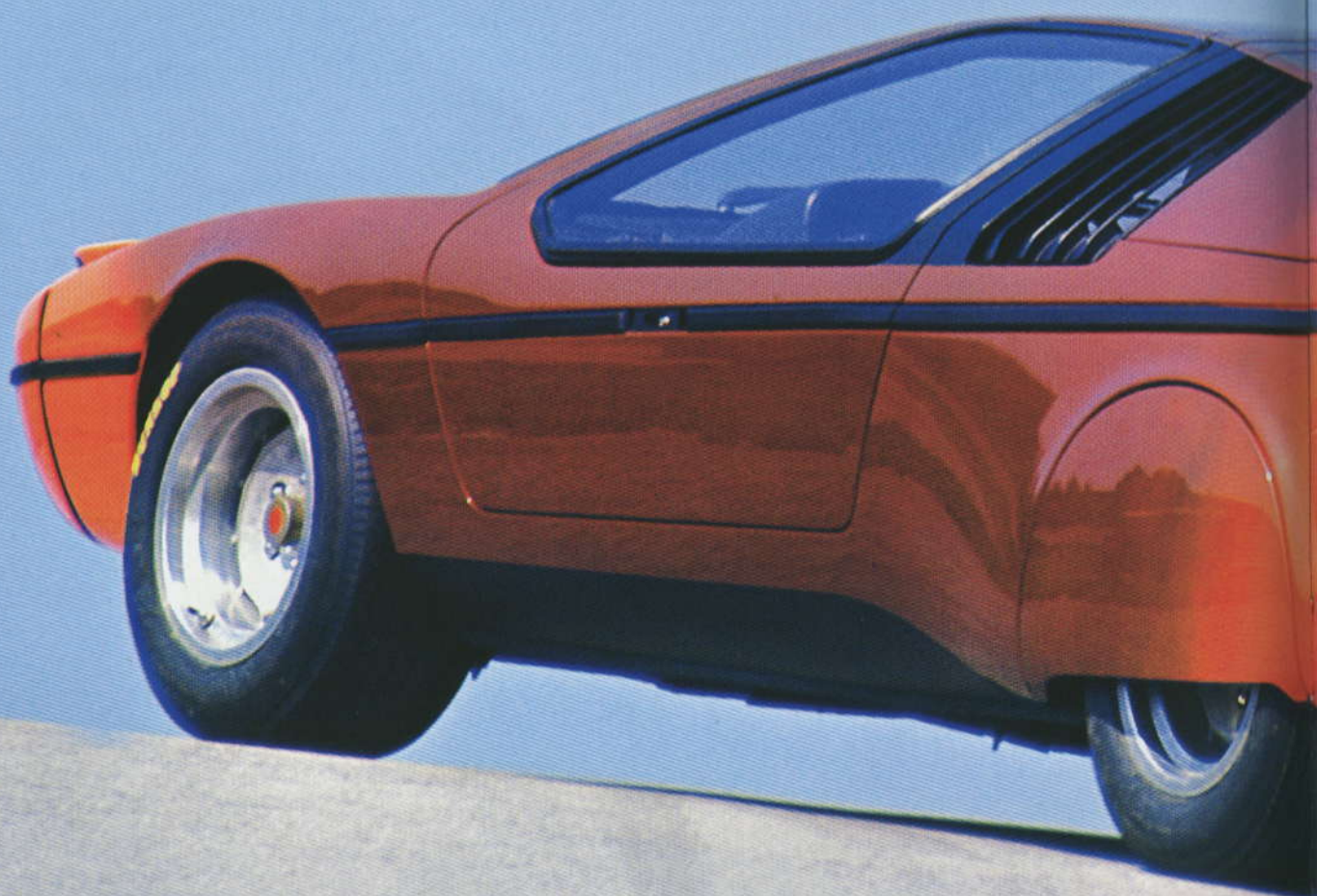


Innovations in the BMW Turbo study

1972: the future – today: the norm

The BMW Turbo was a combination of design study and technological guineapig and had a finely developed sense of active and passive safety. BMW presented the Turbo in 1972 as the world's first safety-oriented sports car. And this research laboratory on wheels allowed a glimpse into the future with innovations which were gradually to find their way into series production.

