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ENGINEERING NEWS

Battle of the bots: Behind the scenes on Robot Wars

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(</images/default-source/default-album/robot-wars-main.jpg?sfvrsn=0>)

Team Concussion race against time to rebuild their robot (Image credits: BBC/Mentorn Media Scotland/Alan Peebles)

The lights go down. "Roboteers, stand by," announces a disembodied voice. All attention turns to the arena floor as the voice continues: "Three, two, one... activate!"

And, with that, another battle in the ongoing Robot Wars has begun. Now nearly two decades old, BBC Two's mechanical melee first ran between 1998 and 2004. Last year, the show was lifted from the scrapheap and brought back to life – and everything has been a little upgraded.

In April, the second revived series – series nine for those keeping count – concluded, and saw the formidable spinner Carbide take home the trophy. But Carbide were old hands at Robot Wars, having competed in previous series as well as the US version of the show called Battlebots. Perhaps more excited to have made it to the grand final were the newcomers Tim Rackley, Carl Yeo, Sam Griffin and Nick Oliver, who together are Team Concussion.

Their robot is an intimidating piece of engineering in its own right: painted bright orange and weighing 109kg, it is the first British-made robot to feature a solid 6,000rpm drum spinner capable of tearing chunks of metal from opponents, or throwing them across the arena.

Tim Rackley is 24, lives in Dorset and is an electrical engineer. He decided that he needed to build a robot for competition after going to see the 2016 series being recorded as a guest of the team behind one of Robot Wars' most iconic alumni, Razer. A 109kg, four-wheeled mechanical monster, Razer uses a hydraulic crushing claw to rip other robots apart.

Having caught the roboteer bug, Rackley put together his team of engineers. He was going to look after the motors and the wiring, Sam Griffin was a wizard at CAD, Carl Yeo was to be in charge of the remote-control connection for the robot, and Nick Oliver was a skilled coder. Then it was a case of designing, building and fighting a robot. How hard could it be?

Creating a robot

So what's the first step for building a robot? Shane Lale, 21, is another roboteer who competed in the most recent series with a flipper robot called Meggamouse. He's been a fan since he was six, when he started building robots with his dad, and he thinks that, when it comes to design, it starts with figuring out the weapon.

Lale's design process starts by looking at the competition – seeing who the Robot Wars champion is, and then asking “How can I build a robot who can beat them?” This means that Robot Wars is a bit like an arms race. “If you can't beat the top dog, then you're not going to win,” he explains.



As luck would have it for Team Concussion, both Rackley and Yeo hit upon the drum spinner idea in their rough sketches at the same time – so they knew exactly what to pursue.

Most serious roboteers then turn to CAD, and this is where many of the deliberations take place, before a single bolt is tightened. But both Team Concussion and Lale say they have found that building a mock-up first, from wood or cardboard, is a useful way of testing the concept. It isn't perfect, of course, as the materials will impact the weight and performance of the components, but it did confirm that Concussion was capable of pulling a car around their works car park.

All in all, Team Concussion say the design process took around nine months, and thanks to CAD the actual build only took four or five weeks. But this isn't to say it was easy. In the days leading up to the show, the team realised that in the testing their spinner had been pushed a little too hard: the motors powering it caught on fire, and melted. “We thought, ‘we're not going to Robot Wars... we'll have to pull out’,” Griffin worried.

Luckily, they were able to source new, powerful motors with just a few days to spare. They worked until 3am to check that everything was once again working, before getting up two-and-a-half hours later for the mammoth, eight-hour drive from Dorset to Glasgow for the TV show.

“It was crazy, we were so close to not making it,” says Rackley. “I think it's that determination, remembering when I was a little seven-year-old kid, that really helped – I thought ‘I'm not missing out on this’.”

Fighting the war

It was finally time for the Robot Wars to begin. Team Concussion were the rookies – their robot had never before been in battle. “Our aim was just to have something that worked to get out of the melee,” says Griffin. He knew that the pressure was on. “You’ve got to impress people, you’ve got to impress complete strangers with something that has come out of your head,” he says.

And so the first melee round began. Although inexperienced, Concussion managed to take out Tauron, before tangling with Chimera 2 and Thor. The team had survived the first test, but their robot was badly damaged.

