PORSCHE

Press Information

Porsche Plant in Leipzig

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In brief

Porsche in Leipzig – high-tech plant and handcrafting: Production of new Porsche Macan officially launched in Leipzig

Porsche plant in Leipzig expanded into comprehensive factory with 500 million euros
Macan, Cayenne and Panamera are produced in state-of-the-art sustainable factory

Porsche is kicking off 2014 with one of the most exciting projects in its over 80-year history. The sports car manufacturer is launching the Macan, a completely new SUV model series, and it invested 500 million euros in its automobile plant, many aspects of which were re-conceptualised. In Leipzig. Made in Germany. Porsche expanded its plant – one of the most advanced and sustainable in the world – for the Macan. This included a new body shop and paint shop. Also new in Leipzig are 1,500 additional employees.

Production area tripled in size, 17,000 metric tonnes of CO_2 savings. For production of the Macan, Porsche accomplished a factory expansion – that is really equivalent to the building of a new plant – within an extremely narrow time window. The assembly factory was extended into a highly innovative fully capable factory with a new built-up area of 17 hectares – a land area equivalent to the area of 24 football fields. In the expansion, the site's total production floor area increased from 76,000 to 259,000 square metres, more than tripling in size. In expanding the Leipzig plant, Porsche also created one of the world's most eco-friendly automotive factories. Thanks to new and innovative technologies, Porsche is reducing its annual CO_2 emissions by nearly 17,000 metric tonnes compared to conventional systems. In addition, 1,100 new trees were planted at the plant site.

Production curve of Macan is ramped up. Currently, Porsche is ramping up its production of the Macan according to schedule. Starting on 5 April, it will be sold at German Porsche centres with prices starting at € 57,930. Siegfried Bülow, Managing Director of Porsche Leipzig GmbH: "In October 2013, we were manufacturing five Macan cars per day in pilot production; by mid-2014 we will already be producing around 300 Macan cars daily. And indeed at a quality level that distinguishes every Porsche." This ramp-up of the production curve is significant, not simply because production volumes have been historically lower at Porsche, rather it is important because a quality of customisation and precision in details

is being accomplished that is more reminiscent of handcrafted manufacturing. Matthias Müller, Chairman of Porsche AG, had this to say: "In the Macan, we are implementing a very complex design. One example is the wrap-around aluminium bonnet, which is unique in the automotive world. No other carmaker has implemented a bonnet that is as complex as the bonnet our team is producing at our high-tech plant in Leipzig. That is a typical Porsche innovation."

Customisation in handcrafted style. As noted, a characteristic aspect of the sports car manufacturer is that it offers Porsche drivers nearly limitless options for customising their cars. Dr. Oliver Blume, Member of the Executive Board Production and Logistics at Porsche AG: "The Porsche production system combines modern production methods with the traits of handcrafted carmaking. A high degree of customisation is an important criterion for our customers. For example, in Leipzig we are using the latest painting technology, but we can also offer any desired custom colours. At Porsche, customers never get an "off-the-shelf" car; they can even have a car painted in the same colour as their neck tie if they wish." Just as at its main plant in Stuttgart-Zuffenhausen, and at the Group plant in Osnabrück, in Leipzig Porsche benefits from the precision of highly advanced production methods while offering the exclusivity of handcrafting. Dr. Blume: "When we take a look at the redesigned assembly area at the Leipzig plant, for example, one key aspect is of course our innovative linkage of producing three very different models – the Macan, Cayenne and Panamera – on one line. And this indeed at an extremely high level of complexity while attaining an extremely high degree of customisation. The truly innovative aspect of the Porsche production system is precisely this perfect combination of high-volume production and the wide variety of optional features that is characteristic of handcrafting."

Made in Germany. The Porsche plant in Leipzig, which was founded in 2002 and was significantly expanded for the Macan between 2011 and late 2013, is a typical example of the performance capabilities of German industry. It is the employees in particular who made it possible to implement a top level of production technology in Leipzig. Chairman of Porsche AG, Matthias Müller: "For us Made in Germany is an important quality characteristic. We get this primarily from the qualification of the people who work at our company. Here in Germany, our dual-track vocational training system gives employees a qualification level that is higher than in many other countries of the world. Aspects that are rightly associated with Germany

include its typically high reliability, conformance to scheduling, well-structured work on the car, measurability, high analytical competence and sense of responsibility. Also important are its high level of technological understanding and the innovative drive to continually improve processes. Germany has a competitive lead here."

Advantages of the Leipzig site. Dr. Oliver Blume, meanwhile, explains why the Leipzig plant was chosen to produce the Macan in Germany: "The team at Porsche Leipzig GmbH had already proven – in its production of the Cayenne and Panamera – that it could manufacture highly complex products with top Porsche quality. The Leipzig plant also has an ideal strategic location as a good economic hub with excellent transportation connections. In Leipzig, we also have a factory with ideal expansion capabilities, its own customer centre and – something that to the best of my knowledge is unique in the world – it has a race track and off-road course. Last but not least, Leipzig possesses the know-how for our front-mounted engine versions; while we produce rear and mid-engine sports cars in Zuffenhausen and Osnabrück, we produce the versions with front-mounted engines in Leipzig. This gives us a very good distribution within the Porsche production network." The factory in Leipzig is the sports car manufacturer's second dedicated production site along with its home plant in Stuttgart-Zuffenhausen.

Up to 50,000 Macan cars annually. As noted, Porsche already produces the Cayenne and Panamera model series at the Leipzig plant (2013 Leipzig production: 107,000 vehicles). The launch of the Macan will now add significant production volume. After a successful ramp-up of the new SUV, approximately 50,000 Macan cars will be produced annually in Leipzig.

The Porsche plant in Leipzig – details of the environmentally-friendly factory

Plant expansion from autumn 2011 to late 2013. The decision to produce the future Macan in Leipzig and therefore to expand it into a fully capable factory was made in 2011. From then on, everything happened in quick succession. In October of the same year, the foundations were laid for the plant expansion. At that time, the stated goal was to start production at the end of 2013. This ambitious goal was clearly reached. In particular, the short amount of time required for the many approvals to be issued by regulatory authorities speaks highly of Germany's potential as a place to do business and of the results oriented performance of the Porsche project team responsible.

New body shop supply centre. The aluminium and steel sheet metal body parts – currently for the Macan – are produced at various press works by 40 suppliers, both internal to the Group and external, and are delivered to Leipzig at specific cycles. In the new body shop supply centre, which has a floor area of around 10,000 square metres, the parts are then electronically logged-in and transported to the body shop by tugger trains. The Porsche logistics concept enables fast turnover of pressed goods; no conventional warehousing is needed.

New body shop. In June 2012, Porsche celebrated the topping-out ceremony for the body shop; just three months later, the first systems were installed in this area. Thanks to a highly professional team of Porsche planning specialists, experts and architects, as well as the company's close and cooperative working relationships with responsible standardization organizations and government authorities of the German state of Saxony and the city of Leipzig, Macan pilot series car no. 1 was produced for internal status quo evaluation just 16 months after excavating for the first foundations. Over a production area of 35,000 square metres, 387 industrial robots are used to build the new Macan bodies in mixed aluminium-steel construction and at the usual high level of Porsche quality. The steel and aluminium stamped body parts that are delivered via the Porsche production system are joined together in Leipzig with around 6,000 welds.

Electrical consumption reduced by solar power. The energy efficiency of the new facility was optimised by installing a photovoltaic system on the roof. It was designed to generate up to 800,000 kWh of electricity annually via solar power. In parallel, Porsche always saves energy wherever possible. In body manufacturing, for example, a newly designed cooling system for robot welding rods reduces annual electrical consumption by over 365,000 kWh; that is equivalent to the annual electrical consumption of over 70 four-person households in Western Europe.

New paint shop. The new paint shop was built almost simultaneously with the body shop. The time window for implementing the 360 metres long, 72 metres wide and 30 meters tall new building qualifies was relatively narrow. After excavation work in October 2011 and structural construction that began in March 2012 had been completed, the topping-out ceremony for the building complex with 60,000 square metres of floor area was held in November of the same year. Here too, the classic comparison with the size of a football field

(standard FIFA football field) illustrates the enormous dimensions of the shop: its 60,000 square metres is equivalent to the area of around eight professional football fields. The first painting robots were started up back in the summer of 2013 – less than one and a half years after construction of the building had begun. A total of 81 robots paint the vehicles in eleven different colours and a wide variety of custom colours.

Clean air and heat from biomass power plant. A newly developed separation system ensures that the emissions in the paint fog are reduced to a minimum. At the same time, 2.3 million cubic metres of air is moved per hour – as supply air, exhaust air and recirculation air. The exhaust air is cleaned in a wet chemical process. The paint shop sources the energy that is input into its operation innovatively. Here, Porsche uses a biomass power plant located next to the factory; this sustainable alliance covers 80 per cent of the paint shop's heat needs CO_2-neutrally. The results: CO_2 emissions have been reduced by over 8,000 metric tonnes annually.

Extended supply centre for assembly. Supplying an entire automotive plant with parts is a logistical master achievement. To supply these parts to the assembly lines with cyclic precision – without an intermediate warehouse – deserves even more respect. That is precisely how it is done in Leipzig. Because the Macan is now also assembled here, Porsche doubled the floor area of the existing "assembly supply centre" (not to be confused with the new "body shop supply centre") – from 20,000 to 38,000 square metres. Around 4,500 different parts make their way into the assembly hall from here.

New assembly line. Production of the successful Cayenne and Panamera models has been running at a fast pace for many years now. By the end of December 2013, around 700,000 units of these two model series were produced in Leipzig. All the more noteworthy is the fact that in parallel to the ongoing production activities the new production line for the Macan was integrated into the extensively enlarged assembly hall. Production experts have compared the extremely challenging timing of this process to open heart surgery on the plant. The operation was successful. Since the start of Macan production, three Porsche model series are now being assembled in parallel in Leipzig by a highly flexible method known as mixed production. In three shifts, employees on the production lines not only assemble Porsche cars with petrol and diesel drive systems, but also hybrid vehicles (currently the Cayenne) and plug-in hybrid models (currently the Panamera).

Picking up a new car at the Customer Centre. In just 2013, over 2,300 of these new Porsche cars were picked up by their owners at the customer centre in Leipzig. One special aspect of picking up a car at the plant is a test drive over the 3.7 km long race track (FIA certified) – where customers are provided with vehicles of the same type as their new car. If the vehicle is a Cayenne, a test drive on the 6.0 km long off-road course is also included. An instructor shares information with customers about their new cars and about the vehicle run-in track and test track. All Panamera and Cayenne cars delivered from Porsche centres – up to 500 daily – leave the plant via railway and lorry for delivery to over 120 countries worldwide. There will be even more cars now with the addition of the Macan.