Niklas Drechsler





In the early 1970s, the BMW Turbo provided a stunningly sleek riposte to the prevailing wave of ponderous safety prototypes and their bulky add-ons. This was a time when manufacturers were even testing roll bars fixed above the painted bodywork. The Turbo saw BMW go firmly on the offensive – and reinforce the school of thought that “only clearly structured, agile and manoeuvrable cars really have a genuine chance of making it” in the future. The fresh design penned by Paul Bracq, head designer at BMW at the time, opened up a whole new dimension in the debate surrounding safety and gave the public a preview of the BMW M1 sports car to be launched in 1978. Only two examples of the BMW Turbo were ever built – both at Michelotti in Turin. In October 1972 the first of the two was fêted as the star of the Paris Motor Show. The second Turbo was produced with minor modifications in July 1973 and unveiled for the first time at the company's annual general meeting. It also caused quite a stir at the 1973 International Motor Show in Frankfurt.

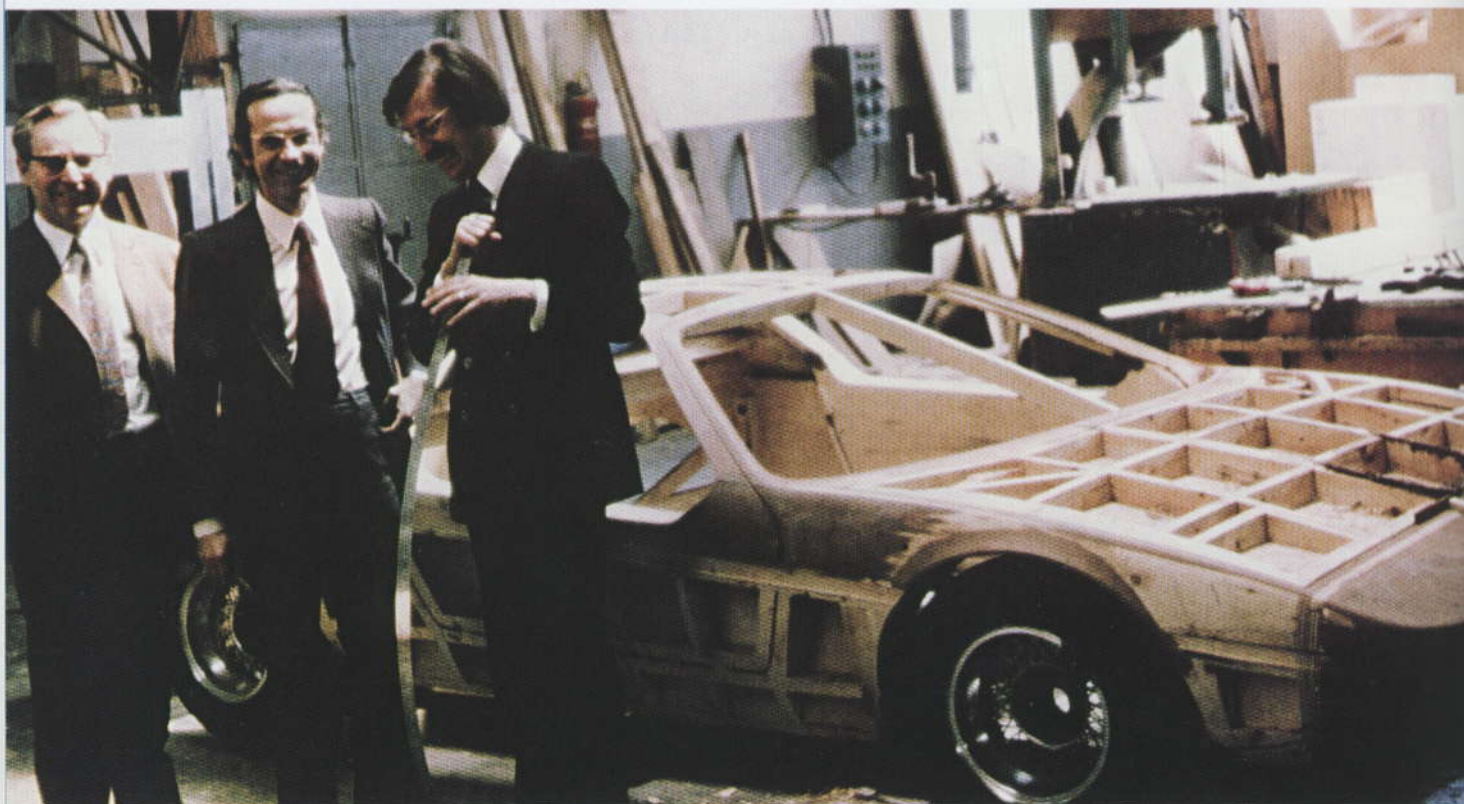
The BMW Turbo was a technological test case and styling concept in one. The design of the car made safety a priority, Bracq ushering in a completely new and pioneering way of thinking for the basic conception of the modern car. The designer explained how his approach put the human element at the heart of the development process: “People are our reference point. Today we build cars from the inside out. The machine we drive should represent an intimate human cell. A car should fit us like a second skin.” The Turbo's commitment to safety was illustrated by characteristics like its all-round visibility (the idea was to eliminate blind spots), well-balanced axle load

