THE ACCIDENTAL MANUFACTURER

I SOMETIMES get asked the question, 'How do I get into racecar design and manufacture?' There is no single foolproof way but my first bit of advice would be to enrol on a good quality motorsport engineering degree course and obtain the best possible qualification that the institution could bestow. The second would be to join the 750 Motor Club. Such luminaries as Tony Southgate, Adrian Reynard, Gordon Murray, Colin Chapman and Eric Broadley have all been members at one time or another.

Of course, not all successful builders come from an academic background. Many substitute their theoretical knowledge for years of simply just doing the job; preparing and racing their own cars. The cars may originally have been designed by others but, over the years, have become progressively modified in the search for speed. One such person is Adrian Daniels, the man behind ADR Engineering of Touchen End, Maidenhead in England.

A member of the 750 Motor Club and campaigning an 850 cc Reliant-engined F750 racer, Daniels saw the opportunity to design and build a car completely from scratch when the club decided to update its regulations to encourage the use of motorcycle engines. The result, after many hours of toil, was the ADR Sport 1000 which featured a four-cylinder 1000cc K series BMW engine with a sequential gearbox driving through the obligatory live rear axle.

To say that the car was successful on its maiden outing is somewhat of an understatement. Probably "too successful" is a more suitable comment, for despite starting at the back of the grid with a 10-second penalty, the car ended up coming third overall. Possibly embarrassed by the performance difference between these motorcycle-engined cars and the more traditional power units, the 750 MC formed a new formula which allowed the cars to race in a category of their own: the Sports 1000 class. This eventually gave way to the club's Bike-Sports category of today.

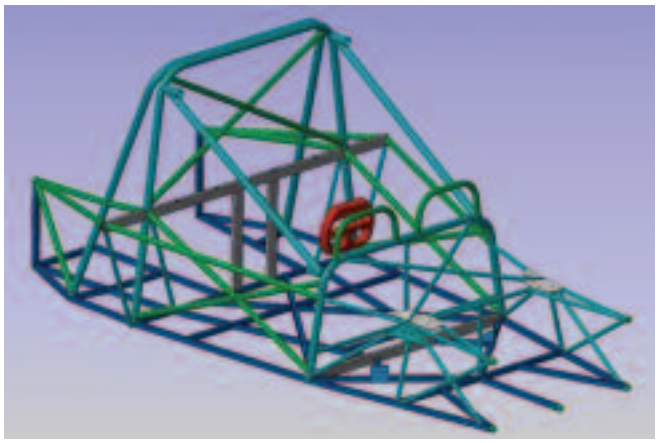
Despite Daniels wishing only to build one car at the outset, demand for the attractive and exceptionally quick racer was such that before long he found that he, together with business partner Adrian Player, had become a manufacturer. In the end some 14 chassis were built.

Although classed as sports racers, F750 chassis regulations don't really cater for two seats – unless, of course, the passenger is a

ADR Engineering set out to build one machine. Thirty-six cars later, it has established itself as one of a new generation of manufacturers. By **John Coxon**

ABOVE Phil Chatterton's ADR3, tailored for hillclimbing, approaching the lower Ess at Shelsley Walsh

BELOW The chassis modelled in 3D CAD



BELOW The Hewland FTR gearbox installation

> "The bodywork needs only to be surfaced over one half and then reflected around the centre line by the computer"

