Industry 4.0

Qualification for the factory of the future

FESTO

Industry 4.0 – the future of production
What changes can industry expect?

The answer to this question lies in the new ways in which people, machines and data can interact. Industry 4.0 combines the real world of production with the virtual world of information and communication technology; therefore traditional industrial processes are supplemented and optimised by the digital world. This creates the foundation for the series manufacturing of individual products to a high standard of quality.

In order to establish Industry 4.0 in a company, the training and qualifications of its skilled workers must be adapted to meet the new requirements of this interdisciplinary approach. For example, service technicians not only need practical mechatronics experience but also knowledge of IT infrastructures so that they can work at a high level to rectify machine standstills as quickly as possible.

Industry 4.0 means that the tasks to be carried out are becoming more demanding, in both technological and organisational terms. Interdisciplinary competencies are growing in importance, which is why it is necessary to adapt the skills and abilities that are taught for the various trades. As the boundaries between the different functional levels are becoming ever more fluid, the need to adapt affects all technical professions.

"People will be an integral and indispensable part of the world of production in the future. Festo Didactic is conducting research into solutions in which people learn to interact directly with technology. In the same way as two people might work together today, it must be possible in future for people to work together with machines."

Dr. Eberhard Veit
Chairman of the Management Board, Festo AG & Co. KG and Member of the Management of the Plattform Industrie 4.0

From industry for industry

Thanks to Festo Didactic's industrial roots in automation technology, we can, as your partner, address two needs at once: on the one hand, we work very closely together with industry and know its needs, which we incorporate directly into our training material. On the other hand, we are part of many Industry 4.0 committees such as SmartFactory-KL and the Plattform Industrie 4.0. We are thus able to play an active part in shaping this project and integrating the latest trends in our learning systems.

Modular entry to the world of qualification

To facilitate a successful change in the world of industrial training, we offer you products on several levels, from individual workstations to a complete learning factory. This allows you, depending on the material that you select, to present your trainees with various scenarios for Industry 4.0 in a clear and practical way. Since learning areas and needs are constantly changing, our products are modular and can be adapted and developed further at any time to meet your individual requirements.

Support for your teaching

We support you with industry-relevant seminars, workshops and teachware to ensure that you have the most current information at all times. This enables you to teach about the Industry 4.0 project in all its various facets. We offer our customers a managed forum for Industry 4.0 so that you can exchange views with colleagues on current questions, project ideas and teaching materials. In addition to your tutorials, trainees can use our web-based training courses to read and learn more about a broad range of topics. If there are any specific problems, the advisors from our Training and Consulting department will be happy to help you.

Project workstation I4.0
Step by step towards the factory of the future

Based on our classic training materials for mechatronics, control technology and automation technology, the universal learning platform MPS® Pallet Transfer System can be expanded step-by-step in hands-on projects to form a fully-fledged Industry 4.0 component with the appropriate practical topics.

Additional equipment level Pallet Transfer System

Station operation: Module expanded with pallet transfer system with stopper

Module

Fundamentals of Control Technology: Individual modules with an easy-to-understand level of complexity

Some of the available projects:

- Analysing mechatronic systems
- Generating parts lists
- Generating I/O lists
- Generating function diagrams
- PLC project engineering
- Functional testing
- Generating sequencers
- Commissioning

