INDUSTRIAL DESIGN: SPORTS EDITION

The Capital City Arts Initiative [CCAI] is delighted to present Industrial Art: Sports Edition*, an exhibition featuring design by five area manufacturers at the CCAI Courthouse Gallery from June 9 - September 28, 2017. CCAI extends its sincere appreciations to Aviso Surf/Solution Marine, Burns Machining/Dirt Tricks, The Cable Connection, Sports Attack, and UCS Spirit. Special thanks also to the Western Manufacturing Alliance, Carson City Courthouse, Gerd Poppinga Jr., and all those involved in the exhibition. In addition, CCAI thanks our commissioned writer, Chris Lanier, who provided the following essay.*

Living in our current era, where so much of what we consume and use is bought "off the shelf," design can become fairly invisible to us. I think we take the objects that we use for granted – there's a feeling that it's inevitable that something is shaped a certain way, or performs a certain task in a certain manner. Of course, nothing could be further from the truth – any man-made object has come about as an accumulation of decisions, good or bad. This exhibit, highlighting the design of sports and sports-related equipment made by manufacturers in Minden, Carson City, and Verdi is an attempt to hit a sort of mental "pause" button, and allow us to look at these objects and consider: why do they look the way they do? What are they shaped and manufactured the way they are? Talking to representatives from each company, I asked them about the design decisions that have informed their processes and their products – and was fascinated by all the details of creative problem-solving that go into manufacturing a quality product, whether it's a more durable motorcycle sprocket, or a baseball-pitching machine that provides an accurate simulation of a pitch from the mound.

BURNS MACHINERY INC./DIRT TRICKS

Greg Burns, the President of Burns Machinery Inc., is a mechanical engineer – and he has also raced off-road motorcycles all his life. A change in motorcycle engines in the 90s got his engineering mind going. The engines went from 2-stroke to 4-stroke, and the added power made mincemeat of the rear-wheel sprockets, which are driven directly by the drive chain from the engine. The ordinary material for these sprockets was aluminum, which had the advantage of being light – but the added strain reduced their usable life from around 100 hours to 10 or 15 hours. A rider could easily be replacing their sprockets every few weekends. Vexed by this, Burns began thinking of ways to use more durable materials for the sprockets.

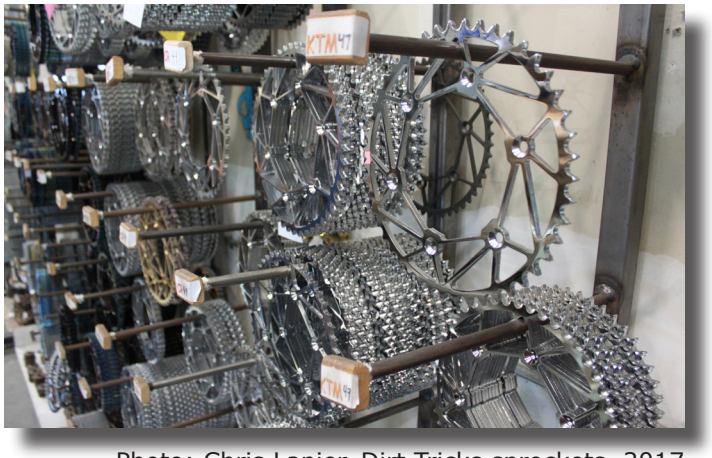

Photo: Chris Lanier, Dirt Tricks sprockets, 2017

He experimented with a heat-treated alloy steel, which has three times the strength of aluminum – but it also has three times the weight. So the design challenge became: how much material could be removed from the sprocket without compromising its structural integrity? Would it be possible to create a sprocket that was actually stronger than an aluminum one, while essentially cutting away two thirds of the disk? The solution he arrived at (and patented) was to work with a lightweight truss structure – if you look at any of the six bolt holes in the sprocket, you'll see three spokes radiating out from it (a fourth spoke joins one bolt hole to the next, a piece of redundancy that will keep the sprocket functional even if one of the bolts fails). Trusses are usually deployed in a linear fashion – they are most commonly seen supporting a roof or a bridge, a series of straight members connected at a joint. Burns has deployed the trusses in a circular arrangement, made to withstand the 6,000 lbs. of pull from the chain.