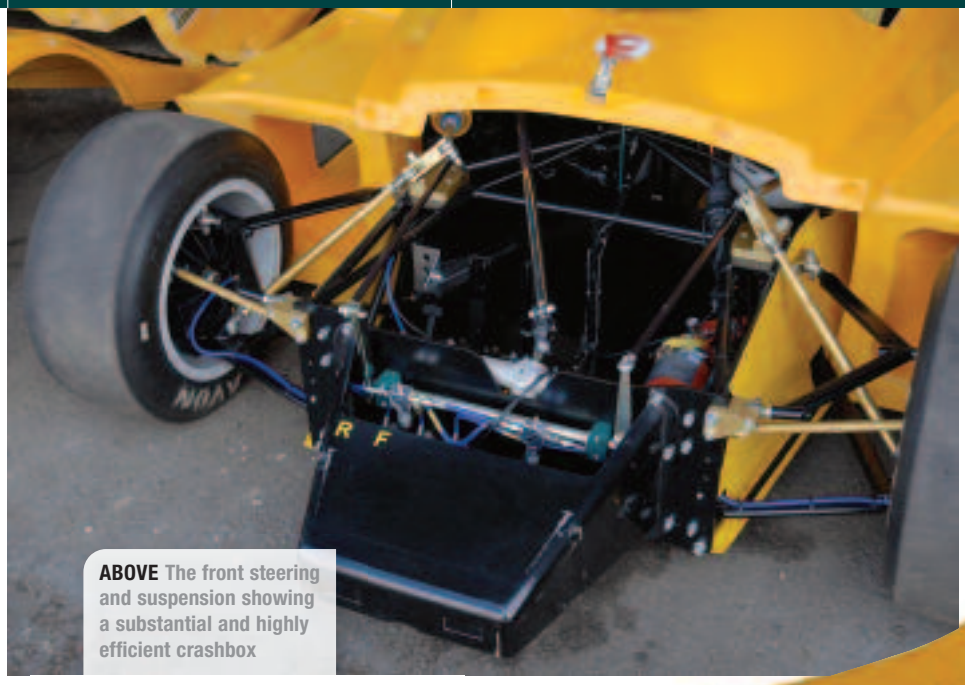
midget with mere stumps for legs. The Sports 1000 therefore gave way to a Sports 2 which, with a widened chassis, was a proper twin-seat sports racer designed to take a much bigger 1300 cc motorcycle engine.

Competing against cars such as the Radical SR3, it was quickly realised that the quality of the bodywork would have to improve. As Daniels puts it, "The Sports 2 was put together as well as we could at the time but we realised that the market we were now entering was much bigger and more demanding. The car was highly competitive but the bodywork was still produced by hand using foam and filler and although good, you could still see the ripples and slight imperfections in the surface."

To compete in this market a new approach to manufacturing would have to be found. Thus the ADR3 was born. The car featured here is not a track racer but a one-off produced for the specialised discipline of championship hillclimbing and owned by regular campaigner Phil Chatterton. The attention to detail and standard of preparation are nevertheless second to none. "To get the quality we demanded, the car and particularly the body had to be modelled in 3D CAD," says Daniels.

However hard you try with a tape measure, traditional methods inevitably result in differences in dimensions from side to side. Although we are only talking millimetres, the quality of the product is therefore not as good as it could be. Using SolidWorks CAD software, Daniels explains that the bodywork needs only to be surfaced over one half and then reflected around the centre line by the computer to give a beautifully streamlined symmetrical shape. Not only that, with the body now in digital form, a quarter-scale model could be easily milled and the full-size patterns necessary to make the final moulds could also be produced from the same data.

