PROFESSIONAL BOATBUILDER

The magazine for those working in design, construction, and repair

NUMBER 152
DECEMBER/JANUARY
2015
$5.95 U.S.

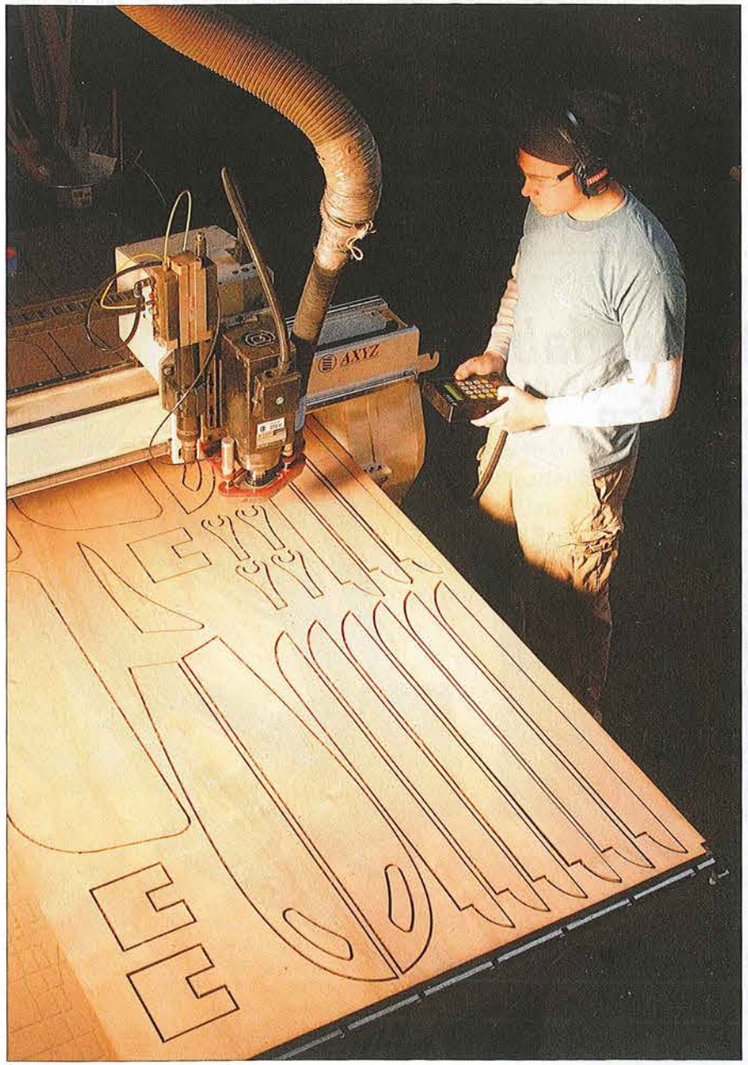
GHT CRAFT
MS, PART 1
NG MARINE
MS ERRORS

Easy Pieces

With roughly 2,000 boat kits sold annually, and double that in plans, Chesapeake Light Craft (CLC) is likely the largest kit-boat producer in the world—proving that a thriving boat business can be built on a foundation of many small parts assembled through persistence, for a market driven by passion.

Text by Steven Callahan

Graphics courtesy CLC (except where noted)

