Trends in the workboat sector

Paul Graville has been in the workboat business for over 35 years. He trained on the famous Ship Science degree course at Southampton University in the UK, then joined UK boat builder Watercraft Ltd., as a trainee designer. After six years working in the design office he went to taste the production side of the business as general manager running Holyhead Marine Services, then mainly a repair and refit yard, now one of the U.K.'s leading small craft building facilities.

In 1987 he left to start Amgram Ltd., a deliberately small design and naval architecture consultancy, specialising in the business of the workboat industry. From 2000 onwards he was also a director of Camarc Ltd., the specialist designers of working craft. In response to market changes he moved away in 2012 to concentrate exclusively on the Amgram business, developing the consultancy and technical support services. Amgram now has offices in the UK and in Bangkok, where Justin Stanley is the manager.

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I've been in the workboat business since 1979 and when I started at a small yard on the south coast of the UK, most pilot boats built at that time were semi-displacement hull form, mostly of the Nelson type and mainly made by Halmatic in the UK. It has taken around 20 years to see a significant change in the pilot boat population in the UK.

I mention pilot boats as an example and, based on this example and these thoughts, I suggest that progress and trends must be viewed as a "generational" thing: development only happens at a steady pace in this industry.

- For industry professionals these craft represent working tools. As such operators are reluctant to play with the tools that they use and so are inherently conservative.

- These craft are expensive and development of big new ideas is inevitably costly. Many operators are small companies, change represents a disproportionately large step.

- Alongside that, because any new idea takes time and money to develop and this is a relatively lowly funded industry, the development time for any change to happen takes longer.

Don't forget of course there is a fundamental difference between the leisure boat and the workboat sector. No leisure user ever needs their vessel. They may want or desire it but they don't need it. The workboat user needs it and actually must have it in order to carry out their job.

So it is a responsibility for those who put forward the new ideas in the workboat sector (which may become new trends) and equally for those who assess them.

When we look back, in order to look forward, what has driven the industry and the changes in the last 20-30 years?

1979 meant UNCLOS Pt V and the introduction of the EEZ. Suddenly it wasn't just 12 miles to patrol but 200nm with fishing, oil, minerals and sovereignty to look after. There was lots of discussions at the time about speed versus endurance; the potential use of multihulls, hydrofoils, hovercraft, etc. Now there's UNCLOS Pt VI - the Continental Shelf and 350nm to patrol.

MARPOL has also driven change. We have seen a steady increase in regulation and now air emissions are a very significant driver at the moment but overboard discharges, oily bilge, ballast water etc., are also important. These regulations have led to the current moves towards investigation and development of zero emission vessels, batteries, electric propulsion and energy storage.

Other regulations such as those affecting the workplace - noise in working areas, cabins, bridge, whole body vibration, etc. Now there are considerations about external noise - effects on marine mammals.

- So the predicting the first trend is easy- Legislation always plays a part in technological change and will continue to be a significant driver in the workboat business.

When we talk about this workboat market, the workboat sector, what do we mean? Clearly we don't mean leisure craft, from the notes above we are only referring to vessels which operators use to perform their professional task.

I'm excluding on one side of the field full-blown naval patrol and strike craft. Although they impinge on the workboat sector and we may make some reference to that, I believe that they represent a business in their own right. On the other side of the field I'm excluding dedicated fishing vessels, again some aspects impinge on our discussions but specialised nature of the business sets it apart from the workboat sector.

So that is what we don't mean and as a result, what we do mean are the craft such as patrol and paramilitary craft, pilot boats and SAR craft, ferries, harbour workboats and survey craft, windfarm service vessels, tugs.

In the patrol and paramilitary boat sector, we see an increasing demand for more speed, driven by the need to intercept higher speed targets and to patrol larger areas. It seems incredible that we are still looking for more speed, but the simple fact is that the threat goes faster.

However, we also see a real realisation that such craft spend high proportions of their time at loiter, which has opened the door to hybrid drives and electric drives to reduce main engine time and to utilise generator set usage more effectively.

Pilot boats and SAR have seen advances in equipment, speed, capability, fendering and crew environments as well as MOB recovery systems.

The fast ferry market has substantially stalled awaiting the arrival of small gas fuelled engines, although there is some pickup in the monohull ferry market.

Windfarm vessels have developed from nothing during the last 10-15 years, which has just really got us to the end of the second generation of vessels. The next challenge is the development and service of offshore wind farms, where another significant period of development will take place to service the market.

We see tugs, which developed significantly during the late 80-90's, now undergoing another revolution as gas engine vessels come onto the market, in recognition of the emission and economic considerations.

The place I think to start is with the enormous changes in design capability, which have come about in the last few years.