The design was tested through computer-modeled stress analysis, and was also tested physically in the shop. They bolted the sprocket to a block of steel, and ran a chain over it, and repeatedly loaded the chain to 6,000 lbs. every second for over a week. Finally, the chain broke before the sprocket did. As Burns said: "We won't be the failure point."

One final note on the color – the rainbow and black coatings on the sprockets are applied through a process called Physical Vapor Deposition. Steel is difficult to color – ordinary painting processes don't stick well, particularly with a surface that would be constantly chafed by a moving chain, and anodizing only works on aluminum. As well as having an aesthetic effect, the PVD process hardens the steel, approaching the hardness of diamond. It extends the life of the steel sprockets from 500 hours to about 2,000 hours. In fact, rather than having a motorcycle run through several sprockets over its lifetime, customers have told Burns they've kept the same sprocket over three or four generations of motorcycles.

AVISO SURF/SOLUTION MARINE

John Omohundro, the President of Solution Marine, describes himself as a "third generation composites manufacturer" – continuing the business started by his grandfather, and passed on to his father. His grandfather worked mainly with fiberglass; John primarily works with carbon fiber. Carbon fiber itself is a very versatile material– pre-impregnated with resin, it can be woven or molded, as a fabric, into various shapes. Once it has been shaped over a mold or "tool" the carbon fiber is heated, and becomes a hard but lightweight material – it can replace aluminum or steel at much lower density. One of the items on display is a yacht mast – on a 200-foot cruising yacht, the sail can weigh 1,000 lbs., and it can take a full day to hoist it up (in Omohundro's memorable phrase, "It's like moving a dead horse"). At sail, the mast has to sustain 30,000 or 40,000 lbs. of load, and has to take a tremendous amount of torque. If you look at the texture of the surface of the mast, you'll see the carbon fiber weave is set at a 45-degree angle, making a perfect checkerboard pattern. This isn't done for decorative effect – the 45-degree angle maximizes torsional resistance.

Omohundro is certainly an innovator – he showed me in-process designs for a carbon fiber tower for a yacht. They are usually constructed from stainless steel, but a carbon fiber construction would be much lighter. Carbon fiber construction has penetrated the sport fishing industry, but in the yachting industry a carbon-fiber tower would be a first.

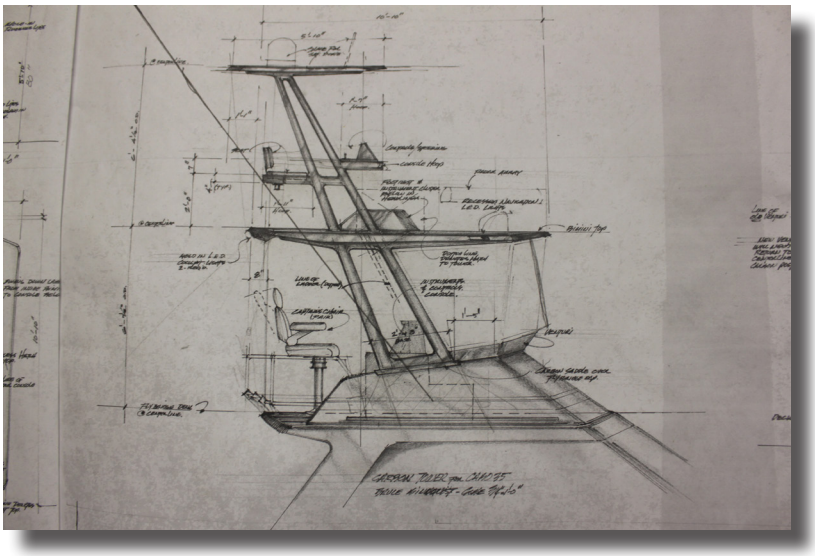

Photo: Chris Lanier, Aviso Surf designs, 2017

One of the things that distinguishes Aviso surfboards is their hollow core (most other carbon fiber boards have a foam core). The hollow shape makes it behave differently on the water. On a solid board, the

board itself makes an s-curve between the feet of the surfer, which increases resistance to the water and slows the board down on a wave. With a hollow design, the top of the board accommodates the weight of the surfer, while the bottom of the board is free to flatten out against the water, and as you pump down the wave, the board accelerates. Though Aviso has had success in the industry – they've sold 11,000 surfboards over the past decade – I could tell Omohundro chafed a bit at the conservative nature of the surfing market. Innovation is a driving force behind his company – pushing materials into new applications – but innovation isn't necessarily prized by the surfing market. Not all surfers are looking for lighter boards that jet faster down the curl of a wave. There's a certain nostalgia or comfort in tradition. "They don't mind if their board is heavy and long," Omahundro laughed. "You get double soul points for doing it the hard way."