The origins of the shape go back to the original Sports 1000 car ▸



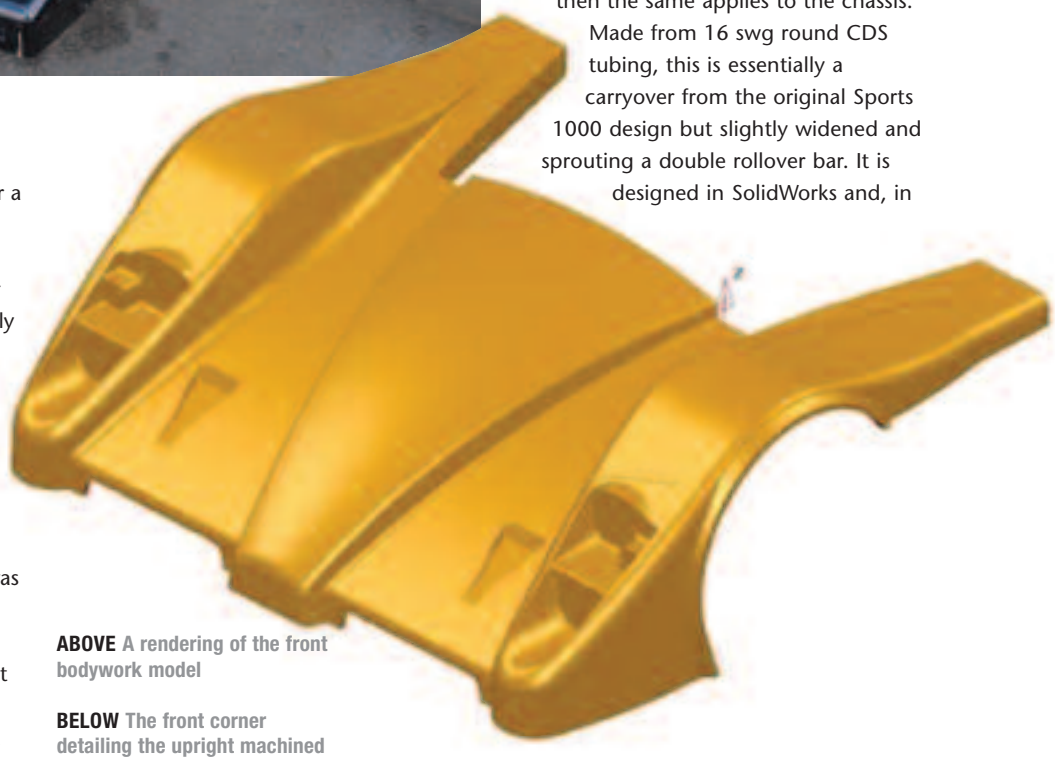
ABOVE The front steering and suspension showing a substantial and highly efficient crashbox

and in reality the basic shape hasn't changed that much. The requirements for a wider rollover bar (since the 750 rules require only a single hoop), new engines and the necessity to incorporate lights for endurance racing produces an aesthetically pleasing shape which is claimed to be quite efficient too.

Initially it was hoped that the quarter-scale model could be used for wind tunnel testing. However, when it was realised that making a suitably instrumented model was likely to cost as much as the complete set of moulds, it was decided to approach aerodynamics consultants C&B Consultants of Poole, Dorset for help. Based on its experience, it gave detailed recommendations that resulted in changes to the sidepods, front and rear underbody profiles and angle of the rear wing all being incorporated. The design was eventually sent to Datum Patterns, in Derby, to produce the master patterns and moulds.

The design and manufacture of the moulds alone amounted to a significant financial investment but the quality of the bodywork is exceptional. The self-coloured panels using a woven fabric and honeycomb technique are all interchangeable – a major consideration for endurance racers. They weigh no more than 35 kg in total.

If the quality of the body is outstanding, then the same applies to the chassis. Made from 16 swg round CDS tubing, this is essentially a carryover from the original Sports 1000 design but slightly widened and sprouting a double rollover bar. It is designed in SolidWorks and, in keeping with the quest for ultimate quality, manufacture is outsourced to specialist rollover protection company, Caged in Frome, Somerset, using jigs supplied by ADR. Caged has a recognised and approved quality status as required by the FIA or SCCA.



ABOVE A rendering of the front bodywork model

BELOW The front corner detailing the upright machined from aluminium alloy

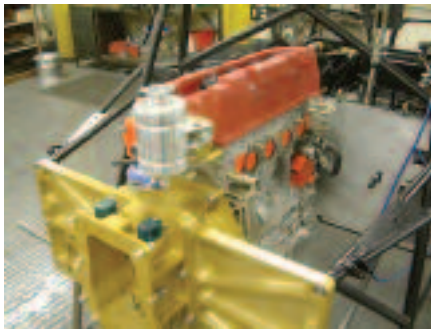
Daniels preferred round tubing to the more usual square offering. He claims that since all the tubing is mitred to the exact length and angle, it 'snaps' into place during assembly into the jig. It is slightly more difficult to achieve exact alignment during manufacture with square tube.