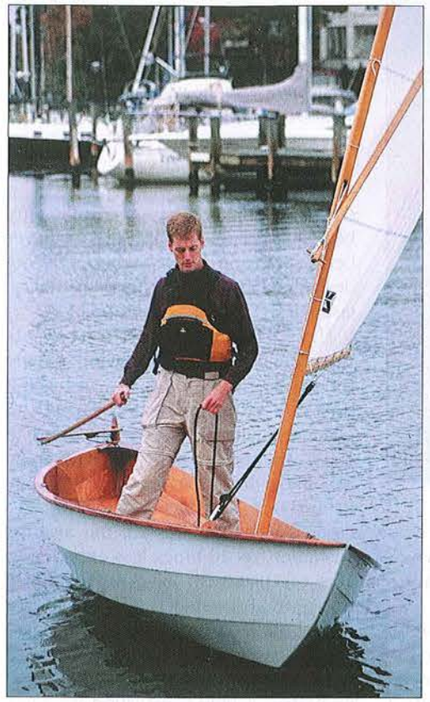


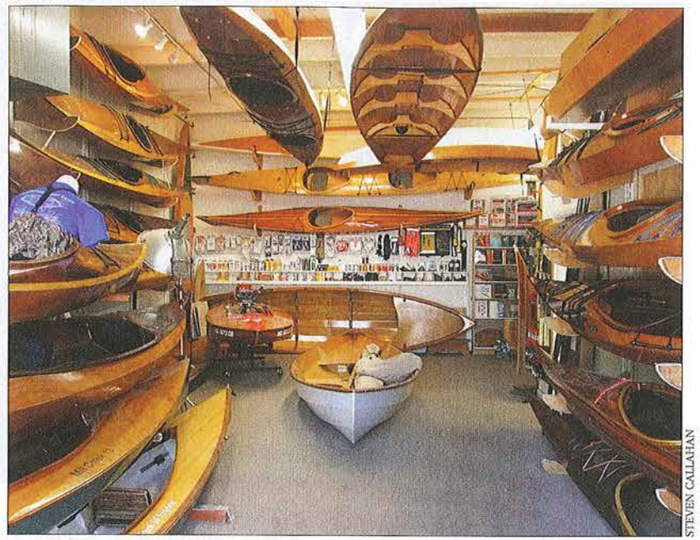
A computer numerically controlled (CNC) router is the heart of the operation at kit-boat manufacturer Chesapeake Light Craft (CLC) in Annapolis, Maryland. Maximizing materials, the technology's software determines the layout of multiple parts to be cut from a single sheet of marine plywood.

John Harris's bulging marine library in his home on the shore near Annapolis, Maryland, his artistic drawings, furniture he has designed and built, his musical instruments, and his wife and child all reveal a man in love with the earth, water, family, art, design, and pretty much anything that floats. These qualities have blended with his ability to work with his hands and maintain a realistic business head to build Chesapeake Light Craft into a successful enterprise that has shipped more than 25,000 kits since 1994.

Growing up in South Carolina, Harris was a self-described "odd kid," because "I knew exactly what I wanted to do from age five when I first formed the thought that one could build a boat." In ways, Harris followed his dad, an avid small-boat sailor, corporate executive, and PhD engineer at Dupont. "If the family needed a coffee table, he would build one," recalls Harris. "He built an air compressor before I was born, and still uses it. I grew up thinking that this was normal." His father also passed on a fascination with entrepreneurship, and Harris "read all the business books he left lying around."

As a young teen, Harris wanted his own boat, but his parents weren't about to buy him one. So "in an unusual act of teenage rebellion," he built his own—a box-section, lauan-plywood rowing shell. Harris still has the bow, declaring, "It was an absolutely terrible boat, horribly unstable, and my 14-year-old's skills were ghastly, but it did keep the water out." He designed and built boats throughout high school, but his counselor was at a loss about helping him become a professional, and his parents talked him out of studying boat design and construction, so he turned to his second love, music, at a small liberal arts college.





STEVEN CALLAHAN

***Left**—John Harris, CLC's owner seen here sailing the 15' (4.6m) Skerry, has been designing and building small boats since he was in high school. His eclectic personal tastes and interests have defined the broad range of designs and kits offered since he took over the company in 1999. **Above**—On display in the showroom, small boats include many kayaks that are designed to be simple to construct, inexpensive to own, fun to use, and attractive to look at.*

Before graduation in 1994, though, he got a job at an old boat shop, mostly repairing wood boats. The owner also made kits for the nascent Chesapeake Light Craft. Between repairing and restoring boats, Harris made kits, developed patterns and router tables, and even kept the books. He noted that kayak kits made for CLC supported the rest of the business and then some.

Despite having orders for about 25 kits, the shop owner ran out of money and laid Harris off, but the owner of CLC then hired him. This worked for a while, but by the fall of 1999, Harris found angel investors to buy the company.

"The designs were kind of a mess; the instruction manuals were not first rate. I was thinking, 'How am I going to pay all this money back?' At 27, I had $4,000 in my checking account and I'm on the hook for $2 million." But it was his dream job. He'd watched his hero, Phil Bolger, turn out original designs that nobody built, or were bastardized so never got a fair test. "I was selfish," he says, taking the long view that CLC could provide enough cash flow to allow him to stretch his legs "in ways that many designers can't." He could build prototypes of "designs that I had been doodling in school—to play with proas, camp-cruisers, all these interesting small craft."

