# Scharnhausen Technology Plant

FESTO

# Contents

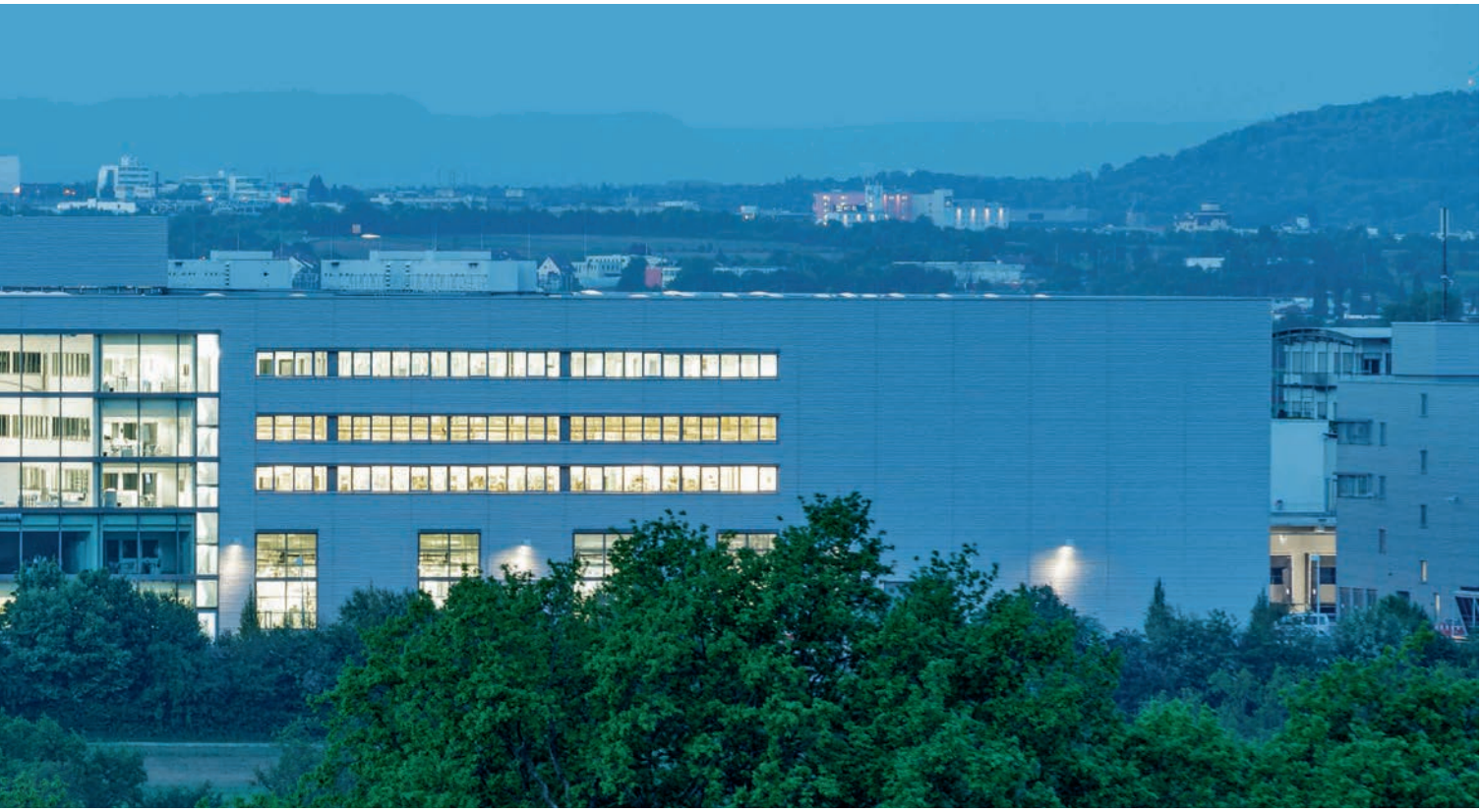
# Shaping the future to be versatile

The Scharnhausen Technology Plant in the high-tech country that is Germany is at the forefront of automation for the future. At Festo it is the leading plant for valves, valve terminals and electronics. The factory is characterised by productive and energy-efficient processes, top-quality products and a pronounced customer focus, as well as sustainable and green production. Thanks to its central location and infrastructure, it is possible to be directly networked with the Festo headquarters, the global customer network and the social environment of its employees.

The success story of the Technology Plant began in 2011. An interdisciplinary team from Festo gathered ideas, sorted through them and formulated challenging goals. The expertise and cooperation of all the employees was called for from the very beginning – be they in purchasing, development, IT, logistics, production or human resources. Thanks to the specialists acting directly with each other across all divisions, it was possible to conceive the complex plant architecture and bring it to life in a very short space of time.

This development process is not finished, however. Even the Technology Plant is subject to continuous, dynamic change. Festo is faced with new challenges in the global competitive arena that is the automation sector with employees who are ready to learn and are open to change. Industry 4.0 is the current term for the change taking place in production. By this, Festo understands a harmonious triad composed of intuitive human-machine interfaces, training and qualification, plus innovative technologies. This complexity has to be managed today in terms of future sustainability.

Many of the aspects of Industry 4.0 are already a reality in the Technology Plant. Every day, employees work with a flexible robot in a direct and totally safe interaction. The robot takes over



assembly tasks that are ergonomically disadvantageous for humans, thus relieving them of the physical burden. Experts are intensifying this future-oriented collaboration so that workers and robots form working units where needed. The necessary norms and standards are currently being developed for this purpose.

The latest information technology is also being consistently applied in the Technology Plant. The tablet, and no longer just tools, therefore represents the principal tool for service engineers these days. A specially developed app helps the experts to rectify technical faults as soon as possible or process orders on-site. Besides the purely technical innovations, value is ultimately created by people. As a result, they are urgently required in the automation of the future. Festo employees are motivated, aware and appropriately qualified for this: ready for the production of tomorrow. Only by acting as a conscious community in a lively corporate culture is Festo able to create efficient value chains and product life cycles in future business models too – for global competitiveness and for the benefit of its customers.