Overview: a systematic approach to production

Leipzig assembly plant becomes a comprehensive factory: Porsche produces the Macan, Cayenne and Panamera in Leipzig

Porsche launches second comprehensive factory in Leipzig with body shop and paint shop
Porsche plant in Leipzig specialises in models with front-mounted engines

Three production sites. Porsche builds four sports cars, one sport saloon and two sport SUVs. The latest model series of its product range is the Macan. The various model series are conceptually subdivided into two groups: the Porsche cars with rear or mid-engines (sports cars) and the Porsche cars with front engines (sport saloon and SUV). The range of sports cars comprises the Boxster / Cayman model series (flat-six cylinder mid-engines), the 911 (flat-six cylinder rear engines) and the 918 Spyder (V8 mid-engine plus electric motors). One of the world's sportiest sedans is the Panamera (V6 and V8 engines; as hybrid plus electric motor). In the SUV (Sport Utility Vehicle) class, the new Macan (V6 front engines) complements the larger Cayenne (V6 and V8 front engines; as hybrid plus electric motor). All Porsche cars are manufactured in Germany – distributed to three production sites based on drive system concept:

- **Stuttgart-Zuffenhausen:**
  The Boxster, 911 and 918 Spyder are produced here – Porsche cars with a rear or mid-engine.

- **Osnabrück:**
  The Cayman and Boxster are produced here – Porsche cars with a mid-engine.

- **Leipzig:**
  The Macan, Cayenne and Panamera are produced here – Porsche cars with a front engine.

Porsche production system. At all three production sites, production and logistics processes are oriented towards the Porsche production system that is considered path-breaking. It guarantees that a new Porsche can be optimally produced with top quality as well as with a large measure of handcrafted individuality in the variety of features it offers. The Porsche production system is subdivided into four modules:

- **Product engineering** – every Porsche is engineered for production and for quality.

- **Process engineering** – systematic implementation of processes for new products.

- **Process optimisation** – continuous optimisation of production processes and products by the Porsche improvement process, also known as PVP.

- **Process assurance at suppliers** – Porsche consistently integrates its partners into the value creation chain.

The Porsche production system was developed in the 1990s and is based on four principles of "lean production." It is still based on these principles today:

- **Flow principle** – all value creating processes are networked with one another by highly innovative logistics. The production steps and materials they require generate the flow of value creating activities.

- **Cycle principle** – manufacturing at the "customer cycle." Here, Porsche buyers as customers establish a certain cycle that results in production volumes. At the same time, internal employees are also viewed as "customers" who are involved in the specific cycles of production. This cycle is the driver for all production and logistics processes during the production of a Porsche.

- **Pull principle** – the internal "customers," i.e. the employees in the body shop, paint shop and assembly – cyclically "pull" materials from the logistics supply centres. In turn, logistics only issues production releases to suppliers for the quantities of vehicle parts needed to meet the momentary supply demands of production. This is done to avoid overproduction and unnecessarily large buffers. That is, vehicle parts are only provided via the supply centres at the plant when there is a need for them.

- **Zero errors principle** – assurance of stable processes and error-free products ("do not accept any errors, do not make any errors, do not pass on any errors").

Challenges for the Porsche production system. These building blocks of the production system are implemented and validated by projects and workshops developed specifically for them. The goals here include continually reviewing processes and boosting efficiency. The challenges encountered by Porsche with this production system are especially difficult, because one vehicle is hardly like another. The reason is that Porsche as a premium carmaker offers a degree of customisation that otherwise can only be achieved in handcrafted car manufacturing. This complexity is escalated by the fact that three model series – with their many different versions – are to some extent produced on one and the same production line in Leipzig. Nonetheless, Porsche is solving these challenges with a perfectly conceptualised logistics process chain. This type of production is based on the string of pearls principle. It achieves very stable information and material flows. At Porsche, this means that the production sequence for vehicles is already firmly established seven days before the vehicle parts arrive in the assembly area.

A Porsche is designed for production. A universal approach like that of the Porsche production system, in which production parameters merge with the engineering of the vehicle, is by no means the standard industry practice. This aspect is already established early in the design phase of a Porsche. Dr. Oliver Blume, Porsche Board Member for Production and Logistics comments: "The Porsche production system not only addresses how the production system is structured, rather we begin to conceptualise a Porsche that is optimally designed for production at a very early phase of vehicle development." It is easy to see why there are large production synergies among rear and mid-engine sports cars related to their similar construction, and such synergies also exist among all front engine models. The centrally controlled Porsche production system is therefore a decisive factor in enabling joint production of the sports cars in Stuttgart and Osnabrück and producing the new Macan together with the Cayenne and Panamera in Leipzig.

From assembly plant to comprehensive factory. "Until the production launch of the Macan, Porsche Leipzig was essentially an assembly plant for the Cayenne and Panamera, because in this phase there was no dedicated body shop or paint shop on the production site with its land area of 400 hectares," says Siegfried Bülow, Managing Director of Porsche Leipzig GmbH. Bülow continues: "The expansion has now made Leipzig a full-fledged plant." The Macan is produced in Leipzig with an even greater depth of production than the Cayenne

and Panamera. That is because, unlike the two larger Porsche cars, the body of the new car is built and painted in Leipzig as well. To accomplish this, Porsche built a completely new body shop and a new paint shop on the production site – by lengthening the existing factory in a westerly direction. Simultaneously, Porsche Leipzig GmbH extended the factory by adding a separate supply centre for the body shop and enlarging the assembly hall. This has resulted in the following construction matrix – and at the same time a new sequence of the production steps – for the Porsche production site in Leipzig since 2014:

- **Body shop supply centre.** The aluminium and steel sheet metal – currently for the Macan – is produced at various Volkswagen Group press works and by external suppliers, and sheet metal parts are then delivered to Leipzig. In the new body shop supply centre, which has a floor area of around 10,000 square metres, the parts are electronically logged in and transported by tugger trains to the body shop.

- **Body shop.** On a floor area measuring 35,000 square metres, Porsche produces the body of the Macan in mixed aluminium-steel construction with around 6,000 welds. In their work, employees in the body shop are assisted by 387 industrial robots. One highlight is manufacturing of the complex aluminium bonnet design.

- **Paint shop.** The largest and most complex new building at the Porsche plant in Leipzig is the paint shop. On its multiple levels and floor area of 60,000 square metres, 81 robots paint the galvanised bodies of the Macan in one of the eleven standard colours currently offered – with cutting-edge efficiency and eco-friendly processes. Upon request – and this too makes Porsche the great brand that it is – a car may also be painted in any desired colour within the framework of the “Porsche Exclusive” customisation programme.

- **Supply centre for assembly.** Supplying an entire automobile factory with parts is a logistical master achievement. To supply these parts to the assembly lines with cyclic precision – without an intermediate warehouse – deserves even more respect. That is precisely how it is done in Leipzig. Because the Macan is now also assembled here, Porsche has doubled the floor area of the existing “assembly supply centre” (not to be confused with the new “body supply centre”) from 20,000 to 38,000 square metres. Around 4,500 different parts make their way into the assembly hall from here.

- **Assembly.** The Macan is now being added in the space where the Panamera and the Cayenne are assembled – in mixed production – on 21,600 square metres of floor area. From now on, instead of the previous maximum of 500 cars, up to 650 Porsche cars will be produced daily in three shifts on the "Door line," "Interior lines 1 and 2," "Underbody lines 1 and 2," "Exterior lines 1 and 2," "Mixed lines 1 and 2," "Engine buildup," "Chassis buildup," the "Marriage" module and finally in the "Test area." The last station before shipping or delivery to the Customer Centre is final inspection.

Test drive to validate top quality. At a testing area integrated in the final phase of assembly, the sport saloons and SUV are programmed, filled with fuel and started for the first time. Then the cars go out onto the run-in and test track: "Every Porsche in Leipzig – and this is a special aspect of this plant – is tested briefly before delivery. This is a process that is hardly the usual practice among the world's car manufacturers, and it underscores the special position of the premium brand Porsche," says Dirk Kolar, Head of Quality Assurance at Porsche Leipzig. In the first ten years of the plant's existence – from August 2002 to June 2012 – 500,000 Cayenne and Panamera cars were produced in this way. By the end of December 2013, nearly 700,000 units of these two model series had been built. With the Macan, the milestone of one million vehicles produced in Leipzig is now approaching – in high-tech production that offers the same degree of customisation as handcrafting methods.

Expansion phase

Like open heart surgery: Porsche Leipzig still ran at full capacity while the plant was being expanded

Porsche implemented the largest construction project of its history in less than 36 months
Production floor area expanded from 79,900 to 245,900 square metres, costing 500 million euros

Series production and handcrafting. The Porsche plant in Leipzig is one of the world's most advanced automobile factories. The Porsche Cayenne has been produced there since August 2002, and in September 2006 Porsche launched production of the Panamera as well. One special highlight of the Porsche brand is the fact that its innovative and precise industrial production of premium automobiles is associated with maximum handcrafting-like benefits in production. This means that cars are created on high-tech manufacturing systems in fully automated processes, but at the same time many Porsche cars are still ordered and built with such details as exclusive full leather trim on the instruments – features that assume a level of customisation on par with that of handcrafted cars. This wide range of production processes mastered at the Porsche plant in Leipzig also made it possible to produce the Porsche Carrera GT super sports car in a separate manufacturing area between 2004 and 2006. In 2010, the plant management in Leipzig began to entertain thoughts of potentially implementing production of the Macan.

Assembly plant becomes comprehensive factory. On 15 March 2011, the Supervisory Board of Dr. Ing. h.c. F. Porsche AG, resolved to produce the new Macan in Leipzig in parallel with the Cayenne and Panamera. At the same time, a decision was made to expand the assembly plant with an investment volume of 500 million euros over the next three years, adding a new body shop and a new paint shop to expand it into a comprehensive factory. Its production area on the 946,979 square metre factory land site would be expanded from 79,700 to 245,900 square metres; the factory, Customer Centre and dedicated on-road and off-road test tracks would in turn be located on 4,000,000 square metres (400 hectares) of land owned by Porsche AG; its land area is larger than the former legendary Berlin Tempelhof airport (386 hectares).