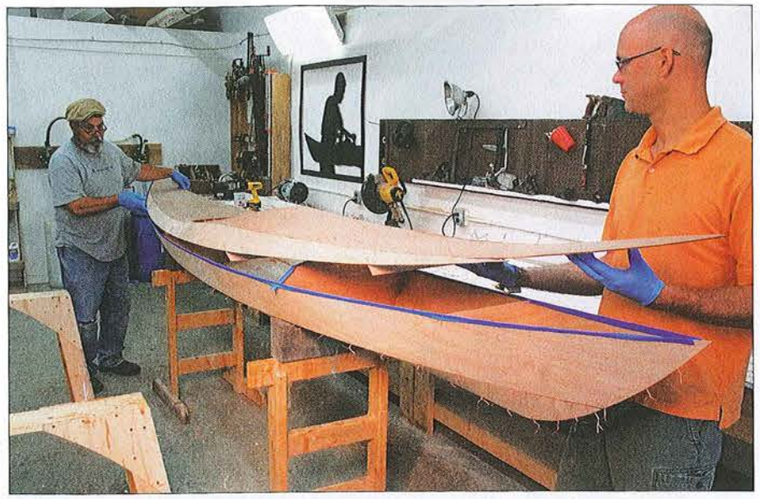
Harris: "The smaller the boat the bigger the adventure. A kayak is the most elegant, pure, and perfectly efficient watercraft ever developed. With the tiniest energy input—less than a tenth of a horsepower—kayaks can do 6 to 7 knots and carry a full camping load. If you're skilled, you can take them out in very rough conditions. Many small boats deliver a huge bang for the buck. I love the fusion of sculpture and engineering. I was beguiled by the idea of a design house where I could create interesting boats that would get built."

He was determined not to approach CLC like artist-builders who typically keep their businesses small with few if any employees and low overhead. "It gives them lots of freedom," he confesses. "They can go sailing for three weeks if they feel like it, but few can afford to bring even a great idea to a wide audience."

By 2004, his backers wanted "hundreds of thousands a year, if you please"—reflecting an approach inconsistent with Harris's goals, so he bought the company outright in December of that year.

"A kit is not just a pile of parts."

—John Harris



All designs and kits are available only after a full-size prototype has been built and tweaked for ease of construction, and performance on the water. It costs about $20,000 to develop a new kayak kit.

The Harris Rule

Once Harris took control, things started falling into place. "I'd learned through the school of hard knocks that focus groups might work for really big companies, but in the niche build-it-yourself market, getting people interested enough to make such a big commitment requires really interesting boats," he says. "Basically, I started doing only boats that I found interesting and fun. Most of the time, they have a pretty broad appeal."

Not all are home runs. He recalls a boat that could be taken apart into three sections, ideal for people with storage and transportation concerns. It was also stable but long and narrow. "I was absolutely certain the orders would pour in, but maybe we sold 15 a year." Customers also suggest designs. "Whenever people see a plywood boat, they assume that it can be made into a kit. I can do the data and a CNC machine can generate a pile of parts, but a kit is not just a pile of parts."

Indeed, the company's success rests as much on its focus on customers, diversification, and a guideline he calls the Harris Rule as it does on boat designs and manufacturing.

Harris says, "The Harris Rule states that if a kit costs more than a good used boat with roughly the same features and capabilities that you might find on craigslist, no one will buy the kit, or they would be crazy to buy the kit. If you can get a good used boat that maybe needs just a little cleaning up, that's what you should do. Only if the kit is compellingly inexpensive for a given performance parameter or it offers something so unique that you can't find it anywhere used for love or money would it justify the huge investment in time to build it."

He cites the example of a small powerboat kit with a high parts count. "The kit is $3,500 to $4,000. You need an engine—another $3,500—and a trailer at $1,000. You're at $9,000 and you haven't mixed your first pot of glue. Why not go out and buy a $9,000 center-console boat on craigslist?"