# Facts and figures

**4**
levels

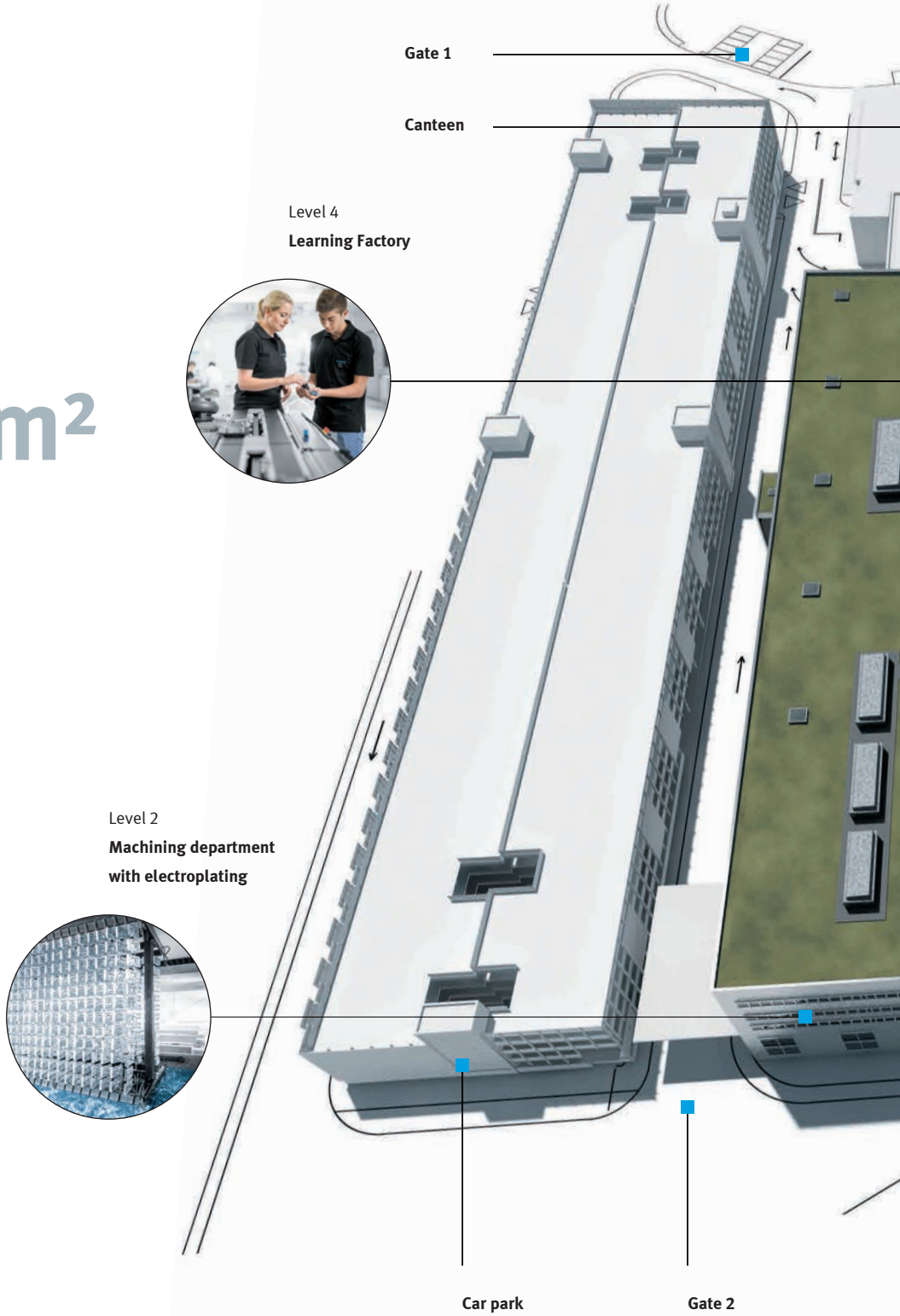
**66,000 m²**
floor space

building height
**22 m**

**1,200**
employees

**20 %**
electricity from own power generation

Learning Factory covering
**220 m²**



Level 4

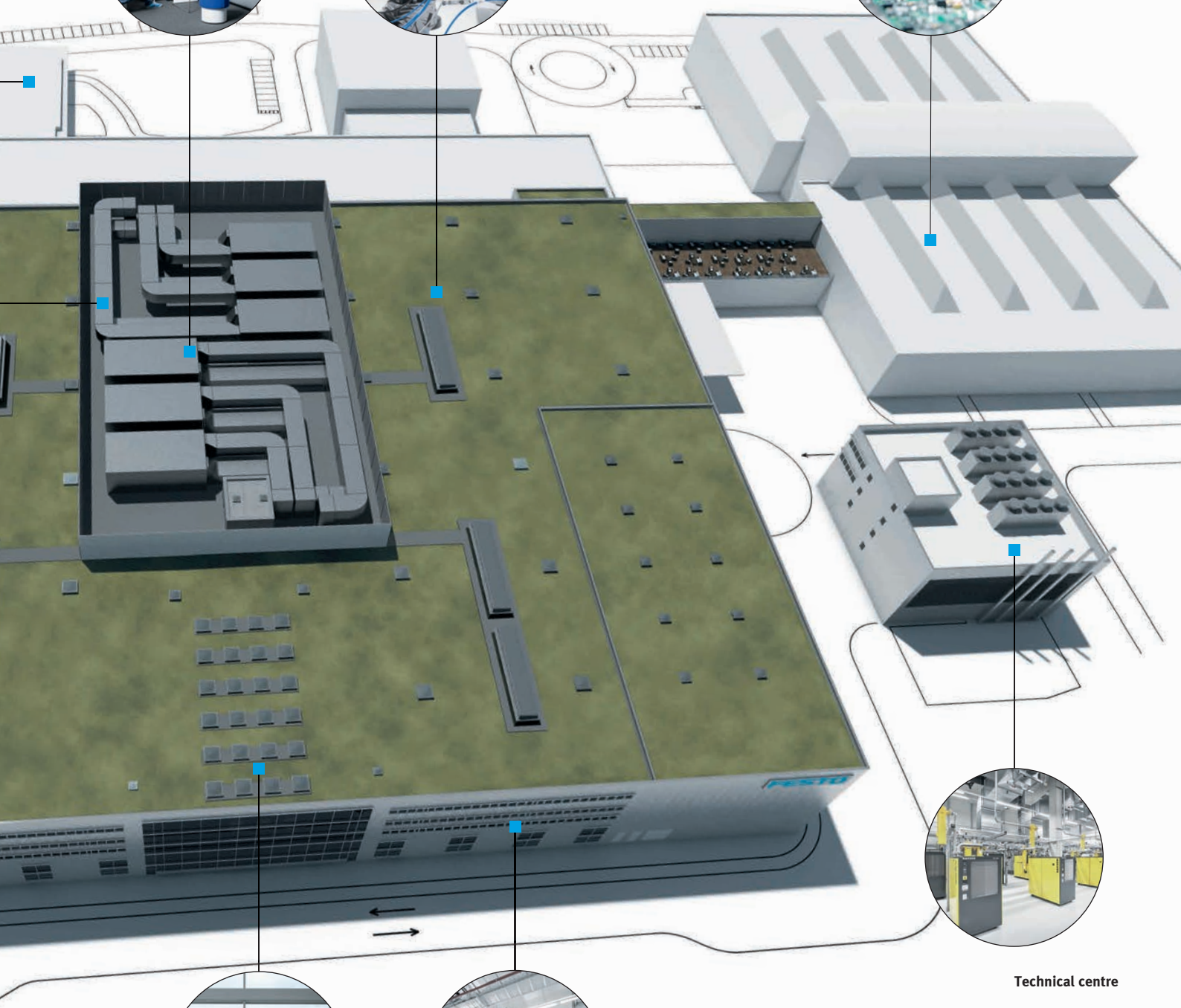
**Hotbeds for ideas**

Level 4

**Customer solutions**

Level 3

**Electronics production**






**Technical centre**

Level 3

**Atrium**

Level 3

**Assembly with VUVG lines**

# Flowing production

The Technology Plant produces quickly, flexibly and reliably: thanks to new methods there is an ideal flow between processes, information and materials

