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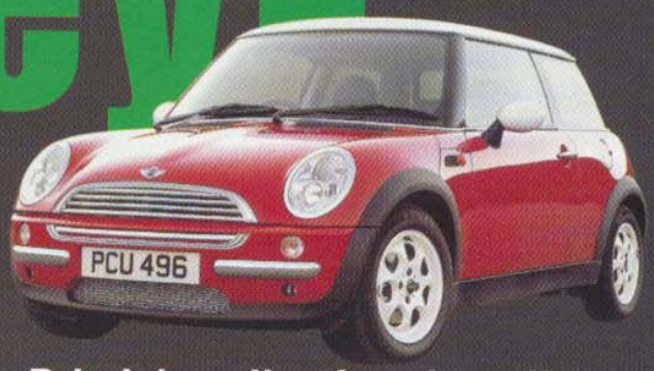
Will Mini Make Money?



Britain's smiley-faced small car delivers premium features at a pint-sized price. BMW is banking on its profitability.

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by Lindsay Brooke

With an overall length of just 142 inches, the 2002 Mini Cooper is the shortest passenger car available for sale in North America. The cute little Brit with the smiley face is a whopping 23 inches shorter than Honda's new Civic Si hatchback. It's also much lighter. Even in fully-laden "S" trim, with an Eaton supercharger, intercooler, 6-speed gearbox and 17-inch wheels, the 2,513-pound Mini Cooper undercuts the Civic by 230 pounds.

The BMW-built Mini may not be as "mini" as its legendary predecessor which sold worldwide, and briefly in the U.S., for 41 years. But you could almost tuck the new one inside a Ford Excursion and have room left over for groceries.

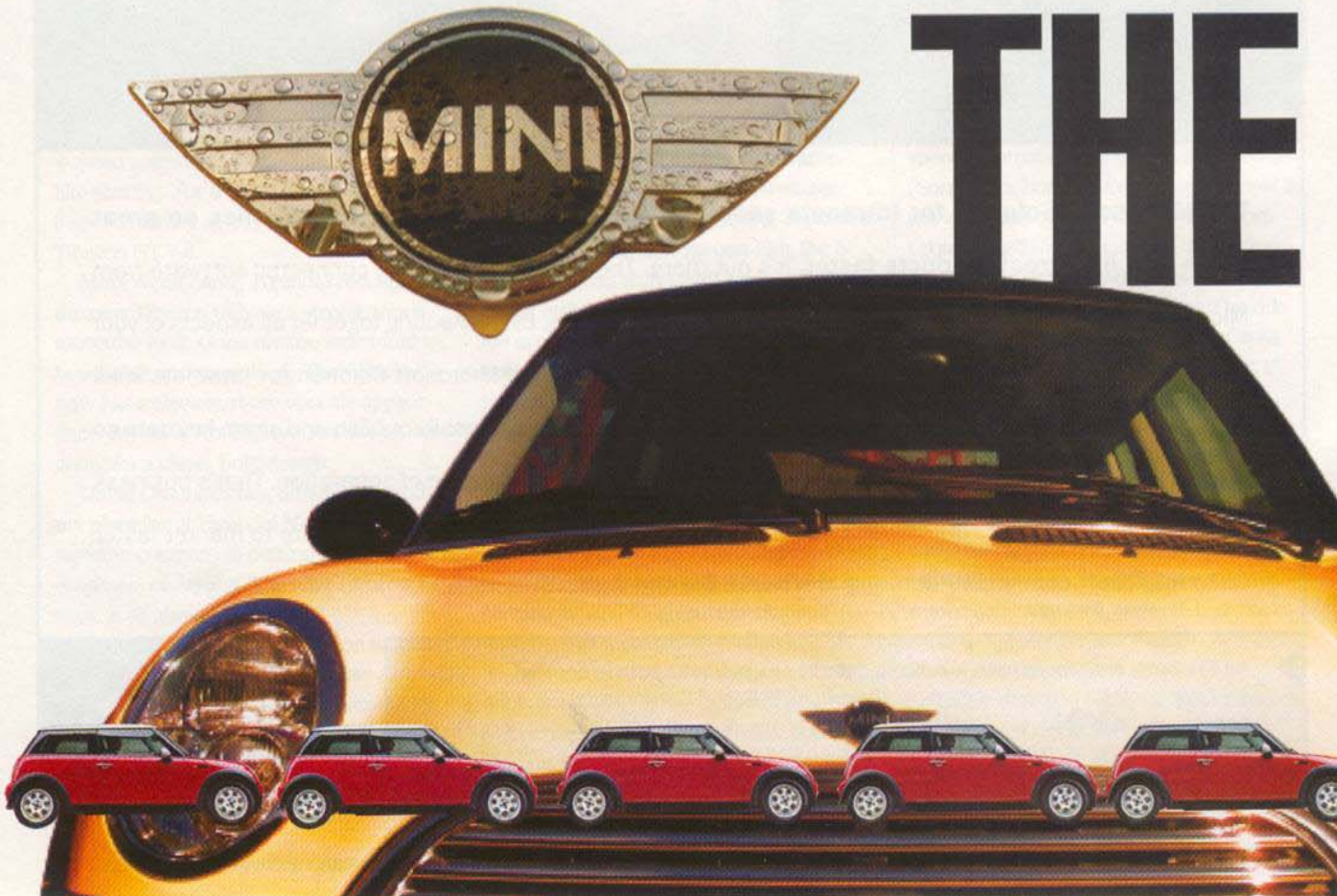
The new Mini is as much about building a strategic brand as it is about a vivacious, fun-to-drive car (*see p. 18*). Establishing Mini was vital to BMW's growth plans for two reasons. The new brand will cover the market directly below the upcoming BMW 1-Series that bows in 2004-05.