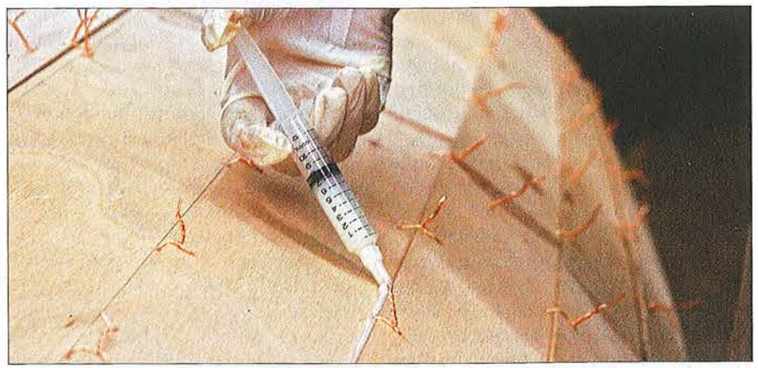
Building Skills Optional

Unlike most boatbuilding businesses, CLC needs a steady flow of customers, and lots of them. In 20 years Harris has witnessed a huge change in their capabilities and expectations.

CLC's business is not honed for skilled builders, who populate the very tip of a marketing pyramid. Harris says, "It's hard to market to them. They don't need you. They can build any boat that they want, and there's never been a time in history when amazing designers have turned out so many fantastic designs for advanced builders."

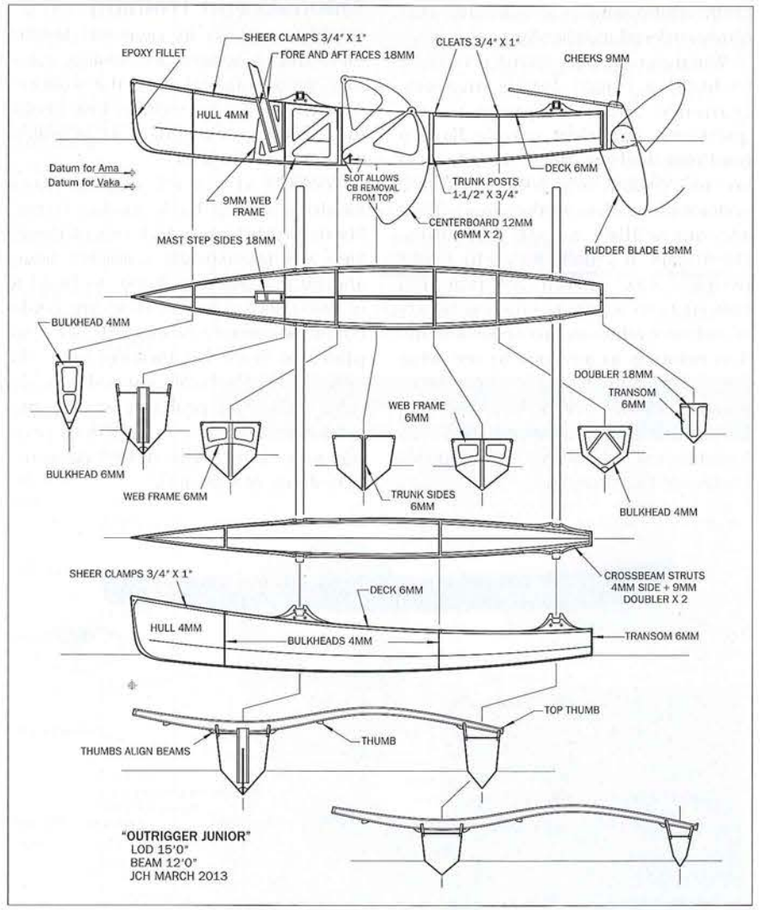
His primary opportunity rests instead among "the 6.9 billion people in the world who've never built a boat," a group that also poses the greatest challenge. "When I started in 1994, we could count on the average kit builder having at least some facility in a shop. The kits have gotten 10 times easier to build, but the average customer has 10 times less experience. Lots of customers have never read a book on the subject. They've never even built a birdhouse. Some do fantastically well. For some, it ends in tears. Telling the latter, 'Well, it used to be worse,' is little consolation."

Some customers are so unskilled that it would be better not to sell them a plan or a kit. "So many people these days can't read plans at all. When a part is symmetrical around an axis and the plans only show half of the part, some people build half of the part. That's happened twice in the last month. One guy made half of the deck and bottom. We were very nice. I guess if you can't laugh, you have to cry. That guy was definitely not laughing, though. We take visualizing reality from plans for granted, but there are powerful lessons in finding out that many people don't even see what's wrong. You can't make assumptions about anybody."



