aching for a sense of quality and authenticity in their lives and through the products they own (and design). The charm and perceived authenticity of locally manufactured, handcrafted objects are answering that need, even as the vastness and transparency of on-line information regarding product performance, safety, reliability and sustainability highlights the shortcomings of manufactured products—from lead poisoning in toys to unintended acceleration (or not) in Toyotas. Meanwhile, the DIY (do-it-yourself) movement and the democratization of rapid prototyping and fabrication equipment are providing the facility by which designers can create authentic products without the compromises required by high volume sales or the restrictions and cost of government oversight and certification.[1]

Like a forest fire, the ebb and flow of the market economy and cultural taste provide the cleansing effect of clearing the entrenched underbrush of the market ecology, burning away the vacuous, the impermanent and the weak—leaving only the strong and clearing space for an influx of new, varied species to try their hand in this new economy. This decentralization is a healthy and necessary cycle in the market as it is in any other ecosystem.

As the field of product design becomes less centralized, independent producers will be challenged to discover new ways to balance quality with cost competitiveness while serving the tiny micro-niches deemed unprofitable by larger corporations. While short-sighted economists, marketeers, pundits and designers condemn the market inviability of low volume producers, they overlook their necessary place in the economic ecology and the new potential the internet has provided to make these ventures profitable. These "fringe species" (Hawken) stabilize the economy—their agility and creativity making them less susceptible to market shifts and more likely to generate the innovation our economy is built on.

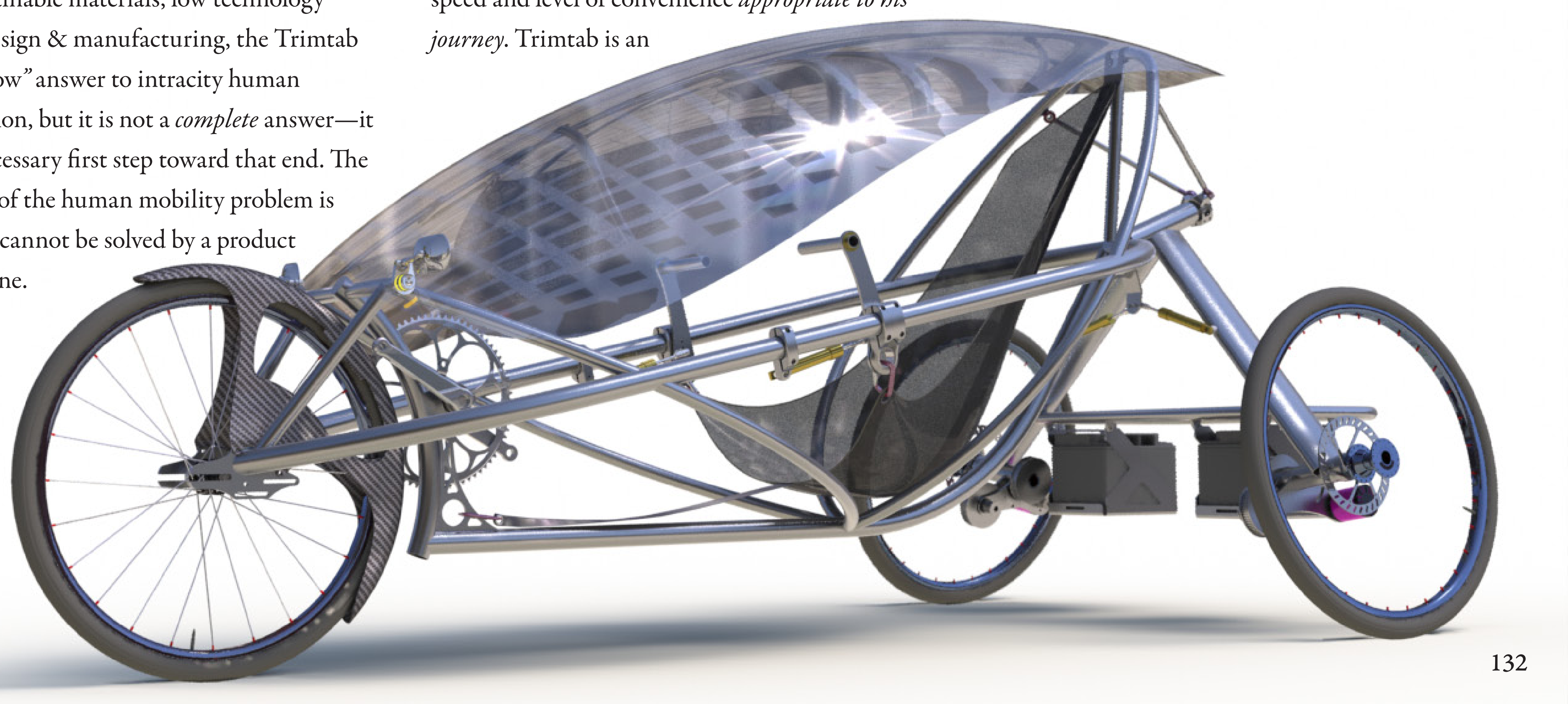
And as the backlash against the high volume, low quality products of mega corporations has shown, today's customers are willing to pay for the unique, the hand-crafted and the innovative.