Production site offers ideal expansion options. In a Group-wide solicitation for bids conducted before the production program, Porsche Leipzig GmbH was named the ideal site for production of the Macan. Various factors were cited as crucial in this decision: "The site has proven, in its production of the Cayenne and Panamera, that its highly qualified employees can manufacture highly complex products in top Porsche quality," says Dr. Oliver Blume. The Member of the Executive Board for Production and Logistics at Porsche continues: "In addition, Leipzig has a strategically optimal location in the middle of Germany – it is a business node point with excellent transportation connections. In addition, we had and still have excellent expansion capabilities there."

Made in Germany. The Executive Board not only voted for Leipzig in 2011; this also represented a vote for Germany as a production site. Matthias Müller, Chairman of Porsche AG comments: "For Porsche and its customers across the globe 'Made in Germany' is a key criterion. Here in Germany, there is an extremely high level of understanding for technology and innovative drive to continually improve processes. In addition, the great art of handcrafting is practiced in Germany, and this has traditionally been an important part of Porsche. Last but not least, in this country we have very well educated workers, and the qualification level in Germany is unique with its dual-track vocational training system. All of these parameters were important to us in making a decision as an automobile manufacturer to produce the Macan in Germany."

Planning phase – how the plant expansion was conceptualised

Plant structural planning looks years ahead. The prerequisites for the plant expansion were already put in place in Leipzig long before the Macan was even discussed in the company's long-term strategy papers. Siegfried Bülow, Managing Director of Porsche Leipzig GmbH and plant manager responsible for the expansion: "At the time the decision was made to produce the Panamera in Leipzig – which was in 2005 – we had already developed initial concepts of how the plant might appear in the years 2015 and 2020. A key aspect here is what is known as plant structural planning – this master plan is used to get an early glimpse of the future of the factory. It involves planning an imaginary additional model series to be produced. We did this in 2005 without knowing that there would be a Macan. From this perspective, the current expansion is essentially a planned extension of the factory."

The first step towards becoming a comprehensive factory. One member of Siegfried Bülow's team is Christoph Beerhalter, Head of the Macan Project. As a production specialist his job was to work together with the local plant manager to create real production systems from the theoretical plans for the plant expansion. Beerhalter: "In plant structural planning, one considers how the white areas on the production site might look built up in the year 2020. And then one knows where to place which systems so that the plant is set up to handle future needs – i.e. it offers long-term development and growth potential. Plant structural planning is the first step!" Siegfried Bülow adds this: "It is precisely at this point that one can make the biggest mistakes. If we had not done our work properly back in 2005 – when the decision was made to produce the Panamera – and had not thought beyond the Panamera in designing our plant structures and extensions – we never would have been able to follow through on these extensions for the Macan."

Construction phase – how the plant expansion was implemented

166,000 square metres of additional production floor area. Christoph Beerhalter, head of the plant expansion team: "We started with a factory here in 2002 that originally had a floor area of 14,400 square metres. During the current expansion – simply due to adding production of the Macan – new buildings had to be constructed that cover nearly twelve times this area." A total gross floor area of 166,000 square metres had to be created – an interior floor area that is 1.4 times larger than the new "Elbe Philharmonic" concert hall in Hamburg. Just to excavate for the foundations of the new factory buildings and modify relevant surfaces of the land site, 20,600 lorry loads had to be moved – that is 515,000 cubic metres of soil. A graphic comparison: this volume is also larger than the total space enclosed by the 110 metre tall concert hall in Hamburg. Expressed in automotive terms, the amount of earth moved in Leipzig is equivalent to the total volume of over 35,225 new Porsche Macan cars.

Perfect interplay of city and country. After the resolution of 11 March 2011 to produce the Macan in Leipzig, everything proceeded very quickly. The primary reason for this is that from the very start Porsche Leipzig GmbH coordinated everything very closely with all approval authorities of the city of Leipzig and the state of Saxony. When this close cooperation is lacking, construction projects of this magnitude can quickly experience schedule delays. Christoph Beerhalter gives an example: "An approval related to the federal emissions

protection law – which is needed before any building activities or erection of a vehicle plant can begin – is not a type of approval that a city can issue. Rather an independent approval agency is involved which demands strict adherence to the various conditions of this law." Beerhalter continues: "It is necessary to coordinate precisely with the authorities to ensure that no dates are missed. A council meeting does not happen every week, rather just once per month. And if you miss that meeting, you have lost one month. That is why we at Porsche joined together with representatives of the city of Leipzig, the state of Saxony and approval agencies to form a steering group, whose goal is to simply handle all issues and flows related to the project with extremely close coordination."

How the body shop was created in detail

Body manufacturing on 35,000 square metres. Just for body manufacturing, 90 binders of documentation were generated – they were filled to the brim with many different approvals. They contained noise, air and fire reports, safety strategies and various other study results. By 14 June 2012 – just 15 months after Leipzig was selected – the topping-out ceremony was held for the 35,000 square metres body shop. The building itself is so large that it is better to ride a bicycle to get from one end to the other. It is 288 metres long and 120 metres wide. There is just one floor space, but it has a tremendous height of ten metres from floor to ceiling. On 1 September 2012, around 10 weeks after the topping-out ceremony, the first systems had already been installed for the Macan that was to be produced in mixed aluminium-steel construction – this effort also involved installing the first of the 387 robots in the body shop – they were sourced primarily from the German specialist Kuka.

Floor modules define distribution. Exactly where specific body parts are joined together is defined by the floor modules that were placed beforehand. Christoph Beerhalter: "When you assemble a car, there is always a certain sequence to be followed. That is, I produce the underbody structure, followed by the side sections and the roof, and finally the doors and lids come into play, and – expressed in very simplified terms – the whole body is finished." Beerhalter continues: "If I know precisely how the vehicle should look, which individual parts it should have, precisely how it should be constructed, what challenges it poses, then I can plan the equipment precisely. Take the underbody, for example. Here, I know that it consists of a defined number of underbody structures, which are in turn created from parts that are defined just as precisely and which are joined by specific joining technologies. New aspects

may enter the picture such as the elaborately constructed bonnet made of aluminium; this then leads to another large change in the floor modules. However, the modifications are narrowed progressively – and at some point this leads to fewer and fewer corrections. In the end, the facility assumes a specific physical form in steel and with all of its robots and computers."

How the paint shop was created in detail

Second paint shop at Porsche. The largest new building of the Porsche plant in Leipzig is the paint shop. It is located in the southern-most section of the factory, right next to the body shop. Like the body shop, the paint shop was specifically built for production of the Macan. Theoretically, however, almost any other Porsche could be painted here as well.

As long as the pit row on the Nürburgring race course. The paint shop has a floor area measuring 20,000 square metres – enough space to (theoretically) park 6,400 Macan cars bumper to bumper. At a length of 360 metres, the paint shop is nearly as long as the entire pit row at the start/finish lines of the Nürburgring race course, and it is 15 metres longer than the Queen Mary 2 luxury liner. The building is 72 metres wide and 32 metres tall. Its gross interior space is 650,000 cubic metres – this too is larger than the whole interior of the new Elbe Philharmonic concert hall in Hamburg. Purifying the air in the painting area requires an enormous effort. Porsche has implemented an innovative wet-chemical method here, which was installed on the upper floor of the paint shop. 2.3 million cubic metres of air is moved per hour in the paint shop – that is 34 times the volumetric flow rate of ventilation air that is circulated in the assembly chamber of the German Reichstag building in Berlin, which definitely has a significant amount of space.

Simultaneous external and internal expansion. "During its construction, the size and complexity of the paint shop led to an even more ambitious schedule than was the case for the body shop. Nonetheless, we were able to integrate this timeline into the overall time window," says Siegfried Bülow, Managing Director of the Porsche Leipzig plant. Bülow continues: "We were able to achieve this, because the team succeeded in intermeshing construction of the building and the process of setting up the equipment systems inside. That is, we had already begun to install the first system areas while the building construction work was still being completed."

Paint shop was built in less than 24 months. In October 2011 – just five months after the decision to produce the Macan in Leipzig – excavation work had already begun, i.e. digging for the foundation. On 14 November, work began on the bored pile foundation; this involved sinking 221 bore piles up to 37 metres deep with 5,500 cubic metres of concrete to support them on very stable underground layers, so that building loads could be optimally distributed in conjunction with the foundation. That is because, despite efforts aimed at boosting efficiency and sustainability in operating the facility, the building itself is still a rather heavyweight object. The installed steel bored piles themselves and the concrete they required weigh 13,825 metric tonnes – that is equivalent to the weight of 36 Airbus A380 airplanes (during landing). Work started on the shell of the three-story paint shop on 19 March 2012. Less than four months later, on 4 July, construction workers had already made their way onto the second floor, nine metres above the ground. Another four months later, on 6 November, Porsche celebrated the topping-out ceremony for the paint shop. Incidentally, the prefab concrete elements installed in the paint shop weighed 40,000 metric tonnes, and the total amount of installed concrete was 113,000 metric tonnes. The latter is equivalent to the landing weight of 292 Airbus A380 airplanes. As mentioned, systems were built inside the building towards the end of the construction phase, and on 15 August 2013 the first Macan body was painted in a test. Less than 24 months had elapsed from the start of construction in October 2011 until the first car body was painted. This was a record time for erecting one of the most advanced paint shops in the world.

Creating the supply centres and extended assembly area in detail

Assembly area extended, supply centres doubled in size. Over the same time period, between autumn 2011 and late summer 2013, an entirely new supply centre was built for the body shop, the supply centre for assembly was built, and the assembly area itself was extended. Another milestone of the factory was construction of the “body shop supply centre” which is 280 metres long and 36 metres wide. It was connected directly to the longitudinal side of the body shop to assure short and quick paths for supplying the facility. Michael Weihrauch of the Logistics area at Porsche Leipzig GmbH: “The building with its 10,000 square metres of floor area was designed so that, after unloading from the lorries, the delivered steel and aluminium sheet metal parts for the new Porsche Macan could be transported from the body shop supply centre without forklifts despite the significant sizes of some of these sheet metal parts.”

Six bays for parts delivery. A technical prerequisite for doing without forklifts in the buildings was met by implementing a special conveying system that utilises tugger trains with rolling containers. The containers, each of which may weigh as much as 800 kg, are all pushed manually from the tugger train to the production station using an ergonomic handling technology developed by Porsche. The cargo carriers are delivered to the new supply centre by lorry. This is done via a perfectly designed receiving dock system with six bays. Up to six lorries can be unloaded into the bays by forklifts here; this is all done within an action radius of just a few metres, and the cargo carriers are immediately transferred to the tugger trains. As mentioned, there are no forklifts in the building itself, so this factory can really be described as the world's first "forklift-free" automobile factory.