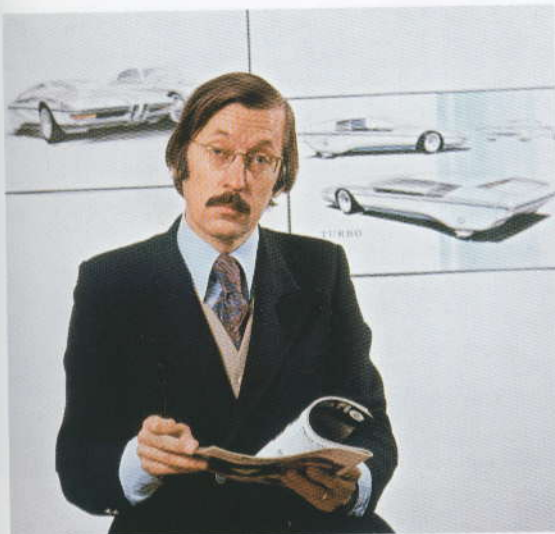
distribution and a paint job which positively screamed safety. Wolfgang Seehaus and Hans A. Muth were heavily involved in the interior design process. Muth later became BMW's first head of motorcycle design, with the BMW R 90 S and BMW R 100 RS – whose designs had a lasting influence on overall motorcycle construction – both conceived on his watch.

Support for the driver. BMW used the Turbo to present a number of driver assistant systems for the first time. The new technology was designed to warn and support the driver in extreme situations. The Turbo's basic concept provided the motorist with an inherent layer of safety padding. A low centre of gravity, wide contact area, specially developed chassis and driver-oriented cockpit were all designed to make critical situations a seldom experienced eventuality. If things did get a bit hairy, the driver assistance systems fitted on the BMW Turbo, such as ABS, the radar-based distance warning device and lateral acceleration sensor, were there to save the day. Should an accident be unavoidable, however, the driver would be protected by an extensive range of passive safety features. These included safety belts which had to be put on before the car would start, a safety steering column with three universal joints, door pillars reaching up into the roof – which performed the function of a roll bar – and safety crumple zones with hydraulic dampers at the front and rear.

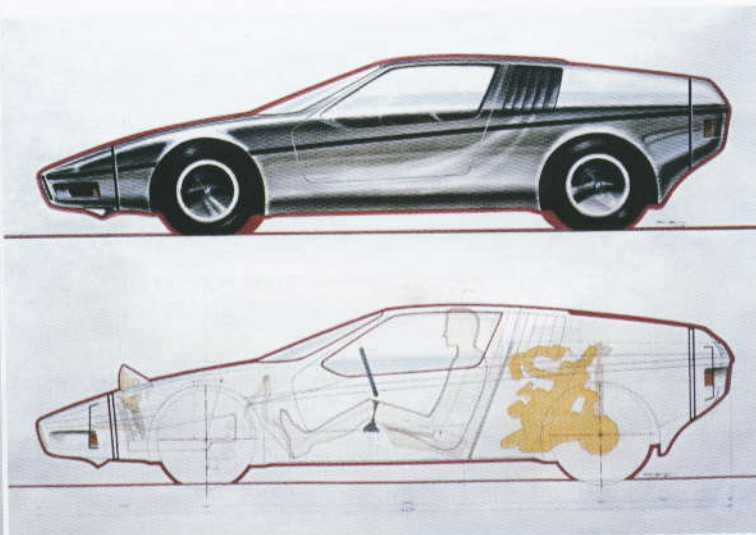
The driver takes centre stage. Stage by stage, the safety features unveiled in the Turbo were fed into series-

Below | Meeting in Italy: Paul Bracq (right) and Giovanni Michelotti (centre) with a wooden model of the BMW Turbo in the workshop.





Above left | Then BMW head designer Paul Bracq with design sketches of the BMW Turbo.



Above right | This sketch illustrates the mid-engine concept with horizontally mounted engine.

produced BMW cars. First to make the grade was the driver-oriented cockpit. As early as 1975 the first-generation 3 Series was kitted out with a cockpit which curved in an arc around the driver. The idea was to make driving easier with a safety belt on. The new cockpit allowed the driver to reach all the buttons and switches without having to lean forward. One of the arguments tendered by the anti-safety belt brigade at the time highlighted the difficulty in using the controls when you were wearing a belt.