To accommodate what Harris sees as the progressively diminishing level of experience of would-be amateur boatbuilders, the precisely cut components are optimized for simple construction, including pre-drilled wire holes for the stitch-and-glue method seen here.

Right—*Offerings like this lively outrigger canoe keep the catalog interesting even to more experienced builders and sailors.*
Below right—*Harris says inking final complete plans is the last step in designing a new model—long after the hull has been conceived of and refined in a design software program, and the prototype has been successfully built and sailed, paddled, or rowed.*



Most customers with problems are not so accepting, though, and some absorb an astounding amount of time. One has sent over 200 e-mails and called nearly daily for almost a year. "When the guy placed his order, we should have mailed him a check for $2,000 and thanked him for getting in touch with us. The problem with this particular guy is that he's very noisy on the Internet bulletin board," a growing source of word-of-mouth advertising and criticism.

"I will absolutely talk someone out of building a boat. We've proved again and again that it's too expensive to end up with someone who is going to tell all their friends what a bad time they had," Harris says. "The customer is always right. We provide free, unlimited tech support. If I have to carry you through, I will, and I have.

"Part of being a customer-service organization is a willingness to not be arrogant. We don't say, 'If you don't get it, you're stupid.' We don't get angry or abandon the person. We simply say, 'You've brought up some good issues here.' It's an interesting intellectual challenge."

To meet that challenge, since 2005 most CLC plans include full-size patterns. CLC also began employing puzzle joints instead of scarfs to make panels longer. Scarfs can slip during assembly, misaligning panels, but puzzle joints are asymmetrical, so they fit together only one way, the way the designer intends. Since 2005 the company has employed mortise-and-tenon joints for fitting components like bulkheads, eliminating even the need to measure. Wire holes for stitch-and-glue are now pre-drilled. The kits are approaching Ikea simplicity, a company whose business model Harris admires.

With more than 60 parts in every kit, CLC sometimes inadvertently makes errors. "It happens," says Harris. "This is the cost of running a volume business. Car companies have development budgets of billions of dollars for one model, and they don't always get it right." The CNC machine can hiccup. Sometimes the wrong

A key to CLC's success is the opportunity for relatively unskilled amateur builders to produce beautiful and seaworthy small craft like this 15' Chester Yawl.

parts get packaged. Responding to customers with such problems, Harris tries to immediately confess the company's failures, overnight the correct parts, if required, and in rare, egregious cases, refund money. It pays off. One such customer received some parts cut from old files. Harris "was horrified. It was totally our fault." But within a month this customer ordered another kit.

When people ask, "What do I need to build a boat?" Harris answers, "Patience and willingness to ask questions. Impatient people have a hard time with kit boats. People who are too proud, angry, or frustrated contact us too late in the game. They are not willing to ask questions. Obviously it's hard to help those people." CLC encourages potential customers to watch its growing library of videos online and to order instruction manuals in advance to see what they'll be getting into. Also, boatbuilding classes are booming, which helps the inexperienced and has transformed education into a profit center for the company.