Assembly supply centre now has nearly twice the area. Naturally, this also applies to the expanded "assembly supply centre." Until now, this logistics centre supplied the assembly area with parts for the Cayenne and Panamera. Now, the area had to be significantly enlarged for the third Porsche model series from Leipzig. Michael Weihrauch explains: "We nearly doubled the floor area of the assembly supply centre from 20,000 to 38,000 square metres." Two sides of the original supply centre were lengthened. Here too, Porsche ensured that the logistics chain would operate perfectly from the very start. Weihrauch: "There are three large freight entrances; this is where the lorries are unloaded. Forklifts transfer the material directly onto tugger trains. These tugger trains distribute the materials – without the use of forklifts – directly into the pick-and-place zones or supermarkets." Like the assembly area, this supply centre was extended and retrofitted while production of the Cayenne and Panamera was running at high speed. Plant manager Siegfried Bülow: "In a sense, this expansion of the supply centre and assembly areas was similar to open heart surgery." Michael Weihrauch explains how operations were run at the supply centre: "Naturally, the top priority of logistics is to ensure a stable supply of materials to production. That is why we completely restructured the supply centre; this was accomplished by a tremendous effort spanning a time period of just twenty weeks – Tetris with Porsche parts." To be exact, the total number of parts was 4,500 at full start-up of the Macan.

Capacity for up to 650 new Porsche cars daily. These parts are assembled on the production lines of the assembly hall which now has 49,200 square metres of floor area (not including intermediate levels or decoupling modules). The lines had to be supplemented with cycles specific for the Macan here – stations at which individual parts and modules are assembled in and on the cars – and numerous stations had to be modified. This applies in particular to the chassis and engine build-ups, which is the term used by production experts for assembly of the suspensions, exhaust systems and engines. The lines were also made longer overall. An entire line was added for the Macan in what is known as the testing area – among other tasks performed in this area, the vehicles' control units or computers are supplied with data ("parameterised"), and the engines are started for the first time. Once again, Christoph Beerhalter: "Lines were in fact lengthened, new equipment was brought in, equipment was redesigned, and lines were made faster. In the assembly area alone, we are talking about an investment of 40 million euros for new production equipment. Before the expansion of the Porsche plant in Leipzig a maximum of 500 Cayenne and Panamera vehicles were produced daily in the assembly area and shipped to the 120 countries in which Porsche has a presence. From now on, with the Macan, up to 650 new Porsche cars can be made in Leipzig every day.

Production

How the new Macan is produced: Aluminium-steel body can be painted in any colour

Aluminium bonnet is masterpiece of body manufacturing
New paint shop can paint car in any conceivable colour that a Porsche customer wishes

This is how cars are built. The Porsche plant in Leipzig produces the new Macan, the Cayenne and the Panamera. The greatest depth of production of these three model series – i.e. the share of the creation process of a car – is attained by the Macan in Leipzig. Because unlike the Cayenne and Panamera, the body of the Macan is also manufactured and painted at the latest comprehensive plant of the sports car producer. As a result, the new Macan illustrates very well just how a new Porsche car is manufactured in Leipzig.

How the new Macan is produced

Perfect interplay in the value creation chain. Anyone who observes production in Leipzig – and the creation process for the Macan – experiences the nearly playful ease with which the processes are intermeshed. This impression is repeated like a common thread throughout the entire production chain. In Leipzig, this chain begins with delivery of vehicle parts to the two supply centres (body shop and assembly shop supply centres), then it extends to the body shop, paint shop and assembly shop until the final check of the finished car.

Porsche production system networks car engineering with production. The Porsche production system is a decisive factor in the precise production that appears to flow with such ease. Dr. Oliver Blume, Board Member for Production and Logistics: “The crucial aspect of the Porsche production system is the fact that we examine everything thoroughly, from the beginning to the end. Therefore, the Porsche production system not only relates to how an advanced production system is laid out – rather it is much more important systematically to engineer and design the car for production in very early product phases.” Porsche sets very special standards here relating to how perfectly and easily a complex, innovative and high-quality automobile should be built. An example is the headlight – just two screws

are used to mount an entire headlight within seconds or to change it out later at a service shop in case of damage. This technical innovation relates directly to the design of the headlight itself and the engineering solution of how it is installed. That is because Porsche engineers not only focus on the technical performance and design of this headlight when they engineer it, rather they also focus on how an employee in production or service personnel at a Porsche centre can later work with this headlight. Dr. Oliver Blume: "The Porsche production system is always designed for people. Not the other way around. The all-decisive aspect is where value is created. After all, that is what our customers pay money for. They do not pay for the method by which the part is installed in the car; they pay for the quality which is ultimately integrated in the car; they pay to own an uncompromisingly high quality product. The process – how the part is installed – must operate as perfectly, easily and quickly as possible. And that can only succeed if production employees can handle the part easily – including from an ergonomic perspective. Therefore, the person who installs the individual parts in a car is the centre of focus at Porsche. We design the Porsche production system around this person – and management is a classic service provider in this context."

Step I – body shop supply centre

Two supply centres, one logistics concept. The Porsche plant in Leipzig is part of a production network. This network consists of the company's plants and those of the Group. Representing another part of this network are the total of 600 suppliers primarily from Germany and Europe who deliver parts to Leipzig – parts ranging from individual screws to an entire cockpit. From the logistics supply centres, the parts for the new Macan are delivered to assembly with cyclic precision. The aluminium and steel sheet metal parts for the Macan are delivered to the "Body shop supply centre," while parts for all three model series arrive at the "Assembly supply centre." The logistics concept that was introduced for the first time with the Porsche Panamera in 2009 was also applied to logistical processes for the Macan. Michael Weihrauch, Head of the Logistics business unit, comments: "As much as possible, we adapted the lean and efficient logistics strategy for Assembly to the Body shop supply centre, but it was also further developed." That is why many solutions are identical in the two supply centres: Most of the shipping containers are the same, and the majority of the processes and the IT system with its underlying logistical processes are identi-

cal. But there are differences as well. Michael Weihrauch cites a few examples: “Large parts such as the side panels are unloaded directly from the trailer to the tugger trains, and they are immediately transported to the body shop stations. There is no such direct delivery in assembly. And there are processes in assembly that we do not find in the body shop. They include the entire just-in-sequence supply of assembly with vehicle-specific modules.”

Body shop, paint shop, assembly. Since the body must first be manufactured and painted in the Macan production sequence, the “Assembly supply centre” comes into play later – after the paint shop.

Parts warehousing eliminated. Step no. 1 in Leipzig in producing the Macan is delivery of the individual body parts by lorry to the “Body shop” supply centre. They are steel and aluminium sheet metal parts, which are produced at external press shops, but are not assembled there. Rather, the individual parts for the underbody, side walls, bonnet and boot lid, roof or doors are delivered to Leipzig by the lorry. There is no conventional warehousing; Porsche eliminated that. Michael Weihrauch: “In many body shop supply centres, parts are warehoused for several days of production. In contrast, we at Porsche prefer very small buffers and transparent processes. Thanks to our logistics chain, we can make do with a buffer of less than one day.” Weihrauch adds: “We receive large-volume parts in specified cycles by direct shipping from the supplier, and they are transported directly to production stations by tugger train. So there are no warehouses or intermediate buffers.”

Tracking ensures stable process flows. Michael Weihrauch: “Porsche relies on very precise tracking of materials.” Tracking, that is the process of determining the up-to-date status of material movements and parts deliveries at a precisely defined time point. Weihrauch: “Together with our shipping service provider, the Fenthols company, we currently track material directly from the shipping point.” When informed that parts are to be picked up by the shipping service provider, the supplier must actively report that the material is available. This is done at least one day before the material is picked up at the supplier. If the supplier does not provide active feedback, then the situation is immediately discussed with the supplier. This process chain lets Porsche reduce its safety stock, because the process sequence is one hundred per cent stable.

Six enormous delivery bays for six large lorries. The process flow begins in the 10,000 square metres supply centre of the body shop when parts are delivered by lorry. Like an airline pilot, the driver steers into one of six large gates that are equipped with gigantic side unloading doors. This means that as many as six articulated lorries can be unloaded at the "Body shop supply centre" simultaneously. Already waiting in the gates are two trains known as tugger trains – one for the new goods and one loaded with empty containers. The tugger train with containers of new goods generally takes the parts directly into the facility. Forklifts transfer the containers from the lorry to the tugger trains. However, in the supply centre itself – like in other areas of the plant – forklifts are no longer used. Michael Weihrauch explains: "We want a forklift-free body shop. That is because the forklift needs wider traffic aisles, it has a lower load capacity, and there is always a higher risk of accidents. Furthermore, the tugger train used by Porsche does not just pull one container, but instead as many as four containers."

60 different parts containers but a single container technology. The containers themselves are available in a wide variety of versions and sizes; one characteristic that they all have in common is that they can also be moved without a forklift or tugger train thanks to the Porsche container technology used here. Even 800 kg containers can be moved very ergonomically by hand. 18 container versions were designed for automatic parts removal – robots can grasp the parts directly from them. This is done, for example, in the containers that hold the bonnets manufactured from aluminium. At the Volkswagen press shop in Bratislava, these parts were also automatically placed into the containers by robots.

Step II – body manufacturing

387 robots perform about 6,000 welds. The new body shop has a floor area measuring approx. 35,000 square metres – an area that is nearly as large as five football fields end to end. It is here that the body of the Macan with its extremely high torsional rigidity is manufactured by a mixed aluminium-steel method. Porsche Leipzig attains a production depth of 90 per cent in body manufacturing. Over 100 production cycles, 386 individual parts are joined to produce the lightweight 500 kg body – by resistance welding (around 6,000 welds), 330 bolt joints, high-strength adhesives, rivets and laser brazing. 387 robots are used here. The body grows from bottom to top in four large steps.

Underbody, superstructure, add-on parts, finishing. First, the underbody – the platform – is built. For logistical reasons, it is subdivided into two sections: "Underbody 1" and "Underbody 2." This is followed by the superstructure. This is the area of the body manufacturing process in which the side components and roof are added to the underbody. The superstructure is subdivided into three large areas. In "Superstructure 1" the inner side walls are welded to the underbody structure – these are the plates on the interior. In the next area, "Superstructure 2," the outer side walls are mounted – these are the sheets of the exterior, which make up the design of the Macan. In "Superstructure 3," the body is completed by mounting the roof. Following "Underbody" and "Superstructure" is the "Add-on parts line," which is the third section in body manufacturing. Here, the doors, boot lid, front wings and distinctive bonnet – which were manufactured in parallel steps beforehand – are integrated into the body. Robots mount the doors and bonnet fully automatically, because the tight gap dimensions and transitions between surfaces require automated work methods. The boot lid and the wings are placed semi-automatically by workers. The fourth and final area is finishing, in which the body manufacturers check surfaces and perfect them if necessary as well as fine tune the add-on parts. Then the vehicles leave the body shop and are transported to the paint shop. It is especially exciting to take a close look at the production startup of the Macan in the body shop: the very elaborately manufactured aluminium bonnet, quality assurance and the Competence Centre, the manufacturing precision exemplified by gap dimensions and the actual birthplace of the car.