"And of course, Mini is very important to us in North America for helping to keep our CAFE situation in balance," adds BMW's new Chairman, Helmut Panke. With his company soon to add its second SUV, Panke needs more fuel economy in his product portfolio.

Small as it is, however, the Mini Cooper is shockingly well equipped. It boasts engineering, technology, materials and features that typically grace larger, more expensive vehicles. It's built and handles like a little BMW and its list of standard fitments almost reads like a 5-Series window sticker.

Included are a compact version of BMW's famous Z-axle multilink rear suspension; 4-wheel disc brakes gripped by Bosch's 4-channel ABS with Electronic Brake Distribution and Cornering Brake Control; a Simula-supplied "smart" airbag system (dubbed AHPS-2) with sausage-shaped side bags for head and upper torso protection; Siemens' throttle-by-wire and I-Bus modular electronics; a Valeo rolling-code ignition immobilizer, and ZF Lenksysteme's electro-hydraulic power steering.

Much of this is pricey stuff, and there's more of it available in Mini Cooper's three option bundles. Mini-maniacs can add heated seats, xenon headlamps, stability control, a Siemens navigation system, Goodyear run-flat tires, a ZF continuously-variable transmission and the Eaton blower, among other goodies.



The Technology's Paid For

Automakers generally don't make money selling small cars. So how does BMW aim to do it with the new Mini? Positioning the brand upscale and loading up the cars with surefire options may ensure profitability in the short term. Since Mini's U.K. launch last summer, the richly-equipped Cooper models have accounted for more than half of total sales. They are in effect subsidizing the Mini-1, the more sparsely equipped base version for the U.K. and general export markets.

Only Cooper-spec cars are planned for North America where $16,300 starts you on the naturally-aspirated 115-hp Mini Cooper, and $19,300 gets the 163-hp S-model, which can be optioned up to about $25,000.

Jack Pitney, general manager of Mini USA (the U.S. distributor) and a former BMW executive, asserts that the brand's overall business plan is built to be profitable even on the low content Mini-1. He argues that technology investments, such as using the high-cost Z-axle design, are amortized over BMW's worldwide production — more than 900,000 units last year.

"We'd be foolish not to take advantage of R&D that's already been paid for," he says.

The company's initial U.S. dealer plan is limited to 70 stores, each owned by an existing BMW franchise but requiring a separate location and staff. Pitney's numbers show that each U.S. dealer can be profitable selling 300 Minis per year. "That's 21,000 cars per year — a profitable level for us for the first year," he adds.

If Pitney and his counterparts in other markets need more cars, the Cowley plant in Oxford, England, can build them. The plant is capacitized for 200,000 units annually on three shifts. Recently the third shift was added, and analysts have adjusted their production radars upward.