»With the planning of the value streams, we have started on the “green field”. Our aim was to organise ideal processes in the Technology Plant. We wanted to increase value creation in the plant and prevent waste. In various teams we have now created efficient procedures and standards for an environment where it is a joy to work.«

Simon Scheible, Head of Handling Technology Value Stream Scheduling

**Lean production**

- Optimising logistics and material flows
- Minimising stocks
- Producing without bottlenecks
- Involving suppliers

The organs in the human body are supplied by the circulation of the blood. Each one gets exactly the substances needed and contributes to keeping the whole body healthy. This is exactly the way a flexible and reliable production process behaves. The required material must arrive at the appropriate place, at the right time and in exactly the right sequence. Only in this way can each area of the Technology Plant make its contribution towards maximum efficiency.

**Sleek and lean**

When everything flows, an optimum of costs, quality and through-put times can be achieved. The specialists call this target state “lean factory”. From the order coming in to the production process and delivery to the customer – all processes must be harmonised without unnecessary waiting, transport or idle time.

**Everything flows**

The activities and procedures in production form value streams. Besides overriding value streams like order and material control, there are four main areas: handling technology products, valves and valve terminals, electronic components and customer solutions. The Festo experts analyse the value streams systematically in interdisciplinary teams that span all the divisions. In this way, idle times during the through-put of an unfinished part, from goods received to the finished product, can be tracked down and minimised. With the help of this long-term methodology, the employees actively add value. A striking example of a value stream optimised pro-

01 Material is transported in the Technology Plant with pinpoint accuracy via synchronised tugger trains.

01

duction chain is much shorter transportation routes for delivering, sawing, machining, deburring, cleaning and electroplating components. Whilst the process used to be distributed across several plants over a distance of 32 kilometres, they were able to be reproduced across just 120 metres inside the Technology Plant.

**Logistics performance**

In the lean Technology Plant, material flows through the production halls like blood through arteries and veins. The individual manufacturing processes are combined with each other by the shortest of routes and arranged so that, as far as possible, there is need for interim buffering across warehouse stocks. So-called tugger trains ensure the smooth flow of materials between production and logistics. These are small electric vehicles with trailers, which stop at defined points in the production department in a fixed cycle like service buses. The transfer points are uniformly marked throughout the plant so that it can be immediately seen where and which goods have to be dropped off or picked up.

**No bottleneck**

Any process chain overall can only be as strong as its weakest link nevertheless. In order to prevent bottlenecks, the factory experts apply the Theory of Constraints of the physicist, Eliyahu Goldratt. Instead of improving each partial process individually, the focus should be on the bottleneck according to Goldratt. The bottleneck is specifically optimised and the process steps before it only feed it the amount of material that can be processed. In this way, an optimal result can be achieved for the whole factory.

**Setting standards**

Suppliers are also firmly integrated in the factory processes. They are responsible themselves for delivering materials according to defined inventory limits. Their link is established, whenever possible, by means of standardised and cyclically synchronised delivery vehicles. Besides material logistics, there are numerous standards for work materials, among other things. Employees select their own office supplies or tools from a standard work system. In order to ensure the adaptability in future too, today's standards are constantly being developed as part of the Festo production system Festo Value Production (FVP).

# Perfect in form

Turning, milling, drilling and grinding – in the machining department, precision components made of metal are manufactured for further processing in the assembly process

01

**Numbers in the machining department**

- 40 million valve cartridges a year
- 35,000 valve housings a day
- 1,000 individual components for handling products
- 8,000 machining tools

Metal-cutting machines weighing tonnes stand on an area covering 14,000 square metres on the ground floor of the Technology Plant. The highly automated facilities work around the clock and produce the basic elements for the Festo products in the shortest of time: valve housings, valve assemblies, valve cartridges and individual handling technology components for linear units and rotational drives. The components are highly precise, custom-fit and of the best surface quality. The processing route from the warehouse for the delivered metal bars through to the surface finish in the electroplating department runs over just 120 metres in the case of many components.

**Classic mechanical engineering**

The ring-shaped cartridges are the centrepieces of the valves, as they provide the seal. Valve assemblies form the base on which the valves are screwed. The parts for valve housings and handling technology, due to their complexity, are subject to the highest demands in terms of geometric tolerances. The individual process steps for manufacturing the valve housings – such as sawing, machining, deburring (removing edges) and washing – are done on interlinked facilities using robots. Depending on the task, the specialists implement different levels of automation in this respect.

**Well rounded**

The manufacture of components for valve housings used to be a time-consuming process with individual distributed steps. A new large installation in the Technology Plant, a so-called rotary transfer machine, reproduces this process automatically on an area of 140 square metres. The delivered metal bars are sawn into pieces and deposited on a rotating table by a robot, where the individual pieces are machined. With the aid of various tools, 14 stations arranged in a circle are completed in cycles lasting just seconds. Afterwards the valve housings are deburred and washed in a high pressure washing facility so that they are ready for assembly.

01 The machine inserts seals in the pre-produced valve cartridges.

02 The components' surfaces are enhanced in the electroplating department.

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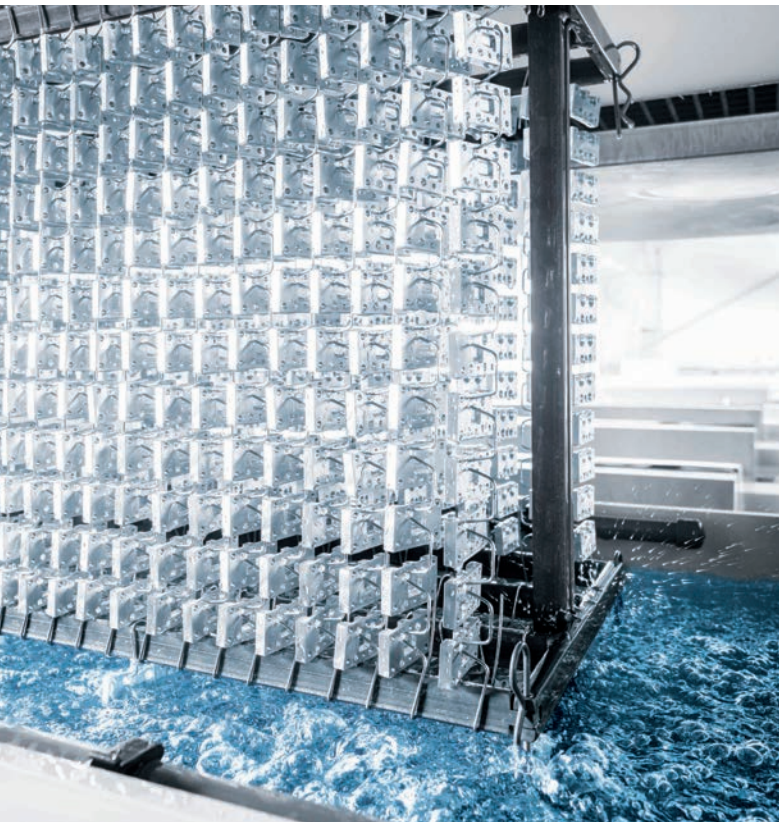