Manuals and Training

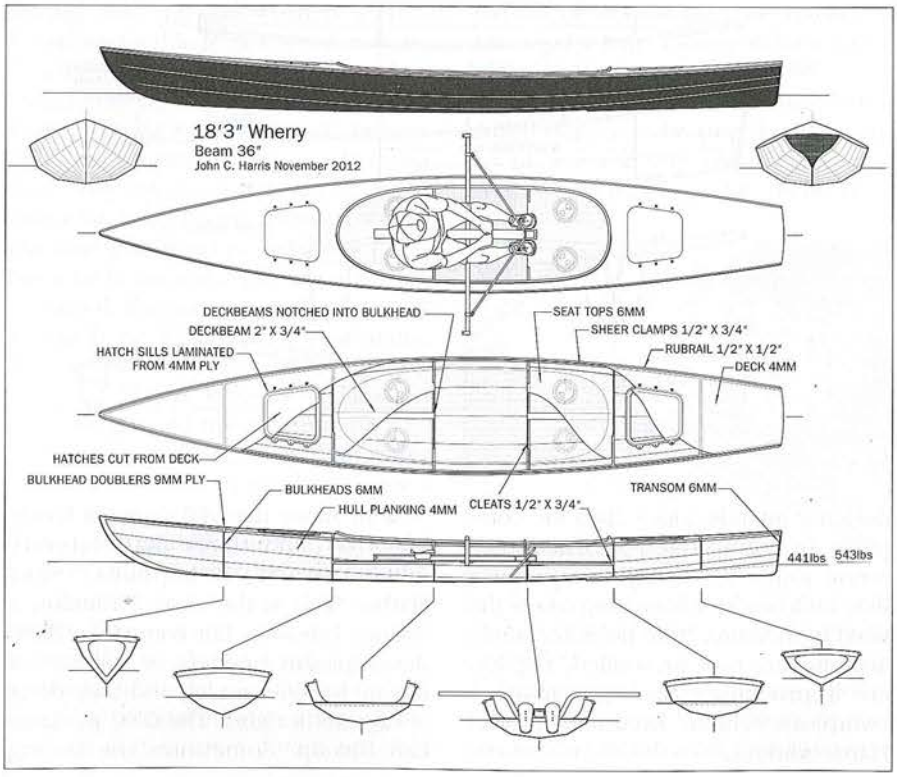
CLC maintains its own art department that produces advertising, catalogs, plans, manuals, and the website. A book could be written just about the evolution of manuals, 41 of which are currently in print.

Looking at a stack of boat-plans catalogs dating back to the 1940s, Harris says, "I get a kick out of these. Here's a fantastically complex boat, and all you need to know to build it in two pages. Until 1994–95 we could count on people being able to read plans, at least by looking at a 3D view. They probably owned a scale rule. They had probably read some books. In 2014, three out of four people who build kits never contemplated any of this stuff."

So although in CLC's early days, cash flow was derived largely by a roll of plans and a manual, "these days, manuals have to address the first-time builder with few skills," Harris says. "On a bell curve, about 5% are advanced builders. They may not even read the manual, or if they do, they won't have any trouble and might even improve the directions. Most builders are in the middle. With a decent instruction manual, they'll build a pretty good boat. Maybe they will call or send a couple of e-mails with questions. About 5% rest on the other end. They'll struggle to build anything, and probably shouldn't be building a boat."

On Internet forums, people also talk about their struggles assembling CLC boats, and complain, especially about the manuals. Harris considers this "critical feedback."

"A manual can be beautifully designed, intricately and artfully put together, but unless your instructions are perfect for beginners, then it will not be a success," says Harris. As customer skills declined, and more people complained, "we listened and acted." In 1995 when most kit boats came only with plans, CLC's popular Mill Creek kayak had an 18-page manual "that was probably as good or a little better in detail and clarity than anything out there," but by 2002 it had grown to 209 pages. "We still got plenty of complaining," recalls Harris, because there was too much text, but



A page from the plans for this 18'3" (5.6m) Expedition Wherry specifies the plywood for all major components and indicates the layout of bulkheads and frames for the lightweight, easily driven vessel.

STEVEN CALLAHAN

In addition to the simplified kit construction and comprehensive manuals for each model, CLC offers classes at its own facility and at several satellite locations in Maine, Washington, and Michigan. ***Above****—Students from the Calvert School in Maryland work together on an Eastport Pram kit.* ***Right****—Harris among the rolls of plans the company offers—96 distinct designs and counting.*

the 451-page fully photo-documented manual for the Arctic Hawk was way too much. Besides costing $50,000 to produce, "builders would get to about page 120 and just be worn out." The boat was a "catastrophic marketing failure. That was an important lesson. You can take it too far."

By 2008, the manual for the Wood Duck, which has sold thousands, was 66 pages. The layout is simple, with photos and captions. Some manuals are longer, "but it's not about the page count; it's about the content."

CLC continues to work on the manuals' quality. "It's helpful to fly back up to 10,000 feet once in a while to get an overview. The PocketShip manual does this," says Harris. Each section begins with an overview of what's to come, what's important, and what not to worry about.

The complexity of such learning curves in the business is why Harris says, "I'm not afraid to talk about the nitty-gritty of what we do. Without having been at the end of the tech call line for 20 years, I don't think that anybody can create manuals that anticipate where the amateurs go off the rails as well as we can."