“We had some serious issues with the drive system and we were having quite a lot of trouble with the motors – they were being pushed to more than they could do,” says Rackley. “So we rebuilt the machine three times over.”



Mercifully, thanks to Griffin’s design and Rackley’s obsessively neat wiring, the team were able to get Concussion repaired in time for the next battle. “The timescale is definitely the hardest thing about that. You’ve got two hours and, because of the cost of making the TV show, they really don’t give you any extra time,” says Rackley.

It was also during maintenance that each member’s specialist knowledge, and their ability to work as a team, really started to pay off.

“We all had our own jobs,” says Rackley. “Nick did batteries, I took control of motors and wiring, Carl did the remote-control side, and Sam sorted out the drum.”

In a hugely impressive feat for a team of first competitors, Concussion then scored several victories. First they bested Thor again in a direct head-to-head match-up, then they took down Heavy Metal, and MR Speed Squared, scoring themselves a place in the heat final where they would once again face the mighty Thor.

Here they managed to use their powerful drum spinner to knock out the CO₂ supply for Thor's axe a second time – and were able to nudge Thor into the arena flames. The judges' decision made it official: Team Concussion was going to the series grand final.

Unfortunately for Concussion, it was in the grand final that the underdog team's ascent finally ended. Facing two grizzled veterans, the bar-spinners Carbide and Ironside 3, Concussion was quickly on the receiving end of a joint attack, which saw it immobilised and knocked out.

"The dream ends here," presenter Angela Scanlon remarked at the time. "We went past the dream ages ago," replied a still-delighted Griffin.

Looking to the future

So what's next for Team Concussion? Its members are already looking ahead.

They submitted an application to appear on the next series of Robot Wars, expected this year, and they've already started working on some high-tech upgrades to Concussion.

"Anything that worked well we've just accentuated," explains Rackley. "The drum worked well, so we're making it out of something a lot harder and a lot tougher than our previous material." Other improvements include "a lot faster acceleration, and the battery access is also considerably better," adds Griffin.

Perhaps the most intriguing upgrade, though, is the new custom-made telemetry circuit, which Oliver designed and for which he also did all of the coding. Using wi-fi, the circuit will report back realtime data from the robot to an application installed on a tablet.

This will enable the team to monitor the temperature of the drive motors and the weapons motors. It also enables the team to monitor Concussion's battery voltages. "We're the first team to do true telemetry in a robot," says Rackley proudly.

One practical upshot of this could mean a better understanding of the motors – something that he and Yeo identified after the competition.

"You change the dynamic of a motor if you cause it mechanical stress and we didn't consider that as a factor," explains Rackley.

So, if Robot Wars returns next year, Team Concussion are hoping that they will be back in the competition.

But how do they feel about once again having to spend all of that time perfecting their designs, and having the stress of building a fully functioning robot warrior? What motivates them to go back?

“When you’re building the robot, it’s 100% off your own back,” says Rackley. “I thought, whatever happened, I’m going to have a great time – something I could tell my grandkids about, something I’ve actually achieved.

“It’s over hundreds of hours of effort. So it is just an unexplainable achievement if, on your first-ever go, you get in the top five out of 40 teams.

“To win the whole thing... I think I'd just explode with excitement.”

Show's house robots grow more powerful



If Robot Wars is an arms race, it isn’t just the competitors who have to keep up – the show’s iconic house robots need upgrading too. James Cooper had been a fan of the show since its earlier incarnation, and when it returned last year his company, Robo Challenge, was enlisted to ensure that Dead Metal, Matilda, Shunt and Sir Killalot were every bit as terrifying and awesome as viewers remembered.

“The house robots have to come back how the fans would have imagined them,” says Cooper. “Obviously, Killalot wouldn’t be the same Killalot he was 10-12 years ago. He’d be beefed up! He’d be more battle-hardened!”

So all four robots are entirely new builds – with no parts taken from the originals. “We had a good look at them and, though they were very good back in the day, they were starting to get beaten up quite often,” says Cooper. “We knew that nowadays they’d get torn apart by the likes of the spinner robot Aftershock and the flipper Apollo, so they had to be a completely huge step-up. All of them are at least 50% heavier, some 100% heavier.

“The weapons are so much more powerful than before, and the drive systems are much more powerful, so that they wouldn't get pushed around and can stand up to any of their competitors.”

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