To support the engine and transmission, an aluminium mounting plate or backplate is bolted across the rearmost part of the chassis. Made from 30 mm thick 6082 T6 ▸

> Round tubing is preferred to the more usual square offering as it 'snaps' into place during assembly into the jig

grade material, this is fully machined to 6 mm thick in places to maintain strength but reduce the weight. It is anodised in gold, the colour favoured for all ADR-produced aluminium parts.

Although the car was conceived to use the Suzuki Hayabusa 1300 cc motorcycle unit, Daniels realised that to widen the market appeal the chassis would need to accept a car engine. The example here is consequently a modified 2.0-litre Honda K20 developing something like 260–270 bhp, but a popular choice is the 2.0-litre 240 bhp 'standard' unit available directly from Honda.



The first of the ADR3 car-engined chassis was designed to accept a lightweight 1800 VVC Rover 'K' Series. With the subsequent collapse of the Rover Group and the realisation that the unit in its highly tuned form might not be as reliable as many customers would wish, particularly for endurance racing, the decision was made to use the Honda. Fortunately, no modifications were necessary to the chassis as the forward engine mount accepted both engines. But, since the exhaust ports are on the other side of the head, a different backplate was needed. So convinced is Daniels that somebody will inevitably ask to install a Rover 'K', that he still retains the parts in his store.

For all 2.0-litre Honda engines the favoured gearbox currently is the Hewland FTR. This is a six-speed and reverse sequential box rated at 240 lbs/ft of torque and is commonly used in Formula Three. The unit has an integral engine oil tank in the bellhousing and will happily accept suspension inboard pick-up and integral rocker mounts. The FTR may be ideal for the application but, mindful of the customers' desires, it is hoped to offer an alternative in the form of the SADEV unit in 2008.

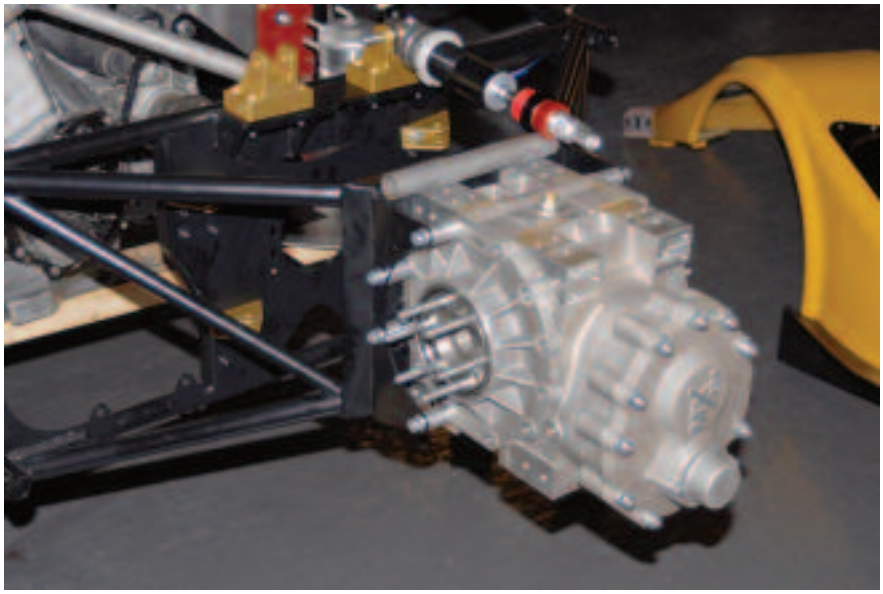
For hillclimbing purposes, the featured car uses the high duty FTRS version. This beefier product was recommended by Hewland for the repetitive standing starts and tyre 'burnouts' prior to the runs.

