UNIVERSITY OF AUCKLAND Business Review
Volume 10 No. 1

When art meets science

- Bruce Farr

When *art* meets SCIENCE

By Bruce Farr

The author reflects on his career in boat design; how technology continues to reshape the industry; and how design teams manage the creative and research process.

Winner of Kea New Zealand and NZTE's "New Thinking" Award, 2008

When I started designing boats seriously in the late 1960s, it was more art than science. It was all about feel, experience and trying new things to see if they worked. Building boats was a cottage industry, but there were some very experienced people who passed on their experiences to others. Since that time it has become a global industry, but along the way there was an interesting transition when the old design processes complemented the new.

Things changed rather slowly, but the initial revolution was created by waterproof glue, which allowed the use of plywood and the process of lamination. It was a huge stride toward producing high-performance boats. Fibreglass construction then had a huge effect on prices and therefore the availability of boats to the public. The realisation through that period that you could build fast, safe and easy-handling off-shore boats was really the focus of more of my work in the 1970s. Then, with the intensity of the America's Cup, the tighter rule restrictions and the of use scientific tools, the finer nuances of the performance of boats became the focus. New processes enabled the testing of designs before any commitment to the building process. For many years, however, computer-based tools were pretty crude and slow (not to mention expensive and unreliable), and access to pre-build testing was somewhat spotty. It's only probably been in the last ten years that computational-based tools have really become effective.

It has all led to new ways of doing research. Fifteen years ago you would think of an idea, kick it around, and some level of prediction was possible on a computer. But to actually test the shape, you'd go to a tank testing facility and tow the boat for a week at huge expense. Contrast that with today where you can think of a whole series of variations, test them in a fluid dynamics environment, and depending on the computer programme, have the answers back in anything from one to three days. Across a series of data you can see trends and get greater insight into the differences-but also learn what's causing the differences in performance. This has been a tremendous revolution, but the advances are probably going to plateau when the computational fluid dynamics have become fully effective, fully proven and fully trusted. We're still not quite to that point. There are varying degrees of success, but on the whole they're very useful tools.

Hand in hand with those developments has been the evolution of materials used in the construction of boats. Most high-performance boats these days are built with carbon fibres and a sandwich-like construction, with a PVC foam or honeycomb core for example, which saves a huge amount of weight. This obviously opens up the design sphere to make new gains.

Bruce Farr is the Vice President, Director and founder of Farr Yacht Design Ltd.

Farr (left) on board BMW Oracle US71 in 2007

Building wooden boats in "the old days", we simply fastened pieces of wood together. Then in the early days of glued wood construction and composite materials we usually built the shell of the boat on some kind of form, a plug or mold. We'd build a frame, plug o mold, and continue building outwards. Today, more emphasis has been put on reproducing a shape more accurately. It's partly about eliminating the loss of shape as you build something, but there's also a thermal instability issue. The latest trend has been carbon fibre female moulds that are thermally stabilised through structural design and/or some sort of a heat cycle before they are NC milled to their final shaping. We even use reverse engineering, which in simple terms means we allow for predicted levels of distortion. The shape at the start is consciously made different from the shape you want at the end, and computers help you produce the required shape more easily. This approach became quite common in America's Cup boats, where there is a very high standard of construction and accuracy needed to eliminate any surprises.

With this new technology, the total design and build process can be shorter, because we can now deliver full-size patterns for parts and 3-D models of the components. That cuts a big amount of time from the process, and gives some degree of freedom in allowing building of parts separately and knowing they're going to fit when they all come together. The improvement in accuracy has enabled the quality of parts to improve rapidly.

It has all resulted in performance and speed. Multi-hulls have always led the way and I think some of the records being set today are quite astounding. First is the fact that somebody could sail singlehandedly around the world in 52 days, which is 20 to 30 days faster than a fully-crewed multi-hull from 10 to 15 years ago. It's quite a staggering improvement. It's the same with a monohulls, with the various swing or canting keel designs and the huge improvement that's possible with modern materials and lighter structures. A few years ago one would not believe that single hull boats could be averaging well over 500 miles per day, but that's what's happening today.

As designers, the results on the water always surprise us. You always seem to find more advancement than you're expecting at the beginning of a research project. Sometimes it's a big idea but quite often it's the small changes that can produce the bigger effects. When you go into something like an America's Cup programme you never really know where you're actually going to find the gold, so to speak. You begin with some ideas about potentially useful areas to investigate, but we're often surprised where the little nuggets are found.