»I started my training at Festo 33 years ago. Our machines in the Technology Plant produce the cartridge sleeves in a matter of seconds. We develop the special tools that are needed for this ourselves.«

Roland Knuth, Head of Valve Cartridge Production

**Safe, clean and efficient**

Metal-cutting facilities require a lot of energy due to the effort needed when machining metal. Machines and ancillary units were therefore efficiently designed from the start using innovative technology. As soon as they are idle, they switch to a suitable energy-saving mode that takes start-up times, product quality and safety into account. The functionality of the machines and the product quality are continually checked and ensured. The workstations of the specialists for maintenance and test procedures are therefore located in the middle on the machining department level, where they are most needed.

The mechanical metal machining results in chips and exhaust air containing oil. An ultra-modern extraction unit is used to filter the air and recover heat. Even the finest particles are therefore unable to get into the air in the factory. The chips created are collected, pressed into briquettes and resold as aluminium scrap.

**Plating and pickling**

The components are immersed in plating tanks to give them the necessary surface properties using electrolysis. The washed and degreased aluminium parts from the machining department are firstly pickled, whereby a layer of about ten micrometres is removed. In the anodising process they are finally given a 20 micrometre thick coating, which protects them from corrosion and ensures a low-friction surface. The plating process at the Technology Plant is energy efficient. Several components can thus be anodised simultaneously in one tank and no retooling is necessary to change the anodising substances. A heat exchanger allows energy to be recovered from the ventilation system.

# Automated and adaptable

## Products are manufactured in a very short space of time on highly flexible and energy-efficient assembly lines

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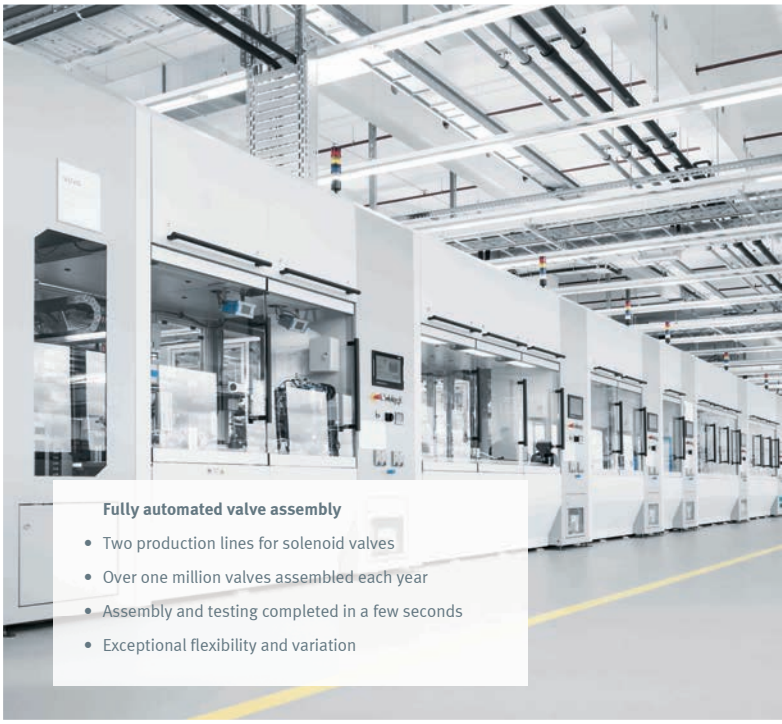
»We ensure the quality and availability of the automated assembly facilities. In the morning we get together for a short, standardised coordination meeting. Our aim is not only to rectify problems but to analyse them in a proactive way. Especially when assembling large quantities, we want to identify critical process values early enough so that we can react before a fault occurs.«

Tobias Müller, Head of Assembly Work Preparation



**Fully automated valve assembly**

- Two production lines for solenoid valves
- Over one million valves assembled each year
- Assembly and testing completed in a few seconds
- Exceptional flexibility and variation

A wide range of solenoid valves and valve terminals are produced automatically or even manually in the assembly department. Many of the company's own products and applications provide support here: Festo products are used to manufacture Festo products. For example, small, compact solenoid valves are automatically assembled on the latest assembly lines. The lines each produce over 50 individual variations of different sizes, whereby 20 variations make up over 80 per cent of the total volume. When it comes to assembling the valves to make valve terminals, manual work is still required. An enormous product variety of 10 40 types – a number one with 40 zeros – is possible in the case of many products, which have to be made according to individual customer specifications in a very short space of time.

**Cell by cell**

In the assembly lines there are up to eight production cells spread one after the other over 30 metres; this is where the motion sequences for assembling the individual valves are controlled and executed.
This includes spray greasing the housings, pressing in the cartridges and fitting the seals, as well as ensuring the respective process monitoring procedures.
The specialists for automation created the cells both in the hardware and the software with a modular design and networked them with each other. The individual processes are autonomously set up, whilst the cells' interfaces are standardised. It is possible to convert, replace or extend the cells without a great deal of effort. A time slot no longer has to be planned even for retooling, as the system retools itself within the cycle time. The consistent standardisation process means that even assembly cells or modules made by other manufacturers can be integrated as required.

**Correct greasing**

To grease the pistons, the Festo experts use a clever method in the automated assembly process: special grease is finely atomised by a heatable spraying system and applied safely and accurately using spray nozzles. The process data for this production step is constantly monitored. In service life tests, the solenoid valves thus perform five times better than before.
For testing the valves after the last production step, an innovative test system has been developed, by which it has been possible to reduce the time required for this to just a few seconds.

01 Valves are automatically assembled in the production cells of the large modular lines

02 An employee works with the assembly robot in an intuitive and risk-free manner.

02


**Everything can be tracked**

Right from the planning stage, the experts ensured a high energy-efficiency level on the assembly lines. The energy consumption can now be individually determined for each unit today. Possible leaks are automatically detected, whilst pressure and flow rate are continually monitored. Locally employed valve terminals reduce the consumption of compressed air on the machines considerably. Thanks to cameras and laser sensors, each separate assembly step is inspected without delay. Barcodes and RFID chips (radio frequency identification) are used across the entire production process and beyond, from the supplier to the customer, to record batch data, process parameters and all test results. Unfavourable trends in production can thus be identified early on, and waste or reworks avoided.