The growth of computing power is well documented but it is has enabled every design office to have a comprehensive stability software. Stability is not the real point, it is just an example, the real point is the combination of computing power, software availability and staff capability has brought about such change in design abilities.

Computing brings of course the ability to study so many more options so much more rapidly.

In the marine world we are still behind the curve, if we compare ourselves to the motor industry, many product designers or the aircraft industry. We see in these industries that the level of integration with computer aided design systems is significantly higher. Nevertheless the changes in our industry are dramatic.

Undoubtedly this is a trend that will continue and much of the future and progress is dependent on this.

It is also dependent on skilled inventive designers and engineers, no software will change that!

We used to consider that aluminium and steel were great materials, especially for one-off construction but if you wanted to have volume production, then GRP was the material to choose.

However modelling software and that powerful combination, the software kit and the NC cutter, has transformed the productivity of using aluminium and steel.

The argument that this process increased the time in the design office has pretty well died away as production teams eagerly standby cutting machines, waiting for parts to be delivered thus allowing them to construct units, sub-assemblies and keeping production moving.

It makes the production designers life harder but you can use this technology to start a project running where previously it might not have got off first base.

Whilst the production team is busy building three quarters of the boat, the design team can be refining and optimising a propeller tunnel shape using in-house CFD. They don't necessarily need to head off to the towing tank or flow tunnel.

In fact there's a trend, they may not have been to the towing tank at all this project. They may be using base data, interpolating or modifying it-all much easier with the accessible computer or refining and optimising on a comparative basis with CFD. That whole process may be done in the time taken to write the order for a towing tank model.

Richard Korpus at ABS wrote a very useful article in the Naval Architect clarifying and demystifying CFD and its use as a design tool.

In the big yards the design offices are frequently equipped with comprehensive 3-D design systems, modelling, generating working drawings and producing bills of materials. However as another trend, that technology is becoming available further down the food chain to small yards and small design offices.

For the metal boats there are now hardly any working drawings for the structures: pre-cut parts, flanged parts even 3-D shaped parts quite often get their definition direct from the design model. The consideration here is a requirement for clear and comprehensive assembly books, showing the workforce how to assemble jigsaw of parts. That of course means an ever-increasing responsibility of the designers to interface with production to get value engineering.

These technology changes seemed to make aluminium a more favoured material than FRP, because of the saving in production costs. Now similar technology has changed the face and potential of FRP production.

Software based design tools allow 3-D models to be sent directly to 5 axis milling machines, plugs and even moulds to be cut rapidly (previously the big issue with FRP tooling). CAM equipment allows core materials, both foam and other cores, as well as reinforcement clothes to be pre-cut.

Hard on the heels of those technologies cutting down prebuild time, come infusion and resin transfer systems which cut down actual production time. Significant experience centres now exist assisting yards to master infusion and, for the more massive high-risk projects, resin flow simulation software can come to aid production teams.

Another example of a technology development with the driving incentive weaving backwards and forwards between the design office and the production floor.

- We think that is a very significant trend, the continuing development and integration of the design and production interface. We believe this trend is one that will certainly continue to intensify in the future.

Consider the example of a composite construction method, but in this case an aluminium boat where the shell is welded and all the internals are adhesively bonded. We don't think this is mature and production ready yet- but it is "yet".

- We consider that adhesives will become far more significant tools in reducing production times but that further development, not just in adhesive types, but in application tools and training is needed before they become the fixing method of choice.

Turning to consider vessel requirements, think again about the old business of pilotage. Pilots have been conveyed by rowing boats and by sail and, more recently, by power.

It is an established business but it had to develop. We have seen pilot boat speeds rise from the displacement craft, running at speeds up to 10 or 12 kn, in the 1950-1970s to the Nelson type semi-displacement craft running at speeds of 15 to 20 kn that dominated the market in say 1980s to 2000. The desire to move pilots (who are expensive commodities) more rapidly, coupled with the need to service ship owning clients more effectively has caused the pilotage business to change.

Companies such Camarc, with their higher speed double chine hulls, have really led the way in the transformation of this business, responding to its changing nature by providing significantly faster boats, often using waterjet technology, to respond to the operators demands.

Pilot boat development is not just about faster, we have seen significant changes in propulsion systems, fendering, seating, safety systems. Some boats are now self-righting, others have suspended wheelhouses, to provide better and safer working environment for the crews and pilots-the objective being of course to deliver a pilot in good condition capable of carrying out his or her task!

We see here economics (faster boats, quicker delivery), operator feedback (better fendering, less damage, lower maintenance) and also legislation (safer seating, better conditions) driving the developments.

Hard on the heels of the changes in the business pioneered by Camarc, come a variety of other variants trying to push the envelope and refine the product. Examples of these developments are the “beak” bow boats designed by Pantocarene and the wave piercing boats now being developed by Baltic Work Boats.