LEFT The Honda K20 engine installation

BELOW Chatterton on his way up Shelsley Walsh, passing the repairs to the banking after the summer floods of 2007

IN-HOUSE CAPABILITY

Looking around the car, it becomes fairly obvious that, with the possible exception of the engine, all parts are either proprietary, designed specifically for racing, or bespoke items designed and machined by ADR. Other than the chassis and wishbones, there are very few fabricated parts, nor are there any vehicle OEM parts. "This is intentional," says Daniels. "We like to think of our competitors, when they use fabricated uprights or fit vehicle OE parts, as 'fabricators', whereas with our policy of designing and making even the smallest of components in-house, we think of ourselves as 'engineers' to differentiate us from the rest." ▸



LEFT & BELOW The new Elite MX200 differential for the 2008 motorcycle-engined cars, above. Below, the original ADR-designed and built differential

Whatever the policy, the overall effect does seem to be one of solidity and application. A perfect example of this is the pedal assembly. A Trident fabricated part from steel box section on the hillclimber, the new ADR design is carefully sculpted from billet aluminium bar and as such is a work of art. It also happens to be lighter and stiffer!

You might consider that designing and manufacturing such parts for a relatively few number of cars is hardly cost effective. When you realise that ADR also supplies to the much wider 'kit' car market, though, the logic of it all suddenly becomes clearer.

The suspension wishbones are made from what can best be described as flat oval tubular steel operating pushrod dampers all round. The geometry was eventually arrived at with the assistance of Guy Evans of Nitron, which also supplied the two-way adjustable dampers. "On most of the cars built so far we don't run any remote fluid reservoirs," says Daniels. "In the case of this car, Phil specifically asked us to fit the remote reservoirs low down and at the rear. This was so that he could access them easily at meetings without the need to remove the rear body section."

The wheels normally supplied with the cars are 13-inch three-piece centre lock fitting split rims designed and manufactured by ADR itself. According to Daniels, of late there has been a trend back towards single piece rims again. This is partly a result of various championship regulations but also no doubt because one-piece rims tend to be lighter. The rims fitted to Chatterton's machine are therefore 13" diameter aluminium ATS versions, 9" wide at the front and 10.5" at the rear, using F3-type fitments weighing 3.8 and 4.0 kg respectively.

It can often be difficult to package adequately sized discs and callipers inside 13" diameter rims. Using components from the ever-popular Wilwood range, ADR has managed to accommodate 265 mm vented discs with 4 pot forged and radial mounted DynoPro callipers both front and rear.

> "To compete in this demanding market a new approach to manufacturing would have to be found: the ADR3 was born"

At the conclusion of my visit I had a brief word with the 'other' Adrian, Adrian Player, the chief engineer affectionately known as 'little Ade'. At the time he was detailing the 2008 bike-engined car, which incorporated a new differential unit. It would seem that most motorcycle-engined racers opt to mount their engines in an east-west position across the chassis and transmit the drive through a fairly hefty sprocket and chain. ADR, no doubt because of its use of a live rear axle in the first designs, has always preferred to mount the engines north-south, transmitting the power through 90 degrees using a differential unit.

REVERSING BOX

"Drive from the gearbox was transmitted by a shaft through a reversing box (because motorcycles have no reverse gears) attached to the backplate and then to the differential unit," says Player. "We used to design and make all that reversing box with its little gears and chain, as well as all the parts for the differential unit, which was both time-consuming and costly."

All this is to be replaced by the MX200 differential unit made by Elite Racing Transmissions of Stoke. Introduced in early 2007, this unit incorporates an integral reverse gear and after removing the rear plate reveals a pair of drop gears which can be easily changed to alter the final drive ratio. A true racer at heart, and therefore conscious of the weight, at 24 kg 'Ade' thinks the unit is a little heavy and could do with losing at least 6 kg. Nevertheless, the detailing work to re-position suspension inboard pick-up points to give the same geometry as the latest FTR cars will be more than offset by the savings in man-hours over the older design, as well as making ratio changes much easier in the paddock.

ADR set out to build one car. Five years and 36 cars later, business couldn't be better. With such an attractive and well thought out design, no wonder. RT