"The move to a third shift surprised us," says Mark Fulthrope, manager of European forecast services at CSM Worldwide, in Byfleet, England. "The plan was for 100,000 units, but now we're forecasting nearly 150,000 Minis per year. Present sales volumes are looking pretty strong for them."

Production Challenges

Fulthrope and other analysts believe that future product plans hold the key to any sustainable Mini goldmine. A Cabrio is coming next year and a Mini pickup has been approved. Both are expected to have Cooper-S content levels and significant parts commonality with the coupe. A 5-door version is said to be under serious consideration. Mini-1 also will get a Toyota-built 1.5L DI turbodiesel, sourced from the Japanese automaker's new engine plant in France.

"BMW can put a premium price on the diesel Mini and get it, even in Europe," notes Fulthrope.

BMW has not publicly put a sum total on the Mini program's development cost. But the automaker has said it pumped roughly $500 million into new plant and tooling for the program (code named R50) since it acquired the floundering Rover Group in 1994. It also funded half of the $500 million Tritec engine venture (*see sidebar p. 24*).

At the time of the takeover, BMW reportedly inherited nearly

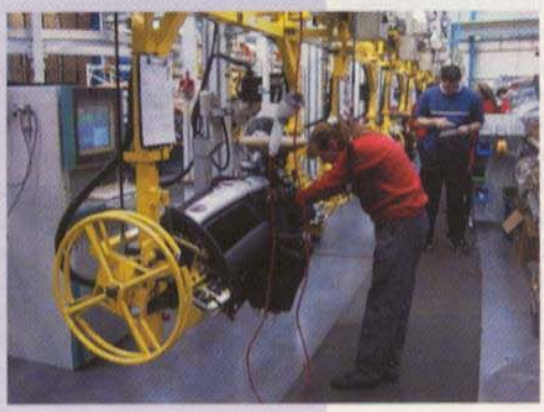
REAL STORY

BMW's new British-Bavarian brand launches a new concept — the premium small car.

Cranking Out The Cockpit At Intier

With nearly 10 billion build variants, the new Mini presents Tier 1 integrators with sequencing and delivery challenges. "And BMW wants near infinite build combinations," notes Norman Taylor, general manager of Magna's Intier plant in Redditch, England, which supplies the Mini's cockpit module and numerous interior panels. To make sure it delivers every one of those different cars, Intier has set up what it calls "a late-configuration facility" based in Redditch that adds late changes for certain VINs (vehicle identification numbers).

Taylor explains that the R50 program represents the first time BMW Group has outsourced such a highly integrated cockpit module. It's also a first for the Redditch plant in managing a supply chain that stretches across the European Union – from Meridian Technologies in Italy (magnesium cross-car beam) to Valeo in Germany (HVAC unit), to Hungary (wiring harness), Spain (air vents) and France (various trim).



Interior design is visually entertaining. Cabin function follows form. Materials quality is high. Cockpits sourced from Magna Intier (photo, left).

The Mini's daunting complexity called for a reliable build process. Intier came up with its own unique assembly system to build cockpit modules. It's an in-plant I/T network dubbed MIDAS – Magna Integrated Database Assembly System. MIDAS has electronic screens at each assembly station to provide operators with instructions, process alerts and build verification on a real-time basis. With the system, parts are checked to prove proper assembly sequence and electrical tests are performed.

Until all checks are made and cleared by MIDAS, the cockpit cannot move to the next station. Taylor calls this a 'no-fault-forward' assembly environment. The system also records traceability of safety-critical items on the module.

Intier won the Mini business in part because it was already a BMW interior systems supplier. But the company still had to jump through serious hoops for R50. "We ran joint workshops every Saturday for months and months, to make sure we had gapping and stack issues handled, to make sure we had consistency," Taylor asserts. "People at Intier want the Mini to be measured equal to very expensive cars."

To win the Mini's door panel business, Intier relied on Magna's technical depth. BMW specified a low-pressure extrusion molded panel; Intier was using that technology at one of its Austrian plants and brought it to Redditch.