Where the pilot boat requirement is an example of an old business that has developed, we also have brand new requirements.

In the Europe the most striking of these new requirements is the wind farm business where operators need to put maintenance crew aboard wind turbines. A business which is scarcely 15 years old has seen rapid growth and enormous technological change.

When windfarms were first installed I suspect they were envisaged to be like remote lighthouses, requiring service once a year. In practice service, maintenance and breakdown requirements are significantly higher and especially so as the wind farm scales up in size, the demand for support has increased. To make that support effective requires the landing of engineering personnel safely and securely. Achieving that has caused an enormous amount of research and design effort resulting in transfer systems, crew comfort and seating and of course the development of lower motion hulls.

With these more demanding requirements and with these new tasks, all of which have a common trend utilising higher levels of technology, comes a requirement for clear and better specifications.

If you want to operate better, you need to buy smarter. To buy in a smarter way you need, if you want to expend less effort procuring for your task, a properly defined specification. We generally refer to this as the technical requirement specification or TRS.

It is amazing, the number of organisations who put out technical requirement specifications lacking the most basic of information.

The task needs to be clearly defined and the operator really has a duty, but certainly the need, to explain to the builder how the task is to be done and what is required. You need to clearly define the duty cycle and operating hours, operating environment and conditions as well as the number of fenders.

The specification work put in at the front end will pay dividends. It will force the organisation personnel to focus on the requirement, it will cut out incapable and unsuitable builders, it will eliminate the waste of time evaluating non-compliant bids, it will refine and minimise the contingency allowances which need to be put in place through the contract.

Some operators are expert and buy vessels on a regular basis and may have an in-house procurement experience. Operators who buy craft infrequently benefit greatly from the sort of procurement service we can offer. Remember, these are specialist pieces of equipment bought in a very technical market where a high level of expertise is required to differentiate between the options and to get value for money.

- Getting help to procure value for money craft, in an increasingly technical market, will become even more important for workboat operators.

Moving onto hull forms and taking as an example this new business, that of wind farm support vessels, what sort of changes have we seen in hull forms?

The first generation chine hulls have grown in length and most craft show increased sheer and height forward. This is partly to do with wind turbine boarding systems but also due to increasing the bridge deck clearance and reducing slamming incidence. Alongside this there have been developments in the second generation with approaches to lower motion hulls in various different ways, axe bows, semi SWATH, full SWATH and trimaran. A significant number of operators have opted for waterjets.

It is quite staggering, if you went to Seawork UK 10 years ago, there were one or two wind turbine vessels of pretty conventional form. At Seawork UK 2014 the whole of one side of the main pontoon was substantially filled with windfarm service vessels with a wide variety of designs.

Operators need to consider the reasons to buy as well as reasons not to. The multihull with its large stable working platform in many senses has been a very attractive option. However motions and hull slamming, coupled with the possibility of harsh transverse motions, have been the reasons not to buy and have most probably limited the number of applications where multihulls are considered.

20 years ago the talk was all of fast freight services and the multihull considerations were catamarans but also trimarans, quadmarans and pentmarans. We watched expectantly as the first naval trimaran, HMS Triton, made her trials in the UK.

Multihulls rapidly appeared in the fast ferry market but it was not really until the combination of lower motion hulls and effective and reliable motion damping systems, that multihulls started to appear in the military and paramilitary market. When they did appear it was mainly as catamarans, albeit that there are some trimaran examples and successes.

So we see now that the multihull has come of age but principally as a refined catamaran, rather than some of the more exotic multiple hull proposals.

- We think that, as a trend, the changes and developments in multihulls will lead to a higher percentage of multihull applications in the workboat sector.

Elsewhere in the business, designers have looked at lower motion catamaran hull forms and started to wonder if those principles could be applied to monohulls and so we see developments with axe, slender wave piercing and lower motion bow forms coming into monohull craft, Damen crew and patrol boats and Rolls Royce design patrol craft being good examples.

- Will the conventional chine and double chine hull disappear- NO. Will there be an increase in the sort of developments we now see in lower motion, lower resistance hull and bow forms- YES undoubtedly.

20 years ago the only seat you could specify was a modified truck suspension seat, unless you wanted to go shopping with a military price tag. They even rusted like trucks seats!

Now there is a proliferation of design techniques used in seating systems to mitigate and protect workboat crew and operators. Shock mitigation seating will most probably always be used on RIBs but, due to some of the developments in lower motion hulls and ride control systems, we end up with the intriguing possibility that such seating may not be required for some projects.

Of course we see in this industry the proliferation of sophisticated electronics driving navigation systems, ride control systems, machinery control and monitoring systems, as well as power distribution systems. These are now a far cry from earlier systems mainly due to vastly improved reliability. They will develop and improve further and, of course like the world of work, they will take over some jobs aboard the vessel.