**Human-robot cooperation**

The adaptability of the automation process combined with an intuitive human-machine interface and the qualification of employees make up key aspects of the production of tomorrow. Special machines or a robot thus take over pre-assembly jobs, which are ergonomically one-sided for people or have a very short cycle. The robot grips a housing, joins cartridges and frame together and ultimately passes the component on to the worker for further processing. Such teamwork poses no risk for the person. Sensors monitor all the robot's actions. As soon as an employee comes too close to it, the robot slows down or just stops. Thanks to safety mechanisms, the robot does not have to be behind bars: a successful example for the future-oriented and competitive partnership between man and machine.

## At the customer's request

Special components and single components for individual customer needs are manufactured by hand assembly in the Technology Plant.

»With colleagues I planned and actively arranged the relocation of our department to the Technology Plant. Today I have a personal attachment to the plant. As a deputy manager I make sure that the employees can work in a balanced, commensurate and productive manner – and by doing so that the different orders are carried out for our customers without problems.«

Angela Biribauer, Customer Solutions, Assembly

**For the customers**

- Customised project handling
- Competence in product complexity
- Short reaction times
- Quick throughput

Whether it is a few thousand a year, a small batch of several hundred or just a single item, the Festo specialists for customer solutions deliver a wide range of special designs. As each customer brings its own wishes and challenges, they develop and produce components with individually unabridged functions and properties.

**Understanding customers**

Many production processes run under extreme temperatures, many require special greases, sealants and cleaning agents. Others in turn have increased safety requirements in relation to leakage, need special flange valves or additional fixing holes. In order to be able to deliver tailored solutions, a direct exchange of information is necessary: the Festo sales engineers coordinate with the customer and work out designs in close cooperation. Single samples and individual prototypes can be produced as easily as complex serial products.

**Variety and applications**

Depending on the application area, valve terminals, control cabinets, drives, control blocks, high pressure pneumatics products or system solutions are produced. In bottling plants for drinks, for examples, different control systems are required for sparkling wine, beer or juice because of disparate processes. Special valves make it possible to sort vegetables or rice reliably using compressed air – rice can even be sorted in free fall thanks to rapid switching. Over and above this, Festo produces specific solutions for other customers from the food industry, for the automotive industry, plant and electronics manufacturers, medical technology, the packaging and automation industry or manufacturers of painting facilities, wood and textile machinery.
Thanks to the wide spectrum of solutions, the experts try to meet the full needs of every customer.

# Electronics – elementary component

Circuit boards and sub-assemblies are produced for the company's own applications and as products for customers: added value thanks to electronics

**Annual performance**

- Hundreds of millions of SMT components
- Several million flat and final assemblies
- Hundreds of types

»I mount, assemble and test circuit boards on different machines. Even 15 years ago, when I came to Germany, I wanted to go to Festo. I have been working at the company for over three years. The atmosphere in the Technology Plant is great: each individual is appreciated, we are always able to learn more and we are often informed by our line managers.«

Maria-Cristina Muntean-Galiu, electronics flat assemblies production

Many products simply wouldn't exist without electronics. In the Technology Plant, 200 employees produce complex electronic assemblies and products on an area covering 6,000 square metres. 2.5 million of them are produced each year for use at the company itself. The areas responsible for further processing receive either complete assemblies in the housing or mounted circuit boards.

**Fully mounted**

At Festo, circuit boards are manufactured using the latest production and soldering methods. This includes the smallest electronic SMT components (surface-mounted technology) and powerful microprocessors with over 500 connection pins. They are processed on four fully automated production lines: Firstly a paste printer applies the soldering paste wafer thin onto a blank circuit board. Several high-performance mounters then place the necessary electronic elements to an accuracy of hundredths of a millimetre – for instance resistors, diodes or capacitors. The soldering process itself takes place in what's known as the reflow oven. In order to ensure exceptional product quality every time, all modules pass through optical and electrical test procedures consisting of several stages. The specialists for electronics manufacturing check and optimise the whole production process with the aid of innovative methods. It can be seamlessly tracked for every assembly.

**Valuable warehouse**

A sophisticated warehouse system accommodates the sensitive SMT components. It works using a shuttle principle, by which the required electronic elements can be quickly retrieved. A former lift shaft, which the Festo automation experts fitted as an automated warehouse with robot handling, is ideal for accommodation purposes. The valuable components are monitored with infrared cameras and are therefore protected against fire and the effects of water.

# Tested and secured

## Future-oriented technologies for serial production: process development as the interface between development and production

»What fascinates me is that we find ourselves on uncharted territory. We evaluate new technologies by sharing information with other departments. Once the selected methods have proved to be reliable, we pass them on to our colleagues in production. We are currently working in particular on digital printing and laser technology for various applications.«

Dr. Axel Fehrenbacher, Process Development


**Process development**

- Reliable processes
- International orientation
- Technical test centre
- Technology road map

The specialists from process development represent the link between development projects and production start-up. They identify, test and evaluate innovations. The latest methods and technologies are expected to be applied practically in everyday factory operations as soon as possible at Festo – in an intelligent, future-oriented and, above all, reliable manner.
With their expertise, the process developers not only work in the Technology Plant, but support the Festo plants all around the world.

**Tracking down trends**

What does the future of production look like? Which technologies does Festo have to master? And in which places should established production routes be replaced by new methods? The process developers assess the potential of new production methods early on and systematically. They focus on the needs of the individual plants, of pre-development and of the development department. The results are disclosed in a comprehensive technology road map, which reveals individual and global trends.

**Under laboratory conditions**

One technology trend alone is no guarantee for a suitable production process.
In order to evaluate a new method, the Festo experts start with initial tests and a feasibility study. If their evaluation turns out positive, a closer look is taken at the process: they define the framework conditions for possible factory applications and combine different methods if required.

01 In the test facility for digital printing, process developers test the possibilities for labelling products.

01

Next up is the analytical evaluation and the statistical assurance, which ultimately allow assertions about future process reliability. If the green light is given, the process developers set up a test installation. The results go into an actual production concept.

In the technical centre at Scharnhausen, experimental constructs can also be found alongside test facilities. The department is completed by its own mechanical workshop and accompanying analysis methods. The process developers work intensively on adhesive technologies, which will take over from classic welding methods in suitable places. Furthermore, there is a special focus on new joining processes, forming techniques, coating and cleaning methods, spray greasing methods, material selection, laser technologies and modern printing methods.

**Digital printing for the future**

Product labelling, which until now has been done by sticking name plates on products, is being replaced by digital printing at Festo. In just a few seconds, a valve housing can be printed on in high resolution and in the desired colours.
Even curved surfaces do not pose a problem. The printing process is extremely flexible due to the software control system, meaning that it can meet the increasing need for the individualisation of products and the associated labelling process.
Before printing, the component is pre-treated, for example with a laser. It removes the top layer for optimal ink adhesion. The ink is dried after printing with UV light. Each separate process step has been tested and assured by the process developers – the digital printing procedure is ready for production.