The cockpit of the BMW Turbo embodied another new philosophy, as a press release explained: "In order to enhance the feeling of comfort and inner safety, hard edges were avoided and all interior components were padded with foam." This idea, too, was transferred to all series-produced BMW cars from the mid-1970s.

Self-regulating technology. Another notable feature of the BMW Turbo was the "secondary display 2" – a precursor to Check Control, which checked the functioning of safety-related systems using glass-fibre optics. In January 1976 the new BMW 6 Series arrived in the showrooms armed with Check Control as standard. With the ignition switched on, both the 630CS and 633CSi allowed the driver to check the following functions by pressing the "Test" button: engine oil, brake fluid, coolant and windscreen wash levels, plus brake-pad wear and, when the headlamps were switched on, the functioning status of the rear lights. The functions covered by Check Control have since been extended significantly and Check Control has been fitted as standard in all BMWs since the early 1990s. Plus, it now keeps a permanent watch on the car's systems rather than operating on request.

The first BMW with ABS. The Turbo saw BMW unveil the Anti-lock Braking System (ABS) on one of its cars for the first time. The system then went into series production at BMW in November 1978 as an optional extra for the 7 Series, and today a BMW without anti-lock brakes would be unthinkable. Maintaining the driver's ability to steer even under full braking has given vehicle safety a considerable boost. The ABS sensors also provide the basis for all anti-skid programs such as DSC and DTC – or ESP, as some of

BMW's competitors prefer to call it. Here, the Turbo's lateral acceleration display comes to the fore. Although today's BMWs do not come with an indicator showing this value, a yaw rate sensor is at the core of all anti-skid systems. The principle of measuring a vehicle's lateral acceleration was the first step along the road to DSC. Today the driver is still alerted if DSC has stepped in, but only via a warning light rather than a needle and dial.

The BMW Turbo included a raft of innovations which drivers take for granted today. A handbrake connected to the rear brake callipers – rather than to a drum brake, as previously – was a case in point, and ventilated disc brakes all round, a safety steering wheel and automatically retracting safety belts also fit into this category. However, the belts in the BMW Turbo boasted another string to their bow, completing the electrical circuit for the ignition lock when engaged. This meant that the Turbo could not be started until the driver was strapped in.

The precursor to the impact absorber system. Joining in the innovative spirit was the BMW Turbo's bodywork. Progressive safety crumple zones regained their shape after minor collisions thanks to solid, foamed U-sections fitted to hydraulic dampers at the front and rear of the car. This construction paved the way for the crash boxes which made their series production debut in the newly developed BMW 7 Series in 1986. Not long afterwards, these boxes were modified and renamed "impact absorbers". This system, which has been fitted as standard on every series-produced BMW since the late 1980s, allows the bumpers to withstand an impact at up to 4 km/h (up to 6 km/h on some models) without any lasting deformation. Deformation elements set further back absorb all the energy generated by frontal crashes at up to 15 km/h, without damaging the front structure or passenger cell. The impact absorber elements can be replaced relatively inexpensively. At speeds up to 15 km/h, the crash structure helps to absorb energy or divert it around the passenger cell. When the system was introduced in the BMW 7 Series, it was claimed that 70 percent of all front-to-rear collisions took place at a maximum 15 km/h. This means that the impact absorber system also helped to keep the car's insurance rating low.



The lights on the Turbo were integrated into the bumpers in such a way that they would not be damaged in minor collisions. Wind tunnel tests showed, however, that this placement had a negative effect on the car's aerodynamics.

The great grandfather of Active Cruise Control. One feature of the BMW Turbo never made it into production, but did serve as the basis for a much wider-reaching system. A radar-controlled distance warning device was already on the menu for the Turbo in 1972. A display was designed to show the distance – between 0 and 100 metres – to the vehicle in front. Depending on the car's speed, if the gap fell below a certain level a buzzing sound would be triggered, and the car's acceleration checked. Engineers returned to this idea repeatedly in the years that followed. The range of functions expanded enormously and were gradually channelled into production. Active Cruise Control went into series production as an option for the BMW 7 Series in 2002. This system not only shows the distance to the vehicle in front and warns the driver if the gap is getting too small, it also maintains a preset distance between the two vehicles. The current system brakes the vehicle as well as throttling back the engine.