From five to 300 bodies daily. "The continual ramp-up of the production curve is always a special challenge," says Siegfried Bülow, Plant Manager in Leipzig. The production expert has been working in this business field for decades now and knows all about starting up new models: "By the end of October 2013, five Macan cars were manufactured daily in pilot production; by the beginning of February 2014, the figure had grown to 100 cars daily. Ten weeks later, we will already be producing 300 Macan bodies per day." And that is not even the theoretical maximum for daily production. Norbert Wagner, Body Shop Manager, explains that the Porsche Leipzig body shop was built "following a construction sequence from north to south." At the north end of the hall, the front wheel housings are the first parts to be assembled, while at the south end, body manufacturing ends with assembly of the add-on parts. Manufacturing of the aluminium bonnet of the Macan is a masterpiece

of production engineering. Wagner: "To produce such a design element, a part of such size and precision is without precedent." The pressed parts of the bonnet come from Bratislava. An outer part, an inner part and the reinforcements between them. The body shop manager: "The individual parts are folded or riveted, and a high-strength adhesive is also applied between the outer and inner sheets. First, the outer skin is placed in the production equipment in which the bonnet will be joined. Then the inner skin is fixed in place. In the next step, a robot with six roller-folding heads goes to work and makes the folds. As an added benefit, the bonnet gets additional torsional rigidity from the adhesive. Then the bonnet is placed in a specially built oven on a special fixture that assures precisely defined dimensional tolerances of the part, even when subjected to heat. This oven cures the adhesive. Then the surface of the bonnet is treated, and it is assembled. The complex production process rewards us and especially our customers with absolutely perfect precision fit of the bonnet."

Quality over quantity. Norbert Wagner once again: "Quality is our number 1 priority. Because with perfectly executed joining processes, we ensure that body properties and safety of the car are top level. That has to be checked regularly." The head of the body shop explains specifically how that is accomplished: "On a regular basis, we tear apart the folded seam joint to see whether both parts were properly wetted with adhesive. We also place high value on weld checking by ultrasonic methods; we do that daily. We have employees who are specifically responsible for this. Porsche Leipzig also has a laboratory in the body shop. There, we study whether the welds hold even under extreme conditions." Fortunately, defects are the exception today thanks to highly advanced technology. Production expert Wagner: "The introduction of adaptive welding control has meant tremendous progress in body manufacturing in recent years. This is a very innovative control method that can detect, during the welding process, whether or not the weld will be acceptable; welding control then automatically adjusts weld parameters. This method is very complex, but it is also very reliable." Another dominant theme in quality assurance is what are known as functional dimensions. Wagner: "The car must be correct in terms of its geometry. That is why there are over 400 functional dimensions, and we make great efforts to ensure that they are right. We also have a dedicated crew assigned to this task."

Competence Centres solve problems. Porsche is successfully striving continually to improve its processes and solve problems extremely quickly. In this context, "Competence Centres" have been integrated at the Leipzig plant in the body shop, paint shop and assembly. Norbert Wagner: "We have these Competence Centres in all four areas of body manufacturing: in the underbody, superstructure, add-on parts line and finishing. These are offices located directly in the production areas. All specialties that are responsible for the specific area are represented in these Competence Centres. Residing in the "Underbody" centre, for example, are the shift leader, planner, quality control specialist and a geometry specialist who is responsible for conformance to dimensional tolerances. An example: if the centre receives a report from assembly that there is a problem, the quality representative routes this report directly to the affected Competence Centre in the body shop. The four specialists have the competence to solve this problem quickly. It is truly a unique arrangement to have these people working together in one Competence Centre."

The birthplace of the Macan. The 100 cycles in the body shop begin, as mentioned, with the welding of the front wheel housings together with their suspension strut mounts and chassis legs. Nearly simultaneously, the front and rear floors are built in a nearby section of the system. All of these elements come together – transported by pallet conveyors – to station 1810 and are joined to become the underbody. As in all of body manufacturing, this is done with what are known as decoupling buffers. Wagner: "If there is a problem on the main line, if a robot fails for example, it is still possible to continue work at subsequent manufacturing stations thanks to the decoupling modules. Generally, we have between 10 and 20 parts in a decoupling station." In fact, every worker in the body shop in Leipzig is familiar with station 1810. Thomas Riediger, Head of Planning at Porsche Leipzig GmbH: "This is really the birthplace of the Macan, because the underbody structure is created here. The car also gets its birth certificate at station 1810 – a transponder, a mobile data memory that serves as the fingerprint of the Macan, which contains the specific vehicle's identification code. This transponder contains all of the details of the future Macan."

An important geometry station. Cycle 1810 is also known as the "Geometry station of underbody 1." That is because with the assembly of the underbody, the foundation has been laid in production for the extremely precise body geometry of the Macan. The reason is that the key elementary welds are made at this station in body manufacturing. Specifically, the

underbody structure is clamped in place so that – in the jargon of the production people – the "geo welds" can be made. All of these tasks are a job for the robots. Incidentally, from this point forward, the structure is referred to as a "vehicle"; previously they were just parts. The underbody structure is now so sturdy that it can be conveyed as a whole to the next stations.

On conveyor skids to the paint shop. From station 1810, a robot with a handling gripper takes the carcass and places it on a transport platform – also known as a skid. From now on, the vehicle is conveyed through body manufacturing on the skid. Other parts are fed in from the side – which visually looks like a fishbone pattern. And it is built up in sequence in "Underbody 2," "Superstructure 1, 2 and 3" and the "Add-on part line" and "Finish." The next step is the paint shop.

Step III – paint shop

Any colour is feasible for the Macan. In the new paint shop of the production plant with its floor area of 60,000 square metres, the Macan bodies are painted in one of a current selection of eleven colours. Upon request, customers can order the new SUV in any conceivable custom colour – the paint shop of the Porsche plant in Leipzig offers a handcrafting-like range of colours here. The paint shop is also one of the most energy efficient in the world. An example: 80 per cent of its heat requirements are covered by waste heat from a biomass power plant located externally near the production plant.

Six stages to a perfectly painted Macan. The processes within the paint shop, which was developed for Porsche together with the German painting specialist Dürr, follow a concept similar to the one at the Stuttgart-Zuffenhausen plant, which however has a more compact framework. It takes around 15 hours for the body of a Macan to run through all phases of the paint shop. Everything begins on level 1 with the "Entry to the paint shop," which is the official name. "The arriving vehicles pass through two work booths here, in which the door hinges, engine bonnet and boot lid are securely fixed in place," says Roland Töpfer, Paint Shop Manager. The vehicles also change their means of conveyance here. The Macan bodies are removed from their skids from the body shop and are placed on the KTL skid. KTL

stands for “Kathodische Tauchlackierung” (cathodic dip coating), in which the body is given a cataphoretic coating, which protects against corrosion and improves adhesion to the subsequent paint layers. But let us address each step in sequence. The process chain in the paint shop implemented by Porsche and Dürr (global market leader in automotive paint shops) involves six stages:

Stage 1 – pretreatment for cathodic dip coating. In pretreatment, the body is cleaned and degreased in a dipping tank heated to 60° C. This removes materials such as grease from the presses, metal chips and other contaminants from the body manufacturing process. Now the body is free of grease for the first layer of paint. This is followed by a phosphating process, in which a zinc phosphate coating is applied in a dip tank. It ensures optimal adhesion for the corrosion protection coating that follows later. The body of the Macan is not only dipped into the tank here, but is also rotated 360 degrees, so that all cavities are reached.

Stage 2 – Cathodic Dip Coating (CDC). In cathodic dip coating, the body is coated with high-quality corrosion protection by dipping it into a primer heated to 33° C. To ensure that all surfaces – even in cavities – are optimally wetted, the body is rotated about its axis in the dip tank. The dipping process is referred to as cathodic, because the solids in the paint are deposited on the body surface by electrophoresis – as a result of a voltage differential of 380 volts that is applied between the dip tank and the body. The resulting voltage distribution in the body yields a very uniform coating. The body is dipped in a total of nine tanks during pretreatment and cathodic dip coating.

Stage 3 – CDC drying unit. Afterwards, the cathodic dip coating of the body is allowed to drip, and then it is dried in a number of drying stages. Here, the Macan body is conveyed into the first of a total of four dryers during the painting process. The first dryer, the cathodic dip coating dryer, reaches a peak temperature of 185° C. After this stage, up to 80 bodies are parked in a colour sorting buffer area, where vehicles with the same colours are bundled.

Stage 4 – sealing of seams: Special PVC materials are used to seal the seams and flanges, so that no water can ingress later on. The sealing process is performed fully automatically by robots. Underbody protection is also applied. It consists of a PVC-containing material and protects the body against stone impact. In addition, the seams at the doors, bonnet

and boot lid are sealed. Very stringent quality standards apply to the visible seams. In this area, the body is removed from the skid and placed on a hanger; at the end of the process, it is returned to a skid for the primer surfacer coat and top coat.

Stage 5 – filler, top coat, clear coat. Now, the actual paint layers are applied at a precisely defined air humidity and temperature. All paint layers – filler, base paint and clear coat – are applied by painting robots with electrostatic paint charging, on both interior and exterior body surfaces. The filler is 30 to 35 µm thick, and the base coat is 12 to 18 µm thick (depending on the specific colour), while the clear coat is another 40 to 45 µm. In painting, a maximum of 85 per cent of the sprayed paint reaches the body surface. The excess paint is filtered from the air to reduce emissions. A fresh air stream at a precisely regulated temperature and humidity carries the paint particles into the paint separator beneath the spray booth. In conventional systems, the solid paint particles are bound by water and chemicals and are discharged. In the new dry separator system developed by Dürr and used in Leipzig, on the other hand, the excess paint particles are bound by powdered limestone already in the air stream from which they are filtered out and disposed. The benefit is that this does not require 100 per cent pure fresh air, and the booths can be operated with recirculation air. That reduces energy requirements significantly.

