

Dream come true

JCB founder Joseph Bamford always wanted to build an engine for his construction machinery. His son, Sir Anthony Bamford, has today realised the dream. Andrew Allcock reports

To the strains of Pink Floyd's *Welcome to the machine*, visiting press at JCB's new Power Systems plant, Dove Valley Park, Foston, Derbyshire, were treated to a display of some 130-odd construction machines ahead of the all-important construction industry show, Intermat 2006, to be held this month in Paris – not the entire range as the company has some 220 products.

Less immediately obvious is the fact that many are fitted with the company's own diesel engine, the JCB 444, in production at Dove Valley Park since November 2004 and currently being produced at the rate of 100/day. The unit now powers half JCB's construction machinery, by volume – the company sold more than 45,000 units last year.

LONG-TERM PURSUIT

The 4.4 litre engine comes after some 25 years' engine design and manufacturing development at JCB, but it is the first to make it to commercial production. And only final assembly and test of the engine is undertaken by JCB, everything is bought in.

Making the engine a reality has been the subject of a five-year development plan, from 1999, and an investment all told of £80 million. Ricardo Engineering assisted JCB with engine design analysis and mechanical design, but JCB ran its own 100-strong project team to support the engine's development and production. From mid-2001 this team took full control, with the decision to go into production not taken until April 2003. Work at Dove Valley – next to Toyota's Burnaston site – commenced in January 2004 in an existing building with



Above, a no-faults-forward policy operates at Dove Valley park. Centre, the JCB 444 powers the company's back hoe loaders. Right, part of the 130-odd construction machine display at Dove Valley Park

engine number one signed off in November of that year.

But why make an engine? Well, bought-in engines are typically designed for a broader range of end-users – rather than tailor-made for a specific job. But an important additional factor today is environmental legislation that requires continual engine modifications. "Over the next 10 years, the dominant influence on construction machine

engineering will be exhaust emissions compliance," confirms group engineering director Dr Tim Leverton. And apart from pushing up engine costs, those



modifications could also see JCB expending precious design effort modifying construction equipment to house upgraded, differently-shaped power units.

In fact, a design parameter for the JCB 444 was that it could accommodate anticipated emissions and noise requirements over the next 15 years; so no upgrade of the base engine will be required up to so-called Tier 4 emissions, phasing in from 2011-2015. As Dr Leverton explains, JCB's engineers can now spend their time investigating new product ideas. This means that this year it has been able to launch new mini excavators, two zero tailswing excavators, six larger excavators and two new wheeled loading shovels, among other products at Intermat.

However, while it is clearly useful in existing products and product types, the JCB 444 is also the basis for a brand new product excursion for the company – the mobile generator set. The UK generator market is reckoned to be around 15,000 units, valued at £150 million, and JCB has its sights set on a significant slice.

The JCB 444 was an obvious step, offers Dr Leverton – after all the company has been making transmissions for over 25 years. JCB expects to achieve a more-than-10 per cent share of the global construction

equipment market in coming years, with its rapid growth being built on speedy product development. This remains a priority and having the engine design within its control will support this as legislation impacts. But just having the business motivation to do something is not enough; it has to be possible.

And possibility is given by three things. First, the company now has the critical mass to support an engine venture. Add to that the fact that manufacturing technology has also evolved to make smaller volumes viable, while, third, there now exists a sophisticated supplier base able to deliver world-class products at competitive prices, often through globalisation. These "technology partners" as Dr Leverton describes them, have contributed their expertise and shared in the risk of the project.

TECHNOLOGY PARTNERS

Thus, crankshafts are machined in Germany at a company having flexible plant and able to accommodate the relatively low volumes; castings for the cylinder head and bed plate come from Turkey; the block casting hails from Germany; pistons are also from Germany; the diesel injection system, sourced through Delphi in the UK, sees injection pumps and filters manufactured in this country, while the injectors are imported from Turkey. The most distant supplier, located in India, casts the camshafts. The machining of the cylinder head, block and bedplate are undertaken in the UK at Mahle Powertrain, Wellingborough, (see *Machinery*, January 2006, page 34) on 18 flexible, UK-built Heller machining centres in a purpose-built machining hall.

Each of the suppliers, of which there are 59, was measured against 15 criteria in keeping with a six sigma 'Advanced Product Quality Planning' approach.

At JCB Power Systems itself, assembly machinery investment costs have been reduced by virtue of a mainly manual assembly process, supported by 'no faults forward' quality checks. Only where manual labour could not deliver a quality result is automation used. Added to this are a lean manufacturing, low overhead approach to deliver cost-effective engine manufacture at the volumes JCB currently enjoys – 40,000/year over two shifts.

Starting with a clean sheet, using no existing design, no existing facilities, JCB was also truly able to apply 21st century manufacturing. Known engine technology is used to eliminate risk, but how design features were actually realised and then manufactured offered scope for cost reduction. Dr Leverton cites the cylinder head which is designed to use a simple five-piece casting core assembly; to be machined only orthogonally; and to have only two core bungs. The result is that the advantageous four-valve/cylinder design requires less machining than most two-valve/cylinder designs.

The benefits for JCB seem clear enough, but what about its customers? Well, they report a reliable, quiet engine that allows them to get on with their job effectively. Simple needs; but far from simple to deliver. □