A mid-engine concept – but not as the M1 knows it. As well as its design and safety features, the basic concept of the BMW Turbo was also genuinely remarkable. The mid-engined sports car was powered by a horizontally mounted 4-cylinder turbocharged engine with displacement just shy of two litres. The mid-engine concept was then taken up again in 1978 for the series-produced BMW M1. However, at the heart of the M1 was a naturally-aspirated straight-six powerplant with displacement of almost 3.5 litres, which was mounted longitudinally. The 4-cylinder unit in the BMW Turbo did make it into production, though, under the bonnet of the BMW 2002 turbo in 1973. Peak output was 170 hp. In the BMW Turbo, the 2-litre engine developed a maximum 200 to 280 hp – depending on the charge pressure of the turbocharger. The two-valve engine was designed with petrol injection and had a compression ratio of just 1:6.8, so as to ensure that the turbocharger and engine compression remained in tune. The turbo principle appealed to the BMW engineers because it meant greater efficiency and allowed environment-friendly combustion. BMW had already gathered a wealth of experience with turbocharged engines for aircraft before the end of the Second World War. However, the BMW Turbo marked the first time that the brand had used this type of powerplant in a car.

The engine was mounted on a subframe and fixed to the floor assembly by four large rubber mounts. The aim was to prevent, as far as possible, the engine from sending through vibrations. The subframe also supported the rear axle, whose construction was described in press information at the time: "The McPherson rear axle works with trailing and transverse links. Fitted in addition to the transverse link, a trapezoidal rod with ball joints controls the rear-axle kinematics." The press release also explained the effect of this construction: "The setting and arrangement of this additional link can be adjusted precisely to achieve the desired axle kinematics. The double wishbone arrangement sees the wheel move parallel to the centre of the car on the longitudinal suspension, suppressing the occurrence self-steering effects."

Post-presentation. After the BMW Turbo was unveiled to the public it was given a thorough inspection by engineers of various specialties. Since its ongoing tour of the international shows meant Turbo no. 1 was otherwise engaged, in September 1972 the Board of Management decided to build a second example for testing purposes. Prototype no. 2 was at work in the wind tunnel as early as autumn 1973. The influence of various modifications to the car was also explored. Tests were conducted on 17 variants in all. Tellingly, the most aerodynamically effective version had a similar Cd value to the BMW M1 which went into production some time later.

An internal test report from 1974 confirms that prototype no. 2 also underwent intensive dynamics tests at the Aschheim proving grounds, with improvements applied stage by stage to problem areas. The use of different tyres, for example, allowed progress to be made on the car's straight-line stability. The build-up of heat in the engine compartment and the oil temperature were other potentially serious problems to emerge from the first round of testing. In-depth tests were also carried out on the car's handling, possible improvements worked out and the limits of the concept discovered. The anti-lock braking system was added to the Turbo at a later stage, and this round of testing also took place without the radar-based distance warning system.

While vehicle number 2 was deeply immersed in testing, its older brother was midway through a major tour. Once the test programme had been completed, the two cars became a frequent sight at shows and in museums. In the winter of 1973/74, car no. 1 embarked on a tour of America, stopping off at the Los Angeles Auto Show, the Import Car Show in San Francisco and the Boston



Facing page left | The second of just two BMW Turbos ever built in dynamics testing in 1974.

Facing page right | The arcing cockpit of the BMW Turbo. The precursor to Check Control is to the left of the driver's seat.

Above | The BMW M1 production sports car (from 1978) takes styling cues from the BMW Turbo study.

Below | Futuristic (for the time) locations were favourite venues for photo shoots with the innovative BMW Turbo.

Auto Show. Following the "documenta6" in Kassel, one of the cars also popped up in Munich in 1977 under the slogan "Vehicles: utopian design". From 1982, car 1 went on show for a good number of years at the Auto+Technik Museum in Sinsheim, while the second car could generally be seen in the BMW Museum in Munich. The first BMW Turbo also guested for several years at the Musée National de l'Automobile – Collection Schlumpf in Mulhouse, as the only representative of the BMW brand. Then, in 1989, it was unveiled once again as part of the press presentation for the BMW 850i. On 12 and 13 September 1992, the then freshly restored BMW Turbo won first prize in the Concours d'Elegance de Bagatelle in Paris, before returning to its home-from-home in Mulhouse. Another notable appearance came at an exhibition at the Kunsthaus Wiesbaden art gallery in April 1993, where the Turbo was displayed along with paintings and sculptures by Paul Bracq. The former head of design at BMW has always been a keen painter, illustrator and sculptor. His oil paintings, depicting cars from various manufacturers and eras, are particularly well thought of in specialist circles.

In early July 2006, the BMW Turbo went on show once again in front of an audience of some 70 international journalists. The scribes were attending the BMW Group Innovation Day 2006 to find out more about driver assistance systems. As the first BMW to be fitted with these systems, the BMW Turbo provided a bridge between the past and the future at the event.