10 years ago when we were designing an 18 m SAR craft to operate in the North Sea, we overreached ourselves trying to fit an integrated control system. Now we are nearly at the point where it would be easier to fit such systems than to create an instrumentation system in the conventional way with gauges, buttons and lights.

- Not a difficult trend to spot- electronics are here to stay! Get training your design staff, production teams and operators right through the workboat industry.

We have to consider changes for our crews and also changes for our machinery engineers. What they may see to operate and what they may have to do on-board.

Machinery, we have seen such large increases in diesel power and power density in the period from the late 70s and this has transformed the type of vessel that can be designed. There is a significant difference in machinery reliability. We will always need to clear a blocked sea strainer but what level of engineering repair actually gets carried out at sea now when machinery diagnostics and monitoring systems allow a limp home at low power?

Unmanned surface vessels (USV) development progress is rapid, the military see great benefits in the possibility to operate without putting the human person at risk. The commercial market is watching closely. I believe we will always need seamen, the sea is random and I think it will be a long while before control systems can perform well enough to deliver, for example, a pilot to a ship (assuming conventional pilotage remains of course), but there are many other tasks which can be carried out economically. Some survey tasks, reconnaissance for sure, mine clearance and hazardous tasks are all prime candidates.

- But as a trend- USV's will take develop and will take over some vessel roles.

So the engineers we need aboard may change, perhaps already they have, needing a higher focus on electronics and electronic monitoring systems than on mechanical engineering. Don't worry, we still need mechanical engineers as well, they just may not need to go to sea.

- We identify changes in the makeup in capabilities and training of crews, on board engineers and other staff as an area where there will be significant change.

7 years ago, specifying a new 25 m fisheries patrol boat for the Government of Northern Ireland, we tentatively suggested use of a hybrid drive system. The client was mildly interested but of the three companies we contacted the first said yes, but they weren't really enthusiastic to pursue the project, the second said no and the third said "we are not ready yet". Anyway our client was reluctant about committing to such technology and an unproven system (a point I made earlier).

Now such a system is perfectly possible on this size of craft and if we were specifying the same boat today we would definitely want to be exploring the potential.

So hybrid drives allowing utilisation of prime movers more efficiently, diesel electric and pure electric drives, developments of energy storing, fuel cells are all subject to great interest and development.

- We think the trend will be that these multiple drive options and alternative fuel systems will become mainstream.

Other big changes are occurring in what might be described as conventional power systems. There are developments increasing the power density of marine diesels. Over the last 10 years we have seen suppliers disappearing out of the market and the market becoming polarised around a limited few. Now we see some new designs, new developments and possibly new suppliers starting to emerge.

Gas engines are developing, we see them in tugs and larger ships, the ferry market as I mentioned earlier is keen to see gas options.

Development of marine diesels and weight competitive diesel engines brings high-powered diesel outboards within our reach. Products are under development which would mean the real chance of removing petrol as a primary fuel aboard a vessel. How many years ago after the UK MOD declared that as an objective?

Down at the business end, at the output of the prime mover, (whatever that may be) we see significant refinements of existing systems.

Conventional propellers, fixed or CPP, are now manufactured routinely from 3-D models via CNC milling to produce a high degree of accuracy and to achieve efficiency increase. This is another example of the integration of the design function and the production environment driving product efficiency and development.

Alongside these refinement processes there are pod drives, previously available for slow displacement vessels or for larger vessels but now available for medium to high speed patrol craft, actively coming into those markets. Linear waterjets, a mixture between waterjet and propeller have been developed and are now under trial.

We see third and fourth generation waterjets, also extensively utilising CFD techniques in design processes, refined and developed with improved efficiency and durable, sophisticated electronic control systems that allow integration with ride and motion control systems. In turn these developmental changes bring waterjets into consideration in new areas with significant capability station-keeping, rough weather performance and of course increased speed.

- Will waterjets replace fixed pitch propellers- No.
- Will they continue to edge up in the popularity, we think Yes- but in conjunction with other packaged propulsion systems- by virtue of the combination of technical improvement, reliability, suitability and possibility of real cost savings through increased production volumes and lower installation cost

Which example brings us back to where we came in, stressing the importance of the integration of design and production processes leading to strong product developments.

In summary, there are exciting changes and development and the sector is increasingly technological so remember to be smart when you come to procure;

- Write a strong technical requirement specification
- Look widely at the market
- Use the technology
- Consider these trends and changes that are coming and as far as possible plan for them
- And take some good advice!

This presentation represents the views of the author but I would like to acknowledge the thoughts and input of my colleagues and associates: Justin Stanley, Ian Short and David Bricknell in its preparation.