Classes perfectly suit amateurs with no building experience, but like manuals, there's a lot to making them work. Each requires a week of prep. Instructors typically have taught a particular class 40 times. CLC teaches at home base from February to May and September to November, and at WoodenBoat School in Brooklin, Maine, from June through August. There are also satellite locations in Michigan and Port Townsend, Washington. Usually seven kits are built simultaneously in a class, with anywhere from one to three students per boat. In 2014, CLC will teach 30 classes. The class fees plus sales of accessories have made this a profitable part of the business.

Finally, the company has augmented its customer outreach with videos on YouTube; one is a 16-part series covering the building of a boat from start to finish.

In Good Kit

"The Internet changed everything," Harris says. "Suddenly our reach extended massively. We went from building hundreds of kits a year to building thousands pretty suddenly."

In 2004, CLC offered a couple dozen kits, and today 96 distinct designs, including 57 kayaks—24 strip-planked, 23 stitch-and-glue, and 10 hybrid—plus 39 rowing, sailing, and powerboats. There's even a popular cradle boat that can be converted to a coffee table, one of the few kits that can ship UPS. (The company also cuts kits for others like The WoodenBoat Store.) The public enjoys a huge selection, but although the company tries to keep the five most popular kits in stock, it's a challenge to keep the numerous other models in inventory. "You might have to stop in your tracks and cut a one-off to order, and that sends employees out back screaming."

For most small boats, the break-even threshold is about 50 boats in the first year or two. Payback time has lengthened as the market for kayaks has become more saturated. Most kits are profitable. Some actually lose money, but the entire line promotes the sale of supplies and accessories, from paint and paddles to sails and trailers. Harris focuses on true value-added products that are difficult or impossible to find anywhere else, many made just for CLC. There are so many elements that Harris hired a career librarian to "beat this place into order in terms of a place for everything and everything in its place."

Kayaks remain CLC's bread and butter, partly because "kayaks are mostly air with plywood ... not too

With 57 different kayak models in the catalog, Harris concedes that they remain CLC's bread and butter, although paddleboards are the current bestseller.

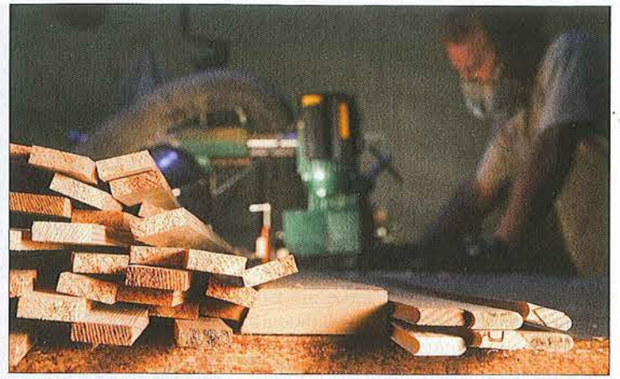
much fiberglass and epoxy," explains Harris, adding, "but our number one sellers right now are paddleboards. We sell hundreds a year, more than the next three categories combined."

The success of this base business has allowed CLC to develop a very eclectic menu, including boats like the 15′ (4.6m) PocketShip. "Under sail, the boat feels like 20′ [6.1m]. It's a big kit with average cost of between $4,000 and $5,000 ... $8,000 with all the options. It ships on a pallet in a big truck and isn't intended for first-time builders." Harris built the prototype for himself, wondering if it would even be marketable, but after posting a video of the first boat on YouTube and getting 125,000 views, he has sold more than 50 PocketShips. Even this niche has become reasonably profitable, thanks in part to the boat's 280-page instruction manual and full-size patterns for every part.

Much about CLC and the kit business appears to be backward from traditional boatbuilding, including how "plans are the very last step in the process, even following the instruction manual," explains Harris. "That confuses people: 'Why aren't the plans available for this design when the kit has been out for months?'

"You first do the 3D models and then you expand the panels. Then you go into CAD, cut the panels up, and design all the cutouts, like bulkheads, hatch sills, limber holes, all the complicated details. You build the prototype on the floor, which among other things allows me to fix whatever isn't quite right." It then takes a lot of time to lay out the pieces on plywood to minimize waste, as does hand-drawing the actual plans with every detail.