In our era of hyper connectivity, perhaps the global backlash against low quality, vacuous products will force manufacturers to rethink their strategies—perhaps the trimtab companies manufacturing quality goods at a grassroots level will steer these mega corporations away from price and marketing driven sales and back toward quality.

In the meantime, the connectivity of the internet has provided the means by which these "fringe species" can achieve profitability. For example, the cost of entry into the transportation industry is astronomical and would appear to be one arena in which low volume, high quality manufacturers could not survive. Yet in the last few decades, a number of companies have challenged that assumption. Tesla Motors, now a publicly traded company, manufactures a line of high end, electric sports cars. Icon Aircraft was built around the simple observation that the new FAA Sport Pilot's license had opened the door to the recreational pilot, a market that has was historically over-regulated and under served. Now it manufactures a folding wing, trailerable, amphibious sport plane for the recreational vehicle market. Similarly, the Teflon®-coated Icon 4X4 is built on the simplicity of early jeeps and land cruisers to provide an uncompromising off-road vehicle for recreational use.

Are these examples of Slow transportation? No, but they establish the precedent of small scale, "Fringe" manufacturers operating *successfully* in the ecotones between larger companies, selling quality, well-targeted products to discerning customers. The Revolution Cycle Company could be such a "fringe" manufacturer, producing high quality, low cost, "slow" mobility devices. With lower costs, local manufacturing and less regulation, the Revolution Cycle Company should be equipped to enter the market with the same or better chances of success than the companies cited above.

Because it combines low-impact fabrication, largely sustainable materials, low technology and local design & manufacturing, the Trimtab 3X3 is a "slow" answer to intracity human transportation, but it is not a *complete* answer—it is only a necessary first step toward that end. The complexity of the human mobility problem is such that it cannot be solved by a product solution alone. There is a solution to intracity mobility, and I believe that the intracity, product component of that solution will be an uncompromising (and vastly simplified) version of the Trimtab that exhibits the purity of the fixed gear track bicycle coupled with the function and performance of a recumbent velomobile. It would combine a clean, efficient and maintenance-free single speed belt drive, a low profile recumbent body made of reclaimable biological or technical nutrients, a lightweight partial fairing and *pure human power*. Unfortunately, this uncompromising vehicle cannot exist without a *better human*—one who is willing to expend the energy, personally and presently, to get where he needs to go at a speed and level of convenience *appropriate to his journey*. Trimtab is an intermediate step toward the creation of this scenario—a compromise intended to create a *better human* and, like its namesake, steer its owner (and society) onto a better course.