**Comprehensive expertise**

The aim of the process development department is to actively help shape the production of tomorrow in terms of costs, quality and the ability to supply. As an interdisciplinary team, the specialists have to repeatedly tackle a wide range of issues. They work in a networked manner and in close consultation with colleagues from other departments. Besides excellent knowledge in engineering, scientific and experimental expertise is called for.

# Energy efficiency planned and put into practice

Energy utilisation already optimised through innovative factory planning: buildings and production processes are networked in terms of energy

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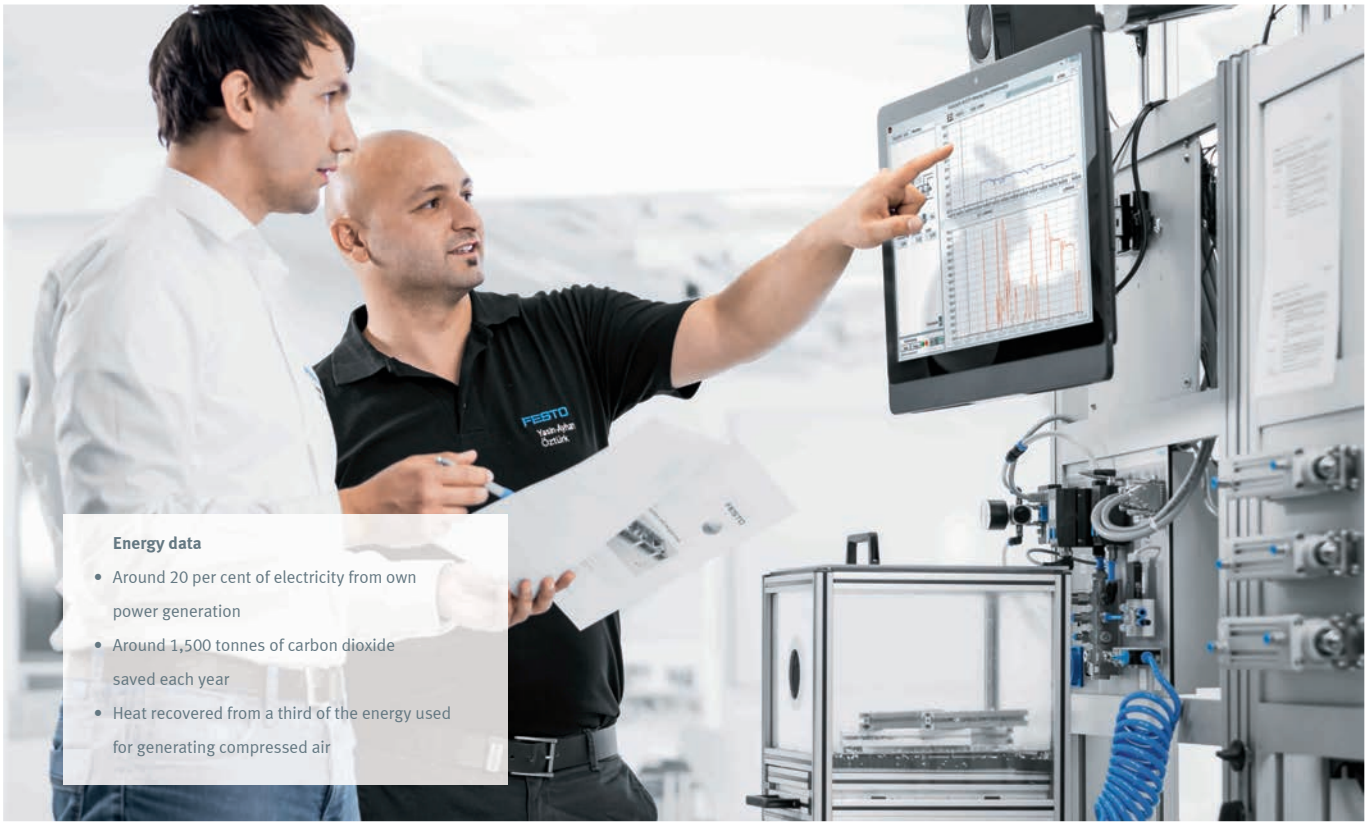


**Energy data**

- Around 20 per cent of electricity from own power generation
- Around 1,500 tonnes of carbon dioxide saved each year
- Heat recovered from a third of the energy used for generating compressed air

The buildings on the Scharnhausen factory premises with a floor space of around 66,000 square metres and 1,200 employees need to be supplied with energy. In the new building alone – with its four levels, it is as big as seven football pitches – there are 9,000 lights, 125 kilometres of cables, 11,500 sprinkler heads, 70 kilometres of data cables, 1,300 smoke detectors and 28 kilometres of pipes for heating and cooling. The air in the whole building is replaced every 24 minutes. That equates to one million cubic metres of fresh air every hour.

**Buildings and production**

In order to keep energy consumption to a minimum, the Festo experts took innovative paths when planning the factory and building: all the departments involved were closely interlinked during the planning phase. They use a joint communication platform, which can be used to make sure that the energy interaction between building equipment and production system is taken into account as soon as planning begins. As processes are often mutually dependent, the energy has to be distributed sensibly. By continually adjusting the generation process to the actual consumption situation, the necessary energy can be provided very efficiently.

**Scientifically balanced**

Based on corresponding preliminary investigations, the specialists developed different energy concepts. Decisions were made according to efficiency and depreciation calculations. Researchers at the Technische Universität Braunschweig (Technical University of Braunschweig) supported this process by carrying out life cycle and profitability analyses for the individual concepts. They also analysed the flows of energy with the aid of so-called Sankey diagrams, which show the overall energy balance of a factory building. Future scenarios were successfully integrated and the effects of individual measures put into concrete figures.

01 Training courses on energy efficiency are part of the education programme in the Technology Plant.

02 The experts are able to monitor the safe operation of the buildings and facilities via a tablet.

02


»We are working on a networked and intelligent energy transparency system. By this means we can disclose current consumption figures to every employee on-site and make potential savings visible. Transparency in the energy consumption figures is the key to becoming more efficient. We have laid the foundations for this with a measuring system that provides us with this data.«

Johannes Linzbach, Production Systems Research

**Flair for energy**

The physical background for calculating the Sankey diagram is the conservation of energy principle: every energy flow into the factory must also leave it at the same intensity.

Strong flows are symbolised by thick arrows, weak flows by thin arrows. The arrow thicknesses correspond exactly to the energy flows and thus make them transparent.

Scales and effects can be estimated at a glance. The Sankey diagram can make it easier to understand the routes of power distribution or carbon dioxide emissions and to directly read off interactions.