I started off as a one-man-band and then grew to a small team of five people. We worked very easily and openly without a lot of structure. As the team grew beyond six or seven people we had to actually start formalising processes to ensure that people understood their roles. It became an

On board Snake Oil, a Farr 43, in Chesapeake Bay in the late 1980s

organizational challenge and the skills were obviously quite different. Like any growing business, you have to either develop management skills or bring in other people who have them.

In terms of our creative process, there are times now when we work virtually. It's not always the preferred way to do it, because I think good innovation needs interaction. Sometimes the interaction possible via the web just isn't quite the same as being in the same room with your colleagues for longer periods of time. We have 17 people in our organization and it's challenging when you have to interact with America's Cup teams which might have a group of 30 or 40 technical people in various locations. In many cases they're people with whom you haven't worked before, so you have to establish a new process for communicating with the group.

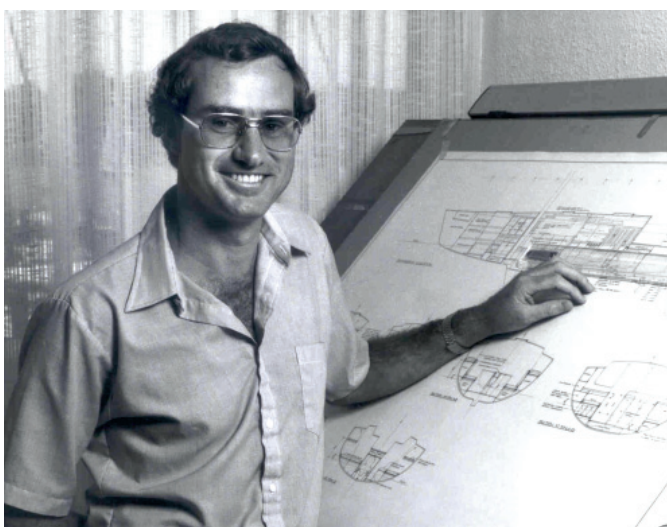
In the last America's Cup we were commuting from Annapolis to Valencia, typically with 5 or 6 of our people working on the project but only one of us working full-time for the team. It's a tough way of doing it, especially from a personal standpoint because you get torn between two places, and you can't really establish a base for the team in either place. There are now a group of designers who are dedicated entirely to America's Cup programmes, and they choose to focus on one project rather than having another life somewhere else.

For us, the America's Cup is exciting because it has the monetary backing to do good research, whereas most other projects only enable designers to dance around the edges. You can do a little bit of research and check out a few things, but you don't ever get a nice, logical development programme that goes on for a year or two where you can truly make some big steps, as is the case in the America's Cup. The irony is that for the last event the America's Cup class had a fairly tight formula and rules. While there was more power to research, there was also less scope to improve.

I think the designers of the future will be better qualified in terms of technical expertise. They'll be required to operate some very sophisticated tools to produce answers to their questions. Yacht design already demands much more technical knowledge than previously, and I think that's an irreversible trend. Technology already allows us to work from anywhere in the world, which I think will really play into the hands of New Zealanders because it's no longer as necessary to travel to interact with clients. I guess a potential downside of technology is the risk of sending designs around the world via computer and not being certain about their security.

The design community in our industry is fairly small and we compete regularly at various levels and various places. On the one hand we work against each other for our clients trying to beat each other on the race track. But when you bring designers together under any sort of forum where they have to work together, as we do when there is a new class rule structure or with technical bodies that are trying to manage the sport, everyone gets on just fine. At those times, we are able to eat together, work together and put all the other competitive stuff aside. America's Cup teams are a great demonstration of teams of designers who may be competitors in other contexts, but have to open up, loosen up and work together. It generally works surprisingly well. It's much easier and a lot more fun if there is some real team spirit, and that comes down to individuals and how they approach it. You can get along with somebody if you put your mind to it and have a good working relationship with them as well.

At a personal level, I miss the more artistic side of yacht design from 30 or 40 years ago because I had a very strong artistic leaning in those days and I've had to reinvent myself for the technology. I also miss the challenge of having to design something and not knowing the result until the boat is in the water. It was a real challenge to produce something in a purely experimental way. I don't think it's necessarily bad, it has just changed. I don't spend much time on the water now, but for fun I get on a small boat occasionally and just to try to reclaim some of that magic of the old days. ■



In his first office in Maryland, 1981