- It begins with the primer surfacer coat that provides stone impact protection and is available in three colours (White, Anthracite and Light Blue). It is already colour coordinated with the top coat that follows. The elastic surfacer is also referred to as the primer; as a substrate it protects the top coat from damage and simultaneously improves its structure. Before the top coat is applied, the body is run through a dryer unit heated to 160° C.

- Now the top coat or base paint follows – and with it the colour of the Macan that is configured by the buyer. To ensure that everything operates ideally, there are not only painting robots in the painting booths, but also handling robots that open the doors or the bonnet and boot lid. The paints themselves flow through the ring lines to the painting robot. Then the top coat undergoes intermediate drying at 80° C.

- Finally, the paint coat is sealed by a clear coat – this is referred to as a top coat finish. Fully painted, the Macan body now passes through the third main drying unit; here, the paint is cured at a temperature of 140° C. for around 45 minutes.

Stage 6 – light tunnel. In the final phase, the paint jobs on the bodies are monitored on the finishing line, and any painting defects are eliminated. In addition, the vehicles are sent through a newly developed light tunnel. This tunnel is equipped with very energy-efficient LED modules. Their light is projected onto the bodies via adjustable mirrors. This generates a very uniform light strip that lets employees detect even very minor bump imperfections on the paint surface. In contrast to tunnel systems with fluorescent tubes, the new ergo-lux tunnel of the Porsche plant in Leipzig not only detects defects better but thanks to the LEDs it utilises, it also saves on energy. This better economy is associated with less energy being converted to heat. In turn, this noticeably improves the climatic working conditions of employees in the light tunnel. The untreated body has become a high-gloss and cavity-sealed Macan, which can now be transported to the assembly area.

Step IV – assembly supply centre

Parts for Macan, Cayenne and Panamera. It is in the "Assembly supply centre" that parts used to produce all three model series first come into contact with one another; these parts are then transported to the production lines in assembly. The parts are delivered by truck to the "Assembly supply centre" via three large incoming goods bays with 21 docking gates for rear unloading. Forklifts unload cargo carriers from the lorries and transfer them directly to tugger trains. The route layout for the tugger trains in the "Assembly supply centre" is organised a little differently than in the "Body supply centre." Michael Weihrauch, Head of Logistics: "Depending on the contents of the containers, the tugger trains drive them to the pick-and-place and sequencing zones or to the supermarket for 'kanban' parts." That sounds like a blend of purchasing centre and computing centre. And in principle, it is both. But what is really complex in terms of process flow – in a perfectly organised and understandable system that has a lead time of seven days – is how it is possible to use small, electrically powered "freight trains" to transport around 4,500 different parts of all sorts into the assembly areas of the Porsche plant in Leipzig, without making any errors and according to a reliable schedule.

From the supermarket to assembly. As described, the containers that are unloaded from the lorries are supplied to the pick-and-place and sequencing zones. The containers delivered by tugger train are placed in these yellow-framed areas, either on the container technology or on flow racks. In the middle, an aisle-way is open; this is where employees pass through with a pick-and-place or sequencing carts and get – via 'pick-by-light' – the information on the parts that are needed and must be gathered. The part shown by the 'pick-by-light' is removed and placed in the pick-and-place cart. The fully loaded carts are then placed in a zone marked for it – at the 'train station.' The tugger train driver, who shuttles parts between the assembly area and the supply centre, takes the pick-and-place carts from there and delivers them to the assembly line. The flow is very simple when the underlying logistical organisation is set up properly.

Step V – assembly

225 cycles at three minute intervals. The assembly of the new SUV follows. With the launch of the Macan, this assembly line – including the Cayenne and Panamera – consists of a total of 225 individual cycles. The cycle time – the amount of time a Macan remains at a production station, e.g. a station where the front seats or roof rails are installed – is three minutes.

Overview of assembly. The Macan bodies in assembly are transported on a plate line (with lift tables) or on pivoting hangers. The assembly area is subdivided into different lines. The Macan and Panamera move together here. Not until the "marriage" of the body and powertrain/chassis does the Cayenne merge with the line by electric rail conveyor. First, there is the door line, followed by interior lines 1 and 2, underbody lines 1 and 2, mixed lines 1 and 2, chassis build-up and powertrain build-up (engine and transmission) as well as the famous marriage (chassis/powertrain merge with the body). The final assembly operation happens at the testing area. Here, the computers of the Macan are equipped with the latest software, the assistance systems are brought to life, the chassis is given fine tuning, the headlight alignment is checked, the engine is started for the first time, the body seals are checked, and – after a brief drive outside on the run-in and test track – final inspection takes place. The assembly highlights in detail:

Door line. "The first step," according to Thomas Riediger, Head of Planning, "is to finish the doors of the Macan. This is done on what is known as the door line during cycles T01 through T12." The T stands for the German word for door ("Tür"). Afterwards, the Macan leaves the door line and arrives at the interior line.

Interior lines 1 and 2. The first step here is to remove the doors from the body at cycle I02. The I stands for "Interior." If the doors were to remain on the Macan, many of the assembly steps that now follow on the interior line could not be performed. In cycle I12, the Macan is equipped with one of the most important components of all: the wire harness. And one of the largest finished modules is integrated in the vehicle in cycle I16: the cockpit. The assembly workers complete this precise job with a handling unit to which the cockpit is first docked, and then it is guided into the car. The cockpit is assembled externally, and – if the Macan is ordered with this option – its upper area is upholstered in the finest leather. I16 is therefore one of those cycles in which industrial manufacturing melds with handcrafting. Not a spectacular production step, but important on its path towards becoming a complete car: At cycle I31, the ignition key is inserted in the Macan for the first time. And the ignition is of course located on the left side – as in the 918 Spyder, 911, Cayman, Boxster, Cayenne and Panamera. This is a tribute to the "24 hours of Le Mans." At the end of the interior line, the car is moved to a different mode of conveyance. It leaves the lift table and is now suspended by a pivoting hanger so that underbody tasks can be performed more ergonomically on the Macan.

Underbody lines 1 and 2. Underbody lines 1 and 2 run in parallel to the door line in assembly. Components installed here include all brake lines (U06), the pressure reservoir for the air suspension that is available as an optional feature (U10) and the fuel tank with a capacity of 60 litres or an optional 75 litres (U13). Naturally, the U stands for "Underbody" line. On the way to the exterior line, the Macan is now returned to the lift table as a mode of conveyance.

Exterior lines 1 and 2. Towards the end of the exterior line, the SUV gets its doors back at cycle E31. Before it arrives there, however, certain features are added such as the windscreen and rear windscreen that are placed fully automatically by robot (E01), the floor carpeting (E03), wiper system (E04), electrically swivelling towbar unit (E05), side airbags

(E10), battery (E12) and the Porsche badge on the bonnet (E20). Of course, E stands for "Exterior" line. After the doors have been mounted, the Macan cars are briefly parked in what is referred to as the body storage area, which creates a buffer for the subsequent lines for the powertrain and chassis.

Engine build-up. The next step is what is known as engine build-up or engine preassembly. The engines and transmissions are fed via a side arm into the assembly process. The transmissions are flange-mounted in cycle A07. In cycle A09, assemblers install the engine wire harness. This is followed by components such as the clutch disc of the automatic transmission (A11), the starter (A17) and the air conditioning compressor (A24). Towards the end of engine preassembly, the oxygen sensors are connected (A29). "A" stands for the German word for the powertrain, which is "Antrieb." The entire vehicle understructure is finished and conveyed on large module carriers or driverless transport systems (DTS) up to the marriage. In this phase, the bodies are still separate from the vehicle underbody and are being conveyed one building level higher via electric overhead conveyer towards the marriage operation.

Chassis build-up. After engine build-up, the subsequent chassis build-up involves mounting parts such as the propshaft and drive shafts. Cycles F01 through F03 are used to preconfigure the suspensions and struts on the large module carrier. In the next cycle (F04), the front silencers are installed, then the propshaft is connected (F05), and finally the drive shafts are integrated (F06). F stands for the German word for chassis, which is "Fahrwerk."

Mixed lines 1 and 2. The most spectacular and best know station in any vehicle assembly process is the marriage – merging of the chassis and powertrain with the now completely assembled body. In Leipzig, this marriage takes place on the mixed line. Mixed, because for the first time all three Porsche model series – the Macan, Cayenne and Panamera – take the same route through identical stations. The assembled bodies arrive at the marriage process – which runs from cycle M01 through cycle M06 – from a decoupling module via an electric overhead conveyor and are lowered down to the assembly line from above. For the Cayenne, this represents the entry point to the assembly line.

Marriage. "The actual marriage takes place in cycle M03, in which the body – the superstructure – is conveyed to the cycle by electric overhead conveyor," says Dr. Martin Kahmeyer, Head of Technology in charge of the assembly lines for the Macan, Cayenne and Panamera. From the side, the driverless transport system brings the large module carrier and powertrain to cycle M03. Dr. Martin Kahmeyer: "The large module carrier is conveyed by driverless transport under the superstructure and then is lifted upward towards the body for the marriage. In cycle M04, the top and bottom structures are then automatically joined by screw fastening. In addition, the spring struts are manually screwed into the towers." At cycle M06, the Porsche is then transferred from the electric overhead conveyor back to the plate conveyor. Further along on the mixed line, final tasks include finishing of the wheels, the fuel lines and the wipers (M07 to M13), application of the badges at the rear (M19) and filling of the new Porsche with fuel, brake fluid, coolant and motor oil (up to M28). Finally, the tyres are mounted to the wheel rims, and the Macan, Cayenne and Panamera can stand on their own four wheels for the first time in their automotive life.

Testing area & finishing. The final 33 assembly cycles are used for start-up, testing and final inspection of the new Porsche. An entire new line was added to the test area for the Macan. One of the first steps performed here is what is known as "parameterisation" (reading error memory, flash and coding operations, learning, calibration and adaptation operations). Driving functions such as braking are checked on a roller dynamometer; the engine is also started here for the first time. Last but not least, final adjustments are made to the chassis and headlights, and the driver assistance systems are calibrated. Then, on a short test track, the cars must demonstrate that all relevant components operate perfectly. Afterwards, the car exterior is washed and a sealing test is performed simultaneously. The last station before the car is driven over to the Customer Centre at Porsche Leipzig GmbH, or is shipped by articulated lorry or by railroad to one of the Porsche sales centres, is final inspection.