(Endnotes)

1 Obviously this is a slippery slope as consumers benefit greatly from the certification of organization like UL and others who exist to protect them from negligent manufacturers. However, DIY designers (for the most part) are not designing airplanes. Perhaps the DIY movement will illuminate the need for a more reasonable approach to product safety and liability.

references

1. Orwell, George. Nineteen Eighty-Four. London: Martin Secker & Warburg Ltd,, 1949
2. Diamond, Jared M. Collapse: How Societies Choose to Fail Or Succeed. New York: Viking, 2005.
3. Fuller, R. Buckminster. Critical Path. 1st ed. New York: St. Martin's Press, 1981.
4. Hawken, Paul. Growing a Business. New York: Fireside, 1987.
5. McDonough, William, and Michael Braungart. Cradle to Cradle: Remaking the Way we make Things. 1st ed. New York: North Point Press, 2002.
6. Norman, Donald A. Emotional Design : Why we Love (Or Hate) Everyday Things. New York: BasicBooks, 2005.
7. Papanek, Victor J. The Green Imperative : Ecology and Ethics in Design and Architecture. London: Thames and Hudson, 1995.
8. The editors of Bicycling Magazine. The Noblest Invention: An Illustrated History of the Bicycle. Emmaus, PA: Rodale Inc., 2003.
9. Wilson, David Gordon. Bicycling Science. 3rd ed. Cambridge, Massachusetts: MIT Press, 2004.
10. Kawasaki, Guy. The Art of the Start. New York: Penguin Group, 2004.
11. Pirsig, Robert M. Zen and the Art of Motorcycle Maintenance. New York: Harpertorch, 1974.
12. LeBow, Victor; Price Competition in 1955; Journal of Retailing, Vol. XXXI no. 1, pg 5, Spring 1955.
13. Poniewozik, James. "" Playboy Feb. 1972: 59 - .
14. Sennett, Richard. The Craftsman. New Haven & London: Yale University Press, 2008.
15. Ehrenfeld, John R. Sustainability by Design. New Haven & London: Yale University Press, 2008.
16. Kay, Jane Holtz. Asphalt Nation. Berkeley & Los Angeles: University of California Press, 1997.
17. Fehlau, Gunnar. The Recumbent Bicycle. 3rd ed. Grand Rapids: Out Your Backdoor Press, 2006.
18. Crawford, Alan. "Ideas and Objects: The Arts and Crafts Movement in Britain" Design Issues 13.1 (1997): 15-26.
19. Walker, Stuart. "Object Lessons: Enduring Artifacts and Sustainable Solutions" Design Issues 22.1 (2006): 20–31.
20. 19. Margolin, Victor. "Design, The Future, and the Human Spirit" Design Issues 23.3 (2007): 4–15.
20. Http://www.exploratorium.edu/cycling/aerodynamics1.html
21. Clark, Kim. "Career Spotlight: New benefit: help with commuting costs" U.S. News and World Report, 9/24/05
22. U.S. Department of Health and Human Services. The Surgeon General's vision for a Healthy and Fit Nation Rockville, MD: U.S. Department of Health and Human Services, Office of the Surgeon General, January 2010.
23. Galson, Steven K. "Surgeon General's Perspectives" Public Health Reports Vol. 124 (2009): 772-773
24. Edwards, Phil & Roberts, Ian. "Population Adiposity and Climate Change" International Journal of Epidemiology 2009;1–4
25. Buckner, Steven & Gonzalez, Joanna. "Americans Spend More Than 100 Hours Commuting to Work Each Year, Census Bureau Reports" US Census Report March 25th, 2005
26. Seifert, J G, Bacharach, D W, & Burke, E R. "The Physiological Effects of Cycling on Tandem and Single Bicycles" Br J Sports Med 2003;37:50–53
27. Keen, Andrew, "New Book Looks at the Internet's Impact on American Life", PBS News Hour, September 17th, 2007
28. Orwell, George (1949). Nineteen Eighty-Four. Martin Secker & Warburg Ltd, London
29. Swmme, Brian. The Hidden Heart of the Cosmos, Humanity and the New Story. Orbis Books, New York, 2009
30. James, Matt, "Ecogeek of the Week Interview with Daniel Quinn" October 7, 2007