UCS SPIRT

UCS Spirit has a manufacturing facility dedicated to the production of vaulting poles in Minden. The poles are made from layers of fiberglass – UCS Spirit is working in the tradition of Herbert Jenks, the first person to patent a fiberglass-vaulting pole. Prior to Jenks' innovation (which grew out of his experimentation with fiberglass fishing poles), vaulting poles were made of hardwood, bamboo, or aluminum. The adoption of the fiberglass pole resulted in records being broken – it represented a genuine technological shift, with the greater flexibility of the material allowing the athletes to launch themselves higher and higher. UCS Spirit has also built on that tradition of record-breaking: the two vaulters who have exceeded a 20-foot vault, Sergey Bubka of the Ukraine and Ranauld Lavillenie of France, achieved their record jumps on UCS Spirit poles.

A vaulting pole is a fairly simple thing in stasis – a straight tube, more or less. Its aesthetic qualities come into play in use. I don't think it's absurd to talk about the beauty of the curve it forms when it's been planted, and the full weight and momentum of the vaulter compresses it into an arc – an inverted "J" that is mirrored in the curl of the vaulter's body, before both pole and athlete straighten to their vertical apex. The curve of the pole is a sort of visual signature of the event, and it is a fundamentally material signature. Aubrey Dooley, a competitive vaulter who wrote a history of fiberglass pole-vaulting for his Master of Science Thesis, was competing during the introduction of fiberglass poles to the sport. He wrote: "The writer recalls not placing at a track meet in Modesto, California, because the crowd was expressing their excitement with "ooo's," "aaahhh's," and screams at seeing the fiberglass pole bend to an approximate ninety degrees. The steel poles had been in domination for some fifteen years and did not bend enough to catch the spectator's eye. Today, the sight of a fiberglass pole bending seems commonplace."

The manufacturing process for the poles is very hands-on. The fiberglass is first spun on a machined mandrel – and this is the most automated part of the process. From

there, workers add layers of fiberglass sheets, in two forms – a body piece, rectangular in shape, and a sail piece, which is cut like a sail, the edge of which spirals along the length of the pole, giving support for the stress that's put on the pole as it bends. These are adhered to the pole with a hand iron. A pole will have at least six layers, and can have as many as nine. They are put into a steam tube that hardens the fiberglass using heat and pressure. After it cools, a weight is applied as a "deflection test" to see that it had the desired flexibility. Then, before it is engraved with the standardized numbers that correspond to its length and flexibility, the pole is put into a cage, where a machine arm bends it as a final test of its structural integrity. And there, the defining arc makes its appearance – a hint of the force that will eventually propel an athlete skyward.

Photo: Chris Lanier, pole testing cage, 2017

THE CABLE CONNECTION

While some of the design features of the objects from the other companies in this show may be visually subtle, or their significance might not be immediately apparent to someone not employed in their industry, the work The Cable Connection performs one step further – it's design that actually strives to be invisible. The Carson-based manufacturer designs and manufactures wire rope assemblies, used for barriers in residential and commercial settings, including sports stadiums. Cable railings are an ideal safety feature for sport stadiums, keeping spectators from falling down staircases or off balconies while leaving the view of the field mostly unobstructed. The Cable Connection manufactures the metal assemblies that anchor the cable to the railings – their priority is to keep the fittings hidden in the railing posts themselves, so that the look of the barriers is as clean and simple as possible (other companies make fittings that protrude from the posts where they grip the wires).