Team

New workforce is growing: The Leipzig team doubles in size

Newly designed training centres guarantee ideal qualification opportunities
New training workshop makes an exciting and outstanding apprenticeship programme possible

1,500 new employees. With the Macan, Porsche has created 1,500 new jobs in Leipzig. Around 400 of the new employees are engineers and specialists in the paint shop, body shop, logistics, assembly and quality areas. These experts ensure that the new production facilities work to perfection; they are all professionals in the automotive industry. Around 1,100 of the employees work in Production; they are specially trained people: mechatronic and automation technology specialists, painters, welders, body manufacturing specialists, industrial mechanics and motor vehicle fitters. "For many of these new 1,100 employees, cars have influenced them in their private lives, but until now have not made their mark in their professional careers," says Stefan Althoff, Personnel Manager at Porsche Leipzig GmbH. Althoff continues: "Even those who already had a lot of experience in the automotive industry are not necessarily familiar with the processes that await them at Porsche in Leipzig. That is why we have developed a training programme that is both sophisticated and innovative; it ensures the qualification of new employees on a uniform top level." Training instructors were definitely helped by one big thing: Porsche – the brand and the Macan – are great motivators.

Great affinity for the Porsche Brand. Dr. Oliver Blume, Member of the Executive Board Production and Logistics of Porsche: "We wanted employees with the proverbial petrol in their blood. And we got them. They have a great affinity for the Porsche Brand, an enthusiasm for building cars. Great commitment. And solid workmanship and know-how. One important criteria we had when hiring new people was that they must fit in with the team already in place in Leipzig. It is the right mix that counts: young and old, a variety of backgrounds and experience, men and women. I like to compare it to a football team: You can only be successful if you have the right mix on your team – you will not win the match with eleven excellent technicians on the field if you do not have the people who do the leg work there in the background." But even the best team has to be trained. Especially when many of the players are new. And that is exactly what is happening in Leipzig. For two years now, we have been preparing employees for the launch of the new Macan:

Employees for supply and production lines

Workers in the body shop, paint shop, assembly and logistics. The new employees in the logistics supply centres and on the production lines (body shop, paint shop, assembly) had to be trained in their tasks in specific ways. To form the teams at the individual stations as flexibly as possible, the team already deployed for the Cayenne and Panamera had to be coached in the Macan as well. "Since the sheer number of employees in these areas was and still is so high, a new training method had to be created, as described above. It went beyond the 'learning by doing' in the parts supply zone or on the assembly line," says Financial Director Dr. Joachim Lamla. "Against this backdrop, we developed a new concept – a new training centre for each of the new or extended plant departments. To guarantee excellent preparation for the new tasks, all new employees had to participate a training programme of three to five days at one of these centres prior to beginning their future career with Porsche." And the existing core team participated as well.

Ideal training conditions. Special training rooms were created at the centres, ranging from 200 to 300 square metres in size. The working environment established there reflects the production system. In addition, the instructors developed a so-called room for pros, in which plant-relevant or model-relevant tasks are simulated in an environment that matches the workplace on the assembly line down to the details. Overview of the individual topics of training centres and rooms for pros:

- Training centre + room for pros "Body shop"
  (2 days, 444 attendees scheduled until mid-2014),

- Training centre + room for pros "Paint shop"
  (2 days, 454 attendees scheduled until mid-2014),

- Training centre + room for pros "Assembly / quality assurance"
  (3 days, 668 attendees scheduled until mid-2014),

- Training centre "Logistics"
  (3 to 5 days, 850 attendees scheduled until mid-2014),

New training workshop

Good start for those up-and-coming. Naturally, Porsche Leipzig also offers apprenticeships in the classic automotive professions – a great opportunity for young people from the region. To create optimal conditions, the company invested approx. 2.9 million euros to expand its training facilities in 2013; this included a second training workshop, which evolved in the process. It is situated in the middle of the assembly hall for the Macan and Panamera; this means that it is integrated in normal operations. From day one, the trainees experience what is what at Porsche and what the jobs they are being trained to do. The training workshop encompasses the workshop proper with 600 square metres, a classroom with state-of-the-art equipment as well as a supply area. The workshop has cutting-edge facilities for working like a pro. The apprentices can avail themselves of a welding area, work benches, four auto lifts and other technical equipment.

Tripling of trainee positions. As part of the plant extension, the number of trainee positions in Leipzig will be tripled over the course of 2014. Currently, Porsche Leipzig GmbH is training "Automotive mechatronics engineers for vehicle communication technology," "Automotive mechatronics engineers with focus on passenger cars" and "Mechatronics engineers." The apprenticeship time for these professions adds up to 3.5 years; with excellent performance, the time can be shortened to 3 years. Siegfried Bülow, Chairman of the Executive Board of Porsche Leipzig GmbH: "Our multifaceted approach to training and advanced training lets us invest in our main capital: the qualification of a new generation of Porsche employees as well as our core workforce."

Sustainability

An environmentally-friendly factory: 17,000 metric tonnes of CO_2 are saved at Porsche in Leipzig annually

Photovoltaic system on body shop roof reduces power needs by 800,000 kWh annually
Up to 80 percent of heat for paint shop is generated CO_2 neutrally by a biomass power plant

Committed to the environment. The Porsche plant in Leipzig is one of the most sustainable automobile factories in the world. This system lets the company pursue the goals of saving resources, using energy efficiently and protecting the environment by lowering its CO_2 emissions and reducing the use of substances such as solvents and waste. The forward-looking way in which Porsche translates such goals into tangible successes at the Leipzig plant is game-changing: thanks to new and innovative technologies, Porsche will reduce its annual CO_2 emissions by almost 17,000 metric tonnes compared to conventional plants. "Sustainable solutions" run like a common thread through all our facilities, especially in the new body shop and the new paint shop:

Energy-saving body assembly

800,000 kWh electricity saved annually. The energy efficiency of the new facilities will be optimised by a photovoltaic system installed on the roof which outputs 880 kWp of power; it will generate 800,000 kWh of electrical energy annually – this is equivalent to the annual power consumption of more than 150 Western European four-person households. In tandem with this, Porsche is saving energy wherever possible. A newly designed cooling system for the robotic welding guns in the body shop, for example, will reduce annual power consumption by more than 365,000 kWh.

Sustainably controlled paint shop

Electrostatic separation system for solvents. An electrostatic separator system in the paint shop ensures that the emissions in the paint mist are reduced to a minimum. Roland Töpfer, the Paint Shop Manager, explains how it works: "Traditional air decontamination technology burns off solvents in the exhaust air in a technical decontamination system; then

the purified air is exhausted through the roof. By contrast, Leipzig utilises a wet chemical method. The air passes through a chemical substance, which binds the solvents. In a second step, the solvents are separated from the chemical substance; they are recovered here and are collected in a tank for further use. We did this at the smaller paint shop in Zuffenhausen for the first time. The fact that this method is being applied for the first time in a line production paint shop is an absolute innovation in the automotive industry."

Particles are captured by limestone powder and processed into concrete. There are other substances in the paint mist, though, that should not be allowed to escape into the air uncontrolled: excess paint particles. Again, Porsche is banking on an innovation. Roland Töpfer: "The entire separator system is located below the paint level with the paint robots. The paint-laden air is guided through a powder limestone cloud, whereupon the solids, namely the paint particles, are extracted from the air. So powdered limestone cleaning is effective for the solids." The powdered limestone with the bound particles is then processed into concrete. Paint Shop boss Töpfer: "The powdered limestone is provided by the concrete industry. We load it with paint particles; the cement industry takes it back, integrates it in its processes and turns it into concrete." Dry separation with limestone powder requires neither water nor chemicals nor additional electricity. "The exhaust system for the particles and the stone powder is absolutely gigantic," explains Roland Töpfer. "The paint shop circulates 2.3 million cubic metres of air per hour – fresh air, exhaust air and recirculation air. One million cubic metres of it pass through the powdered limestone filter system. We do this with compressed air blasts: these blasts of air send the powdered limestone upward and thus run it through air channels with special filter bodies upon which the powder settles. Another compressed air blast transports the air downward and back to the collection basins." By the way, this circulating air method is not only extremely clean but is also efficient. Compared to water-based methods, it offers energy savings of around 80 percent.

80 percent of the required heat is generated CO_2 neutrally. The paint shop is also a leader in terms of the energy used to operate the facility: Porsche utilises the waste heat of a biomass power plant located directly adjacent to the factory. This plant is known as the wood chip combustion facility of the Ingolstadt-based company Prolignis Energie Consulting GmbH & Co. KG, and it is interconnected to the paint shop of the Porsche plant via

enormous pipes that were specifically laid for this purpose. Electric power is generated in the combined heat and power plant by CO_2 neutral combustion of renewable waste wood from sustainable forestry; the waste heat is supplied as process steam or heat. In tandem, the biomass power plant supplies the Cargo Transport Centre Leipzig (GVZ) with long-distance heating – an area where, alongside a number of mid and large-sized companies, Porsche Leipzig GmbH and important suppliers of the plant reside. This sustainability alliance ensures that 80 percent of the paint shop's heat requirements are covered on a CO_2-neutral basis. This results in a reduction in CO_2 emissions of over 8,000 metric tonnes annually.

Automobile factory as a biotope with wild horses and aurochs

LED lamps on the exterior grounds and in the paint shop's light tunnel. While the new Macan, the Cayenne and Panamera come into being in the halls of the Porsche plant under the most sustainable conditions possible, the company closes the circle of its comprehensive environmental protection practices on the exterior grounds of the state-of-the-art factory complex; they are lit exclusively by energy-saving LED lamps. The use of a total of 315 new LED exterior lamps alone reduces CO_2 emissions by 927 metric tonnes per year – 60,000 euros well invested. The paint shop's new ERGO Lux light tunnel is also equipped with LED lighting instead of neon tubes; compared to neon tubes, this innovative light system of LED lamps and adjustable light guiding mirrors saves around 30 percent in energy.

1,100 new trees on the factory compound. Currently, the company is having 74,000 square metres (an area covering ten football fields) planted with greenery; in the process, 1,100 new trees will be planted. They make up part of a terrain that has been largely left in a natural state, upon which are also 30 wild horses and 70 aurochs, living in harmony with one of most cutting-edge automobile factories in the world.