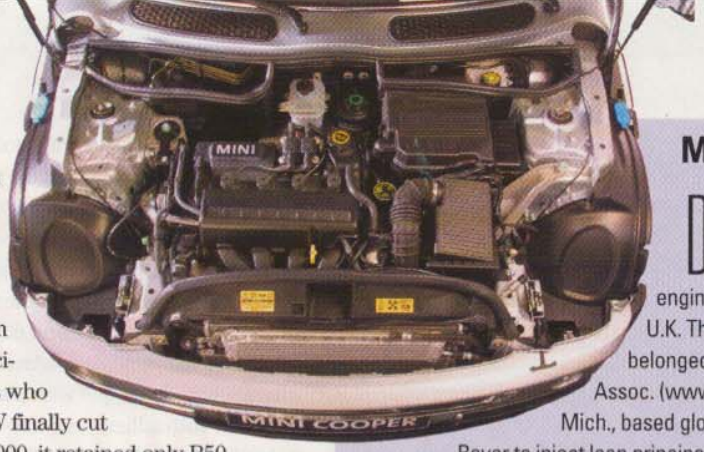
The plant's 350 employees are currently working a 6-day week to keep pace with the third shift recently added at Oxford. The company still supplies MGRover and Land Rover. "Prior to this program we had a very U.K. supply base," recalls Taylor. "Now we're very global." —LB

$200 million in Rover's annual costs. Rover was stuck with a new-Mini design concept and no money to develop it. It was also stuck with a malaise that had gripped the company through 30 years of previous owners British Leyland, the British government, British Aerospace and even former partner Honda Motor Co.

Rover's culture was to do things as cheaply as possible. "We struggled to convince them to use electronic steering, which eliminates the power steering pump and saves space," recalls Mike Oakes, a lean design consultant with U.S.-based Munro & Assoc. who worked on R50. "'Too expensive,' they'd say."

Then came BMW. Chairman Bernd Pischetsrieder (nephew of Alec Issigonis, creator of the 1959 Mini) and his product chief Wolfgang Reitzle immediately approved the Mini design concept and kicked off R50 with full funding. Since then, the car's overall form has remained true to Rover's handsome styling concept. The Mini's evolutionary shape dictated the design and packaging of every system on the car, notes Mark Limage, formerly Rover's DFA (design for assembly) coordinator and now a consultant with Munro & Associates' European office.

Limage recalls that achieving many of the clay model's design details on the production car was challenging. The flush-fitting wraparound glass that creates the Mini's "floating roof" look gave engineers headaches. Packaging the BMW-mandated Z axle became a magic trick that cost precious time, as did shoehorning the supercharger into an already jammed engine compartment. Trying to find room for a larger fuel tank, to increase the Mini's range, eventually led to the run-flat tire option that may become standard on future Minis.



Even with the compact Tritec engine, underhood packaging was a major challenge. Supercharger system adds even more clutter — and heat.

For most of R50 development, the Germans provided financial support and left program management and engineering decisions to the British, say engineers who were on the program. When BMW finally cut its losses and dumped Rover in 2000, it retained only R50. The program had already been active for five years, and many more millions had been spent engineering and re-engineering it to boost value and quality, and to lower cost.

Significant cost had been pulled out of the program in order for Mini to meet its retail cost targets. Most of the hard work had been done by the British team at Rover's Gaydon, U.K., engineering center, with input from a few select interlopers (*see "Munro's Magic," p. 23*).

With the Rover albatross gone, BMW switched its management style and became much more hands-on on Mini. German accents were heard frequently in Gaydon's engineering circles. "There was not a lot of German spoken on program management until the end," notes one R50 engineer.

The BMW-Rover debacle gave the nationalistic British automotive press plenty of fuel to throw on the old "us versus the Jerries" fire, which the media has stoked since Churchill's era. In truth, there was considerable bias on both sides during 1996-99.

"They lost control of the R50 budget," says an executive from a German supplier about the Brits.

"The Germans throw lots of money at a program, engineer it to be very complex, then order everybody to reduce cost at the 11th hour," retorts an ex-Rover man.

By late 2000, engineers and managers from both companies had overcome most of their friction to create a fine product. Cost was coming out of it, but R50 was still running way behind schedule. Suppliers perhaps felt the greatest pressure.

"We had to be responsive to many, many late engineering changes — over 2,000 of them — that came after Rover Group was split up," recalls David Foster, engineering manager at Intier Automotive's Redditch plant which supplies the Mini's cockpit module and other parts (*see sidebar p. 22*).