Cable Connection, stainless steel fencing, 2017

The other point of design that they advertise is ease of assembly. Maintaining tension on the cables as they are installed can be complicated, and the fittings of their competitors can have as many as a dozen parts, with a set of special tools needed to properly get the fittings in place. The Cable Connection has pared down the number of pieces in a fitting to three at most. The barrier included in this show was designed to be exhibited at trade shows – the clean curves of the railing form a kind of platonic ideal of smooth simplicity for the fittings to inhabit. The ingenuity of construction of the fittings themselves is something you'll have to imagine – as they modestly sit inside the posts, content to perform their function in the dark.

SPORTS ATTACK

Photo: Chris Lanier, Hack Attack, 2017

Sports Attack designs and manufactures sports training equipment. The design of the Hack Attack, their baseball-pitching machine, is driven by a problem of visibility. Prior to the Hack Attack, ball-pitching machines used two spinning wheels, set on the same plane, to throw the ball. By varying the speed of one wheel in relation to the other, a two-wheelpitching machine can put various spins on the ball, mimicking a variety of pitches a human pitcher can throw from the mound. The problem with the two-wheel design is that the two wheels have to be set on a vertical plane, one wheel directly above the other. From the batter's point of view, this visually obscures the chute the ball rolls down to feed into the wheels (if the wheels were set on a horizontal plane to leave the ball chute unobstructed, the spin that the wheels put on the ball would not correspond to the spin that comes from usual over-arm pitches – effectively training batters to hit pitches that wouldn't actually be coming from the mound).

This may seem like a small detail – blocking the view of the ball for a second or so as it drops into the wheels – but in fact it throws off the timing response of the batter. In a real-world situation, as the pitcher is winding up, the batter is leaning into their "load" position, in much the same way a boxer will wind their arm back before throwing a punch. Cutting out those moments of anticipation is also cutting out about seven or eight feet of the trajectory of a real pitch; using a three-wheel pitching system, with the wheels arranged in a Y-shape so that the ball chute can be seen by the batter, restores the accuracy of the timing.

Photo: Chris Lanier, Snap Attack, 2017

The Snap Attack, their football-throwing model, shares some design similarities with the Hack Attack. Both machines are made to be portable, are compact enough to fit through a standard door frame, and use guards for the wheels, preventing accidental forearm burns. A big difference, of course, is the shape of the ball (the football traces its unique shape back to the days when players used inflated pig bladders – a shape that was roundish, but not quite a sphere). The two wheels of the Snap Attack can be adjusted to fire off left-handed spirals, right-handed spirals, or kickoffs. One of the unique design features of the Snap Attack is the universal cradle, which holds the ball as it's fed into the wheels. The curved structure can accommodate the ball in both the horizontal "throw" position and the

vertical "kickoff" position; other football throwing machines utilize two separate cradles for each position, which eats up practice time as the person operating the machine changes out the part. When I asked Kurt Brenner, Partner and VP of Sales, if they had used CAD modeling to design the cradle, he laughed: "No, it was Bondo." His father, one of the founders of the company, hand-modeled the shape from the filler putty, and sent it off to a mold manufacturer so that it could be cast in aluminum.

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Hopefully this essay communicates some of the design decisions behind these objects in a way that makes those decisions more visible, when you look at the objects themselves. It is at least an attempt to strip away the patina of "inevitability" that adheres to objects that come into our lives fully formed – making us aware that they don't look they way they do because they "have to" look that way. They look the way they do because designers and engineers have tried to make something better, more innovative, more durable, more consistent – more beautiful, either in function or form.

Chris Lanier
Reno, Nevada
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Capital City Arts Initiative
www.arts-initiative.org

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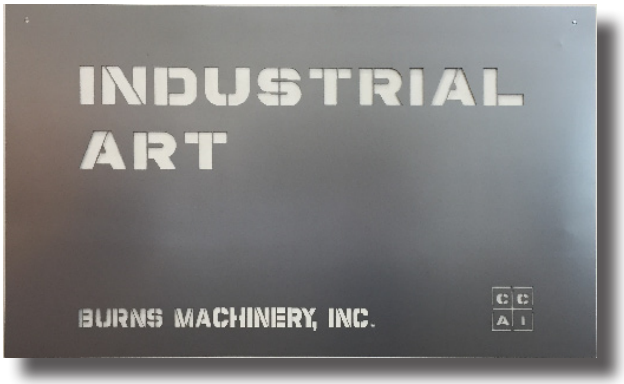

Burns Machinery, laser cut steel, 8'x10', 2017