

# Driving sense into innovation

With Britain looking to rebuild its manufacturing sector, one strategy is to look for emerging markets rather than trying to muscle into existing ones against fierce competitors. And Eco technologies represent just that sort of opportunity

**E**lectric cars look like having a big future, and first generation vehicles are currently being launched by many of the automotive majors. All engineers will know that these will be redesigned and refined steadily over the next 10-20 years until a mature version evolves. One of the technical issues developers are focusing on is the power to weight ratio of the electric motor at the heart of the vehicle. And a rapidly growing company spun out of Oxford University is making the running in this field.

“It started when the University was asked to design a motor for an electric sports car,” explains Tim Woolmer, founder and CTO of YASA Motors, now based in Abingdon. “I was just starting my DPhil was set a goal to make the smallest possible motor for use in the automotive sector.” After some months of research, Tim came up with the novel YASA motor architecture. Further innovations in the cooling, mechanical design and magnetics have meant that the motor is now significantly smaller and lighter than competitor motors.

YASA was set up in 2009 and is long since passed the £500,000 annual turnover mark. It just been named the UK’s Best Enterprise in the Lloyds TSB/Telegraph Enterprise Awards. “Obviously, production will continue to climb as demand for these motors grow. It is a process that we are going to have to manage very carefully and we are

planning well ahead,” explains Tim. “The design cycle for a car is 4-5 years, so we are expecting the first spike in demand in 2016/17.

“Importantly there will be further demand from other industries.

Construction vehicles designers for instance are keen to overcome the inherent inefficiencies of driving the hydraulics from their main diesel engine. They are already working on hybrid designs with electric motors powering the hydraulics. Its only a small step from there into agricultural vehicles, then marine, aerospace etc.”

## Innovative test rig

Currently YASA is doing constant evaluation tests and, unsurprisingly, has developed a highly innovative test rig that makes mounting and dismantling the motor as simple, fast and ergonomic as possible. At the core of this is a TorqSense non-contact speed and torque sensor from Sensor Technology. Tests often involve linking motors back-to-back, with one driving and the other acting as a generator. TorqSense is non-contact and wireless so setting up before a test run is straightforward. Based on surface acoustic wave (SAW) technology, the sensors comprise two thin metal electrodes, which take the form of interlocking fingers on a piezoelectric substrate.



When a radio signal of the correct frequency is applied, surface acoustic waves are set up and it acts as a resonant circuit.

The substrate can be attached to a motor shaft and deforms progressively when subject to torque; the resonant frequency changes accordingly, providing a measure of torque levels – without fiddly wires or slip rings. YASA uses a type RWT321 sensor with integral electronics. This combines high accuracy and resolution with a large overload capacity and the ability to operate both clockwise and anti-clockwise. The sensor also provides information about shaft speed, power and temperature, with all of the data made available in real time. The RWT321 incorporates a CANopen interface, so directly compatible with the company’s data acquisition and analysis systems.

YASA Motors will be continually refining and improving its designs for many years to come. A standard range is being developed, and a custom design and manufacturing service will provide a valuable second income stream.

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