Foster says certain parts were completely re-sourced. With the clock ticking and pressure building from Munich to reach Job One, Intier had to skip prototypes and go directly into hard tooling for some production parts. Standard four-week turnarounds were done in two weeks or less.

"Timing constraints threw this program into overdrive," he says. "Also, we went from dealing with a customer who was located 15 minutes down the road (Rover) to one who's in Munich. We managed this program without sleep."

Munro's Magic

During 1996-97, distinctly American voices were heard at the Rover Group engineering center at Gaydon, U.K. The Midwestern accents belonged to experts from Munro & Assoc. (www.munroassoc.com), a Troy, Mich., based global consulting firm hired by Rover to inject lean principals and cost discipline into the R50 program.

Mini was way over budget and running late — a typical scenario for calling Sandy Munro, the straight-shooting Design for Assembly/Design for Manufacturability guru.

"They (Rover) were trying to attack piece cost," recalls Munro. "Piece cost is not a driver. Our stuff focuses on what's ahead."

Munro's "stuff" is his Lean Design Workshop process. For the Mini program there were 54 workshops, each a week long. Working directly with R50 designers, engineers and suppliers, Munro's team aimed at ensuring the lowest part count, minimizing the number of production operations and driving technical innovation through the program. And they employed a "Quality Report Card" process that determines the cost of quality at the design stage.

"We bring everyone in each area together and thrash through the problem to work it out," explains workshop leader Mike Oakes. "On Mini, we focused on delivering on cost and timing while meeting all functional specs. Sometimes we found alternate design solutions to meet the requirements."

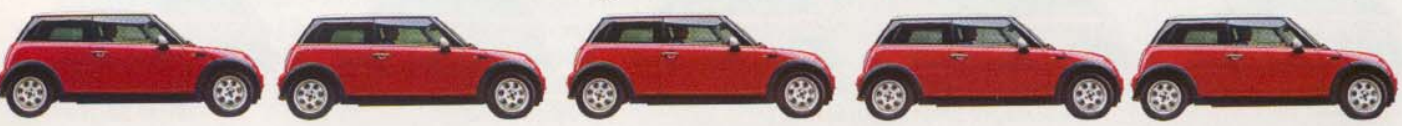
Munro's involvement was only part of R50's cost/quality equation. Oakes calculates the workshops improved the program's IRR (internal rate of return) by five percent. Rover engineering boss Nick Stephenson praised the input as "invaluable" for getting Mini into production with high value and quality. — **LB**

Achieving A Profitable Balance

The production Mini's impressive blend of high content and value was only achieved after much wrangling over what the car should be underneath its classically modern skin.

In the early going before the deal with Chrysler boss Bob

The Germans accuse the Brits of losing control of the R50 budget. The Brits accuse the Germans of engineering in complexity, then ordering 11th-hour cost reductions.



Low-Cost Engine Co-Designed by Chrysler

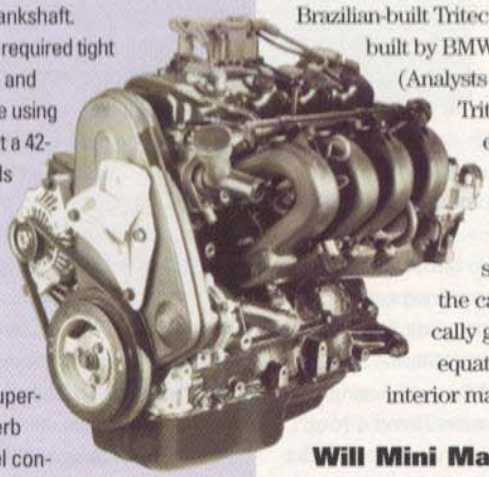
You'd be forgiven for thinking the Mini's 1.6L sohc engine looks like it was yanked out of a Dodge Neon. That's because it was co-designed and developed by BMW AG and the former Chrysler Corp. The project began in 1995 as the outgrowth of joint benchmarking exercises between the two automakers. Both companies needed low cost, more frugal engines for future models – Chrysler was expanding Neon sales into Latin America and Europe, and BMW had just acquired Rover's Mini program.