It costs about $20,000 to develop a new kayak. Eighty percent or more of that cost is for building a prototype, and documentation, creating the instruction manual, and photographing every step. CLC's most popular kits run around $1,200. The kit costs about $380 to manufacture. The rest is supportive to selling the kit. Keeping an eye on the Harris Rule, it's still cheaper for a customer to buy precut kits than to buy the materials that go into one à la carte. Because of an internal audit in 2013, the company might have to alter prices somewhat, figuring everything out down to the penny, and including things like liability insurance, which escalated when CLC expanded into powerboats.



***Left**—Along with the major wood structural members and planking, each kit contains the epoxy and filler, fiberglass reinforcements, and specific fittings or hardware required for construction. The kit's completeness and logistical organization, allowing each one to be packed efficiently and consistently, deliver Ikea-like simplicity of construction.* ***Above**—The CLC mill shop turns out bead-and-cove wood strips for planking in numerous kits.*

The Machine

Perhaps the heart of any kit business these days is the CNC machine, a finicky and expensive investment that lets the company convert raw stock into one or two dozen kits a day, including packaging, which demands painstaking controls. CLC began business with router tables and jigs, but the computer-controlled cutters are essential for volume work.

Harris points out that these are not "magic reproduction machines," though. Bits are expensive and must be replaced daily. Sharpening them would reduce their diameters, changing the sizes of parts and joints. Software glitches can cause the machine to "show signs of mental illness. It will be fine, fine, fine, and then you'll put a $125 sheet of okoume plywood down, and it will grind away the middle." It's been known to cut through the base of particleboard into the milling table, and the particleboard changes with moisture. Clumped wood dust sometimes catches fire in seconds. In addition, the router bits must slow down to accommodate the complex puzzle joints. Drilling the wire holes takes a lot of time.

The new $230,000 C.R. Onsrud CNC machine installed in summer 2014 is more efficient than the one it replaced, and can affix bar codes to each component to aid in managing inventory. It will also be employed to cut kits for other designers.

Although CLC's setup allowed cutting on one end of the table while setting up the other, the company had been subcontracting another CNC shop to keep up with demand. In August 2014 it invested $230,000 in a C.R. Onsrud CNC machine with lots of "gee whiz" features, including a labeling widget that will apply bar codes to every part to help manage inventory, previously done by hand. "You still can only push a bit through wood so fast," Harris says, but the new machine is a little faster and vastly reduces downtime. Increasing production by even 10% or 15% amounts to a lot of money. With good tax incentives, the machine is well worth the investment.

For strip-planked kits, CLC creates strips "by the mile"; and no longer is the choice of wood "whatever the truck brought in." Instead, customers order exactly the tones of wood they wish: Peruvian walnut for dark accents, Alaska yellow cedar for light, and western red cedar in the middle.

CLC's sophisticated software and machinery has allowed it to custom-cut kits for Dudley Dix (see Design Brief, page 16), Robb Ladd, and other designers and take on other subcontract work.

Crafting the Future

Harris sees an interactive Internet as key to Chesapeake Light Craft's future. Like its boats, he wants its website to be fun and informative, and within five years wants to have created online questionnaires that help people choose the right design for their purpose and skill level, collaborative Wiki-style manuals, answers to FAQs, and step-by-step videos.

A paddleboard in build illustrates the thoroughness of the kit design that leaves little room for error with precut limber holes, notches for the deck stringers perfectly aligned, and station numbers routed into the transverse frames.

Shipping high volumes of raw materials in, and large boxes out, also poses a challenge, as does availability of quality wood products. With that in mind, some future kits may be made from foam core, composites, and other alternative panels.

At base, though, CLC will continue to depend on solid design and customer satisfaction so that, when one of its boats pulls up onto a beach, some person among the billions who've never built a boat will ask, "Hey, did you build that yourself? Where did you get the plans and kit?"

"If you're willing to make the investment and have a corporate attitude that's welcoming to these people, they will be building their own boats forever," concludes John Harris. PBB

About the Author: *Steve Callahan has designed and built several boats, authored two books, and written widely in the marine press on modern sailing design, designers, and technologies. He is a longtime contributor to* Professional BoatBuilder.

See John Harris's essay "All I Need to Know About Running a Boat Shop I Learned in a Band" at ProBoat.com.