**Planned and constructed**

Two natural gas-operated combined heat and power stations with a total output of around 1.8 megawatts ensure a basic energy supply to the site today. A combined heat and power station generates electricity and heat at the same time, with an overall efficiency level of around 95 per cent. The heat is used for heating purposes in the cold part of the year. During the summer months, it is converted – together with the waste heat from the air compressors – into cooling for production with the aid of absorption chillers. Although the consumption of natural gas increases by operating the combined heat and power stations, overall efficiency is considerably improved and unwanted emissions are significantly reduced. Energy is also recovered in the machining department: waste heat given off by the machines is transferred into the ground by means of concrete core activation and utilised according to the underfloor heating principle. The result of the energy networking of production and buildings is lower consumption, less costs and lower emissions.

01 Emanating from the central compressed air system, the whole factory is supplied with compressed air via different networks.

01


**Environmental targets**

- Sustainable and ecologically viable operations
- Forerunner in terms of energy efficiency
- One per cent annual improvement in the key energy figures

**Centre for building services**

All the supply facilities – combined heat and power stations, boilers, cooling machines, distributors, pumping stations, cooling towers and the central compressed air system – are housed in a separate building on the premises. Heat, cold, cooling water and compressed air are fed from this technical centre to the production levels via an accessible media duct. Pipe routes, which are arranged at an interval of nine metres, and can be accessed every three metres, make up a continuous supply network. Production equipment can be flexibly rearranged at any time, without changes being necessary to the building infrastructure. The structure also provides every possibility for a further expansion of the Technology Plant if required.

**Data volumes under control**

To safely operate the equipment in the buildings, all consumption data and the correct function of the individual facilities are continually recorded. The data comes together in a central building management system. The facilities are automatically controlled from here. Thanks to the clear visualisation system, any faults can be displayed in real time on a computer or tablet and action taken if necessary. By prioritising the types of alarm, the emergency services can estimate whether they are needed on-site – at night, for instance.

**Keeping an eye on large facilities**

The planners paid special attention to the large facilities from the start. In the Technology Plant, electroplating is the single facility that consumes the most energy. Components are electrolytically treated there and thus made resistant to corrosion or given particular surface properties. Instead of outsourcing it, the planners made the conscious decision to integrate this costly procedure.
Products and components are expected to pass through the factory as quickly as possible whilst conserving as many resources as possible. Sophisticated insulation on the electroplating tank today saves around 15,000 cubic metres of exhaust air each hour. Furthermore, the ventilation system is equipped with a heat exchanger to recover energy. The waste heat from the combined heat and power stations is used to heat water.

The generation of compressed air represents another major consumer of energy.

»I was involved with the planning of the building services from the start. I now see empirical values from other production sites actually put into practice. The new control centre also makes our work easier: I can use a smartphone or tablet to estimate when and where help is needed.«

Michael Höschele, Building Services

The specialists managed to lower the pressure levels of the different networks at the whole site from eight to six and 18 to 13 bar – a sustainable measure, as just a single bar less pressure saves five per cent of energy. To do so, around 100 installations, such as metal-cutting machines, assembly and test machines, had to be adjusted to suit the new pressure ratios.

**Transparency right through to the machine itself**

But not only the large energy consumers, smaller installations with high energy consumption are also expected to make a contribution to conserving resources in Scharnhausen. For maximum energy transparency, certain machines have to continually disclose their energy data: only that which is measurable can be improved over the long term. The experts thus use sensors, for example to record the flow of electricity or compressed air in the facility. The operating and consumption data read off from the machine equipped with such a device is integrated in the production network in a compressed form and ultimately visualised.

**Nature and the environment**

A very direct measure for conserving resources and the environment is the recovery of rainwater. The new building features a reservoir with a capacity of 70,000 litres. This is used to supply the sanitation facilities and water the green areas. Excess water is fed into a retainer tank for seepage so that the Körsch, Stuttgart's second biggest river, does not flood in the neighbouring conservation area. For optimal noise protection, the acoustic planners employed specific building measures to minimise sound radiation. Employees benefit from this in the buildings, as do residents outside the factory premises.

# Values, culture and community

## “ACTING.TOGETHER” is the motto of the Technology Plant: objectives can only be achieved through teamwork

»I started at Festo a few months ago as a foreman with many years of management experience. I am responsible for assembling complex valve terminals. I have already completed the first qualifications, where company principles, but also other content is taught. Continuing to learn and train goes without saying for us.«

Michael Bechtle, Head of MPA Valve Terminals Assembly

**“ACTING.TOGETHER” means**

- We act as a role model.
- We deliver high performance.
- We work for our success.
- We make good decisions.
- We communicate directly.
- We strengthen team spirit and motivation.

When people pull together, they can make a big difference in the workplace. To ensure this, they need a pronounced community feeling and have to feel good in their everyday working life. Neither can be prescribed or bought, however. Only practised values create the conditions for a functioning community. Festo, a family company, offers all employees ideal working conditions in a culture where values are appreciated.

**Flexible and motivated**

The individual teams at the Technology Plant enjoy personal freedom within defined guidelines. Product quality, customer orientation, delivery reliability and cost optimisation form overriding plant objectives and represent key indicators for all areas. As part of the community, the individual teams take interfaces with other departments into account. In this way the factory as a whole is able to react faster to customer needs.

**Open communication**

The most important communication channel wears shoes. Or, to put it another way: when people share information and are well informed, many things become possible. The performance and contribution of every member of the workforce is important to ensure a continuous increase in productivity at the Technology Plant. Sophisticated training concepts allow individual support measures and personnel development.

**Bright times**

Light has a positive effect on productivity, motivation, mood, cognition and sleep. Against this background, the Festo experts have implemented a health-promoting lighting concept in cooperation with the Fraunhofer IAO. It is based on natural solar irradiation, which, over the course of a day, shifts to produce cool and bright to warm and darker light. If artificial light is needed – for instance before dawn and after dusk, in case of dull weather or in winter –


»I like to work at interfaces between different areas. After my professional training, I worked as an electronics trainer and gained further qualifications in the process. Festo has always supported me with my training and development – I have been here my entire professional life.«

Claudia Schäfer, Electronics Production Work

two light colours are mixed with each other. During the early or late shift, employees find a lighting at a working height that corresponds to their natural biorhythms for the given time of day. What is more, the Technology Plant has large windows and skylights so that all employees can enjoy natural daylight around them.

**Ergonomics and movement**

As a matter of principle, Festo wants to keep physical strains suffered by employees to a minimum. The working conditions in the factory have therefore been analysed and evaluated in terms of ergonomic aspects, both in the offices and particularly in the assembly department. As a result, there are now benefits such as height-adjustable workstations to prevent back strain. The company health promotion system offers employees a variety of options, such as fitness classes, yoga, back exercises, Nordic walking or a place to take a short relaxing break during their lunch hour. Special nutrition workshops round off the range.

**Relaxed and productive**

In order to stay productive, people need recovery periods. In order to enjoy their breaks, the employees can choose between smaller coffee niches, break rooms and the central cafeteria in the atrium bathed in light. At the same time, employees on all levels use the atrium as a meeting point and communication platform – whether they work in an office or in production. When the weather is nice they can also enjoy the building's spacious roof terraces. When all parts of the working environment puzzle are put together in the right way, from considerations about people to health and well-being, productivity can be increased over the long term.