Thus was born the "Pentagon" engine project to co-develop a 16-valve unit in both 1.6L and destroked 1.4L versions. The engine is produced at a $500 million plant in Campo Largo, Brazil, as part of a 50-50 joint venture called Tritec Motors LtdA. The deal was inked between Chrysler and BMW at the 1996 Paris auto show.

The then-new 2.0L Neon engine was one of the industry's lowest cost powerplants, and it strongly influenced the Mini engine's basic architecture. Low cost, low friction, high durability and excellent package efficiency were the main design bogeys. The Mini's tiny engine compartment and the car's frontal crash requirements dictated ultra-compact dimensions – just 17 x 22 x 26 inches fully dressed. The small size was made possible by many factors. Bore/stroke dimensions are 77mm x 85.8mm. The camshaft is chain driven and the Gerotor-type oil pump is integrated into the front timing cover. The entire front accessory drive is attached directly to the cylinder block. Mass is sacrificed for cost with a grey iron block and cast-iron crankshaft.

The small, closely-spaced cylinder bores required tight packaging of the valvetrain. Individual intake and exhaust rocker shafts are clamped into place using the camshaft caps. The valves are splayed at a 42-degree included angle and the exhaust heads measure only 23.2 mm – a key to reducing knock sensitivity and speeding catalyst light off. Port geometry and airflow data came from Chrysler's 2.0L North American Touring Car race engine.

The fruits of that work, combined with a high 10.6:1 compression ratio on the non-supercharged version, give the Mini engine superb combustion stability and brake-specific fuel consumption. According to a 2001 SAE paper by Alejandro Regueiro, the 115-hp engine (163hp with Roots-type Eaton blower) meets LEV emissions without EGR and with only one 1.23L catalyst. The ULEV package does not require a close-coupled catalyst.



Chrysler's original 2.0L Neon engine strongly influenced BMW's engine designers for the Mini motor.

Production began in 1999 and both BMW and DaimlerChrysler remain committed to the Tritec venture. But BMW executives indicate that future Mini engines may come from the company's new engine plant at Hams Hall, England. — **LB**

Eaton to establish the Tritec joint venture, BMW and Rover had both pitched their own engine proposals for Mini. Some included 3-cylinder units conceived by BMW's motorcycle group.

Numerous body architectures and manufacturing processes were brought forward. One was an aluminum spaceframe. Another used a steel subframe with plastic fenders and aluminum decklid, tailgate and doors. Still another was based on BMW's low-volume Z1 roadster of the early 1990s. It featured an aluminum monocoque with plastic body panels, possibly attached with adhesives. None of these proposals would have helped deliver a high-value product.

Also developed was a trick modular roof system, which incorporated a clever luggage rack.

Looking back, BMW engineered cost into Mini where it made the most impact on the car's dynamic performance. True to the BMW school of body construction, the Mini's body-in-white has over 3,800 spot welds — an overabundance for this size car. The extra welds add cost but create a stiffer structure — a claimed 24,500 Nm/degree in torsion.

That's 50 percent more rigid than BMW's benchmark 3-Series and is one reason the Mini Cooper feels battleship-solid over rough pavement, and squirts through corners like a slot car.

The Z-axle is an expensive design, but like the Mini's front suspension its cost is offset by use of steel fabricated members, rather than pricey aluminum that have little direct customer value. The Brazilian-built Tritec engine is far less expensive than anything built by BMW, even with its trans-Atlantic shipping costs. (Analysts expect BMW to extricate itself from the Tritec venture and eventually source Mini powerplants from its Hams Hall, U.K., plant).

The CVT from ZF is costly, as is doing business in British pounds, rather than Euros. Offsetting this is Mini's 100 percent steel body and grey-iron cylinder block. And the cars' whizbang electronic features are basically gravy for BMW in terms of the cost/profit equation. Money spent on Mini's high quality interior materials is money well spent.

Will Mini Make Money?

"Over the life cycle, even the first generation of this car will be profitable," promised factory boss Dr. Herbert Diess, during an AI visit to the Cowley plant last summer.

"No question they'll make money, even on the plain-Jane version," asserts lean design consultant Sandy Munro.

"The high content models, and what's to come, should bring profitability," says CSM forecaster Mark Fulthrope.

With its unique fwd platform that's not shared by any BMW, and a replacement not expected until third-quarter 2006, the little Brit with the smiley face has a few years to prove that small can be profitable. ■