Customer Centre

Porsche Leipzig is more than just a plant: Automotive adventure world with race track and off-road obstacle course

Customer Centre for new car buyers and exclusive events
FIA-certified Porsche circuit with route segments from legendary race tracks

Factory pick-up and Customer Centre of a special kind. Over 40,000 guests visit the Leipzig plant's Porsche adventure world annually. The main elements of this adventure world are a 5,200 square-metre Customer Centre, an FIA-certified circuit and the plant's proprietary off-road obstacle course. The circuit and the off-road obstacle course are a unique combination of exclusive features that no other automobile factory in the world offers. This is one of the most compelling reasons for increasing numbers of Porsche buyers to seize the opportunity and pick up their new vehicle in person in this ambience of active driving – whether they have opted for a Porsche from Leipzig (Macan, Cayenne and Panamera) or a vehicle from Stuttgart or Osnabrück (Boxster, Cayman, 911 and 918 Spyder). "More than 2,300 Porsche customers treat themselves to the pleasure of picking up their new vehicle in any Porsche model range directly at the plant," says Dr. Joachim Lamla, Financial Director at Porsche Leipzig GmbH. Dr. Lamla continues: "For these customers, the highlight of the exciting programme – which includes a factory visit and an exclusive dinner at the restaurant in the 'Diamond' building – is an introduction to the vehicle, namely of a dynamic sort: in vehicles that are virtually identical to the purchased car, an instructor explains all the functions of the new Porsche on the race track and – in the case of the Macan and Cayenne – on the off-road obstacle course as well."

A diamond as centre of the plant. The centrepiece of the Customer Centre and architectural landmark of the Porsche plant, visible from afar, is the "Diamond," mentioned by Dr. Joachim Lamla – a tower in the shape of a gemstone standing on its head which is just under 32 metres tall (with a diameter of 58 metres). The "Diamond" has four levels. The reception area, a Porsche shopping area and a lounge with ample glass windows that give visitors a clear view of the race track or the run-in and test track, are situated on the ground floor. All new car buyers who pick up their Porsche personally in Leipzig begin here

in this lounge. Likewise, the handover of the new car takes place on the ground floor in a specially designed pit row. The second level of the "Diamond" houses the so-called "Small Auditorium" for events for up to 80 participants, a cinema and the control centre of the race track. Companies like to use the "Large Auditorium" (1,360 square metres) on the third floor that can seat up to 800 guests; in addition, the restaurant and a show of the latest Porsche models are located on this level. Thanks to the integrated panoramic windows, the entire third floor offers breath-taking views of the plant and the race track.

At the top, on the fourth level, a permanent exhibit of historic Porsche cars has proven to be a real attraction.

Getting to know the performance capabilities of your new car. As one of only a handful of car makers worldwide, Porsche offers its customers in Leipzig the chance to get familiar with the vehicle on the proprietary race track and – in the case of the SUV – on the off-road obstacle course. In addition, training courses of the Porsche Sport Driving School (on-road and off-road) take place on these tracks, which are open for booking. Last but not least, the tracks can be reserved for events. The race track and off-road obstacle course in detail:

- **Race track.** The 3.7 kilometre long and twelve metre wide FIA circuit consists of ten sections, which are adapted from famous route segments of world-renowned race courses – among them the "Loews curve" in Monaco, "The Corkscrew" in Laguna Seca, the "Suzuka S" of the race track of the same name in Japan and the "Parabolica" in Monza. Customers can experience the sporty features of the Macan, Cayenne and Panamera – as well as the Boxster, Cayman, 911 and 918 Spyder, which can be delivered in Leipzig on request – in the truest sense when driving on this course. The circuit was conceived by Hermann Tilke, one of the leading race track architects in the world (his work includes the A1 Ring in Austria, Bahrain International Circuit, Circuit de Catalunya in Barcelona, Hockenheimring, Nürburgring and Sachsenring). While the site is being used for events, everything that is happening on the race track can be followed on various monitors at the track control centre.

- **Off-road obstacle course.** The off-road track is around six kilometres in length. Steep mountain trails or extreme ramps can be scaled here in the Porsche Macan and Cayenne. The total of 18 modules include track routes through water, a stony staircase and a sloped track with a 35° gradient. The SUV vehicles master such stretches without difficulty; the drivers, on the other hand, have to bring along a modicum of courage. Large parts of the site have been left in a natural state and provide a habitat for wild horses and aurochs.

Social and cultural projects

Porsche Leipzig as a part of society
Sports car maker sponsors social and cultural projects

Porsche is main sponsor of Leipzig's legendary Gewandhaus Orchestra
Support ranges from work with youth to preservation of historical monuments

Socially and culturally committed. From the very onset, the commitment of Porsche Leipzig has covered a broad range of social and cultural activities. The plant and its employees, who largely come from the region, are thus even more closely integrated in the public life of the City of Leipzig and the Free State of Saxony. In so doing, Porsche not only dedicates itself to culture but especially to the people themselves. A few examples:

Aid for those most vulnerable. The sports car maker will be organising the traditional Porsche Leipzig Charity Football Tournament for the ninth time in 2014. Teams from many different areas (companies, universities, etc.) engage in competition for a good cause. Proceeds from last year's tournament were donated to non-profits such as "Zukunft für Kinder e.V." and "Hospiz Verein Leipzig e.V." Porsche also provides support for projects such as the "Leipziger Oase" run by Caritas, which provides care for the homeless. Every day, 50 to 80 homeless people get warm meals here as well as help and support in mastering challenges in their lives.

Youth Sponsorship. Another focus of the social commitment of Porsche Leipzig is its sponsorship of youth work. The "GaraGe" training initiative – a "Technology Centre" for young people in the district of Leipzig-Plagwitz – is exemplary for this. More than 80,000 children and teenagers use the learning opportunities of "GaraGe" annually. The range of educational opportunities includes the Porsche Technology Workshop: students get their initial insights into automotive technology under the guidance of a Porsche employee on a real-world example of a 911 Turbo car. "Helping people to experience technology, to develop a fascination for the car and prepare for professional life – that sums up our commitment," says Stefan Althoff, Human Resources Manager at Porsche Leipzig GmbH. Professional applicant training is also offered, in which the participants learn more about the three and a half year

apprenticeship at Porsche. "We make use of this opportunity to spot enthusiastic prospective apprentices – and with success. A number of the 20 apprentices from the 2013-2014 school year currently hired attended 'GaraGe' courses. They are our specialists of tomorrow and they will do their part in shaping the future of the Saxon production site," says Althoff.

Preservation of historical monuments. Porsche also wants to make a contribution to the preservation of historically relevant sites and landmarks in the City of Leipzig. For example, the "Mendebrunnen," a true landmark of the city which was built between 1883 and 1886 and severely damaged in the Second World War, was restored in the summer of 2013, in part by a donation by Dr. Ing. h.c. F. Porsche AG. The commitment of Dr. Ing. h.c. F. Porsche AG made it possible to restore the largest organ in Saxony, the 152-year-old Ladegast organ in Leipzig's Nikolai Church with its fascinating sound.

Cultural commitment. The devotion that Porsche shows for classical music is exemplified in its support of the Gewandhaus Orchestra Leipzig: Dr. Ing. h.c. F. Porsche AG has been the main sponsor for tours and concerts of this Leipzig-based symphony orchestra since the 2011-2012 season. The cultural partnership between the sports car maker and the renowned orchestra has just been extended by another three years to 2017. All residents and visitors to the city of Leipzig partake in this partnership. Background: not least due to the support by Porsche, the Gewandhaus Orchestra has decided to renew its open air concerts in 2014; such concerts were first held in 2004. Two summer concerts with popular works of classical music will be held on a meadow of the "Leipziger Rosental" in July; admission is free for all visitors. Last but not least, the task as presenter of the Leipzig Opera Ball has also contributed to Porsche becoming part of the social life of the city.

Milestones

Porsche Leipzig since 1998

Plant opening for the first generation Cayenne in August 2002
Production of the Panamera launched in April 2009

1998 June	Porsche announces decision to produce the Cayenne (SUV).
1999 September	Announcement of Leipzig as production site.
2000 February	Ground-breaking ceremony and hiring of first employee at Porsche Leipzig.
2000 June	The third model range is given the name Porsche Cayenne.
2000 September	Topping out ceremony for the production hall.
2001 April	Construction begins on Customer Centre and on the run-in track and test track.
2001 June	58 employees move into the Integration Centre – the office and communication centre of Porsche Leipzig.
2001 October	Topping out ceremony for the Customer Centre.
2002 January	Porsche announces decision to produce the Carrera GT high-performance sports car.
2002 March	Construction begins on the off-road track for driving safety training.

2002 July	Decision to produce the Carrera GT at the Leipzig location.
2002 August	Completion of all construction activities and opening ceremony of Porsche Leipzig.
2002 December	First customer car pick-up of the Cayenne at factory.
2003 August to 2006 May	Production of the Carrera GT (1,270 vehicles).
2004 March	The 50,000th Cayenne is built.
2004 November	Factory is expanded.
2005 June	The 100,000th Cayenne is built.
2005 November	5,000th factory pick-up of a Cayenne at the Customer Centre.
2005 December	Carrera GT number 1,111 is delivered to customer in the Middle East.
2006 May	Porsche announces decision to produce the Panamera at Leipzig site.
2006 September	Beginning of plant expansion. Production hall of around 25,000 square metres and a 23,500-square metre logistics centre are built for production of the Panamera.
2006 November	The 150,000th Cayenne is built.
2006 December	Change of generations. Production start of the 2nd generation Cayenne.

2007 April	Topping out ceremony for expanded facilities of the Porsche plant in Leipzig.
2007 September	Beginning of the expansion of the new Panamera assembly line.
2008 January	Employees celebrate the 200,000th Cayenne.
2008 January	Image film of the Porsche plant in Leipzig: "World of Emotions" is awarded first prize as best corporate film at the "International Film & Video Awards" in New York.
2008 Spring	Beginning of test operations of the new Panamera production facilities; assembly of the first prototype.
2008 June	2,000th event at the Customer Centre.
2008 October	The Porsche plant in Leipzig is awarded honorary certificate as "Excellent Training Company 2008" by the Leipzig Chamber of Industry and Commerce.
2008 October	Dedication and commissioning of the new training workshop.
2008 December	Production launch of the Cayenne Diesel.
2009 March	Employees celebrate the 250,000th Cayenne.
2009 April	Start of production (SOP) of the Panamera.
2010 May	Start of production of the second generation Cayenne.
2011 March	Resolution to expand the factory for new SUV – the Porsche Macan.

2011 October	Start of the third plant extension for production of the Macan.
2012 March	Construction begins on body shop, paint shop.
2012 June	Topping out ceremony for the body shop.
2012 August	Leipzig produces the 500,000th Porsche.
2012 November	Topping out ceremony for the paint shop.
2013 February	Completion of the first pilot series body of the Macan.
2013 August	First pilot series body of the Macan is painted.
2013 November	Start of production (SOP) of the Macan.
2013 November	World premiere of the Macan, concurrently in Los Angeles and Tokyo.
2014 February	Opening of extended Porsche plant in Leipzig.