# Room for creativity

## Acting together across departments: sophisticated communication and spatial concepts for intensive cooperation, effective working and an easy exchange of information

01


Innovation means renewal – this also applies to people's creative potential. Atmospheric workspaces, so-called hotbeds for ideas, spark inspiration in day-to-day life at the office. Over and above this, the experts have created a host of areas throughout the factory, such as meeting corners and the central atrium, so that the employees can exchange information spontaneously. Communication has to take place immediately, and above all directly, in order to expand one's own horizons. Only in this way are specialists from research, development, information technology, production, purchasing, controlling, supplier support, human resources or environmental management able to be specifically networked to join forces and create added value for Festo and its customers.

**On an equal footing**

As distances grow, communication wanes. Or, to put it another way: face to face, things can be discussed more easily, questions clarified more quickly and further action agreed on sooner. The offices at the Technology Plant are therefore deliberately integrated with the respective production levels. They are equipped with modern, uniform media technology and communication zones. The generally open design means that you can tell straight away, just by looking at someone, whether or not they're available to talk. The classic meeting rooms can also be immediately recognised. In addition, employees can use the atrium with the central cafeteria, various areas with high tables or small kitchens for a quick discussion.

**Full of inspiration**

With an eye on the company values, the Festo experts first considered how innovations come about. They then implemented their ideas and answers in an outlandish spatial concept: four deliberately designed hotbeds for ideas with an individual character.The green, red, blue and black-and-white spaces are arranged in the form of a snail's shell around a small but central coffee area. The meaningful model for the geometric arrangement are the Fibonacci numbers (1, 1, 2, 3, 5, 8, 13...). Two adjacent numbers add up to the next one in the sequence. If the sequence is graphically represented with the aid of squares, the result is a pattern that frequently occurs in nature. It can be observed in things such as snail shells, seashells, blossoms and cones. Furthermore, the Fib-

01 The spatial concept of the hotbeds for ideas promotes creativity in everyday working life.

02 The open design of the Technology Plant enables employees to exchange information spontaneously.

02


»As an innovation management team, here at Festo we form an interface between many areas of the company. We are a kind of mouthpiece to them and develop great products together. For me the particular attraction is to be able to help establish and mould a progressive factory like the Technology Plant through my work.«

Michael Straub, Scharnhausen Production, New Product Management

onacci sequence has a mathematical relationship with the so-called “golden ratio”. It was formulated in ancient Greece as a principle of beauty and aesthetics.

**Worlds of ideas**

The hotbeds for ideas favour an intellectual change of pace in everyday life. They provide designated areas where people can retreat. Only in this way do group dynamics, intuition and inspiration unlock their full potential. Mentors look after their respective space and its allocation. Several people can act at the same time on interactive walls and network with other sites worldwide by video conference. To ensure that valuable ideas are not lost, the teams can save the materials they compile in the hotbeds for ideas – memories need places. Metaplan boards with notes, drawings, booklets or models can be tidied away so that work processes can be continued in the same place at another time.

**On call**

Besides workstations for use on a temporary basis that are designed to encourage the formation of hotbeds for ideas, there are also long-term workstations in the Technology Plant’s offices: employees from other areas of the company can move their workplace individually to the Technology Plant, for project work for example. When developers on-site meet with production specialists, their expertise has an influence on the processes from an early stage. Development times for new products are shortened. Coherent communication is the prerequisite for efficient and pleasant project work. When all the production stages at Festo come together perfectly, an optimum result can be achieved in terms of costs, quality and the ability to supply.

# Learning as a matter of course

Employees get qualifications and training in a practical and needs-based manner: the Learning Factory as an integral part of the Technology Plant

»When the Learning Factory was set up, I was already well into my first year of training to become a mechatronics engineer. We had plenty of freedom as apprentices. We were encouraged to use our own initiative and our ideas were put into practice. Apart from organisational tasks, we built a glass box for training purposes designed to ensure the efficient use of compressed air.«

Leonie Müller, trainee mechatronics engineer

Education and knowledge represent an essential part of the Festo corporate culture. Individual learning is part of every single employee's career. When it came to planning the new plant, the project team worked with Festo Didactic to develop the innovative concept of the Learning Factory. The aim was to integrate this culture of learning without further delay in the procedures at the Technology Plant.

**Training in everyday work**

Practical learning at the workplace or theoretical learning in the training centre: both can reach their limits if the production process is interfered with or the employee is not dispensable. This gap is closed by the Learning Factory, which is centrally integrated into the plant. Pilot training schemes, product training courses and process qualifications are possible at any time during the working day at the Technology Plant, and are completely flexible as regards duration, contents or participating persons.

**Room to learn**

Four areas covering a space of 220 square metres are accommodated in the Learning Factory: the room modules for machining, assembly, cross-section issues and processes as well as the media centre with PC learning stations. Connections for electricity, compressed air and ones to the network are available everywhere for the test set-ups via hinged media sockets. For an optimal learning effect, the learning stations are equipped with original components and software from production.

**Awareness for energy**

In order to be a pioneer in terms of energy efficiency, a conscious approach to resources is practised at the Technology Plant. For instance, the employees take a course about energy efficiency in the Learning Factory. At the learning station they witness how energy consumption and the price increase when a full kettle is boiled for a single cup instead of the amount required. At two cups

01 Practical training courses take place on-site within the Learning Factory.

01


**The Learning Factory**

- Short-time trainings for everyday business
- Standardised and flexible trainings
- Learning stations with original components
- Systematic training catalogue

of tea on 250 work days for 200 employees, that can easily add up. Added to this is the longer waiting time for a full kettle and perhaps also the water that is poured away. Over and above this, people are taught about potential savings when it comes to the everyday use of compressed air. The employees are aware how much compressed air is lost when hoses are vented, meaning that they develop an eye for the ideal hose length. The practical exercise completes the visualisation of the consumption examples: with the aid of a Plexiglas box, employees learn how to clean metal chips off components in an energy-saving way. A higher pressure does not always lead to a better cleaning result.

**Welcome**

Around 400 employees start work at the Technology Plant every year, whether they are on short- or long-term contracts, holiday workers or engineers. Every fourteen days, everyone starts together in the Learning Factory with an introductory training session lasting one and a half hours. They are given an overview of general topics such as quality, energy, safety, component sensitivity, factory standards and areas for taking breaks. Attention is drawn here to the Festo error culture: new employees are expected to develop an openness with regard to errors in order to be able to work in a motivated and independent manner.

**Training catalogue**

As the Learning Factory is designed as a process companion to the Technology Plant, managers and employees designate potential learning topics once a year. Learning objectives, the number of persons, trainers, duration, repeat sessions and the required methodology of a training course are summarised in individual fact sheets. The aim is a standardised but constantly updated training catalogue. So far, around 90 different training courses have been defined. Reflection and questions as well as openness and curiosity are all part of the basics at Festo.

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50120 en 09/2015