Part No.: D40001
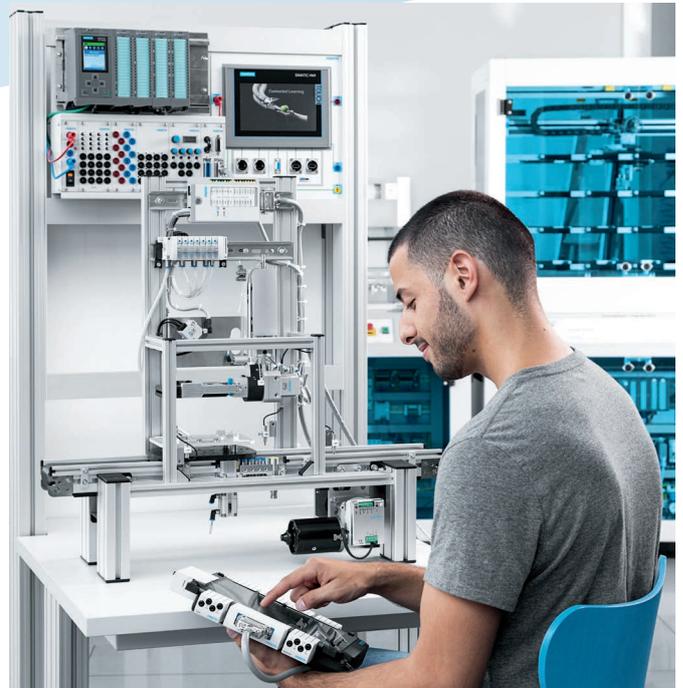
Some of the available projects:

All the topics of the basic module, plus:
- Binary pallet identification
- Pallet identification with RFID (Radio Frequency Identification)
- Working with human/machine interface
- Condition monitoring
- Programming operating mode selection
- I/O control for DC conveyor belt motor
- Control of AC conveyor belt motor using inverter
- Fast conversion of modules and drive technology
- Working with data modules, structures and models

Part No.: D40002

CPS Gate
The CPS Gate is an intelligent pallet stopper with an Internet-capable IEC61131 controller and RFID sensors – a result of Industry 4.0 research at Festo.

Additional equipment level Plug & Produce

Introduction to the Smart Factory:
Plug & produce based on the CPS Transfer System

Additional equipment level CPS

Expanding the classic training topics:
Intelligent CPS (Cyber-Physical System) Gate

Some of the available projects:

All the topics of the CPS Transfer System level, plus:
• Commissioning an intelligent module
• HMI (Human Machine Interface) based on webserver/pad
• Defining SOA (Service Oriented Architecture) function interface
• Implementing the function interface
• Commissioning the NFC reader
• Implementing the plug & produce module identification
• Object-oriented programming
• Managing the module drivers
• Loading the drivers from the CP Factory cloud

Part No.: D40004

Some of the available projects:

All the topics of the Pallet Transfer System level plus:
• Converting from stopper to CPS Gate
• Analysing, function testing and commissioning the CPS Gate
• Commissioning the TCP/IP and OPC-UA interfaces
• Commissioning the web server
• I/O control for DC conveyor belt motor using CPS Gate
• Fieldbus control for the DC conveyor belt motor using CPS Gate
• Programming the CPS Gate
• Setting up the TCP/IP communication between CPS Gate and PLC
• Parameterising the CPS Gate using NFC

Part No.: D40003

CPS Gate

The Industry 4.0 learning system
Seamless, modular and expandable

A seamless learning system – starting with the project workstation I4.0 and continuing via the CP Lab through to the comprehensive CP Factory, the modules and pallets can be used at all stages. The CP Lab can be connected to the CP Factory via the mobile robot Robotino® and the deflector module.

CP Lab – the Cyber-Physical Lab

In the CP Lab, a number of project workstations I4.0 are used to create a realistic industrial pallet circulating system and to teach more about Industry 4.0.

All the topics of the project workstation I4.0, plus:
- Material flow
- Overall process
- System networking
- Information flow in complex systems
- Process planning
- Planning assembly and dismantling
- Teamwork
- Data processing systems (manufacturing execution systems – MES)
  - Order entry
  - Product definition
  - Work schedules
  - Process data acquisition
  - Degree of utilisation, OEE
  - Data analysis
  - Costing and much more

Part No.: D41001

Project workstation I4.0

What does CP mean?
Cyber-Physical: communication networks and physical systems are combined to form a single entity – an important characteristic of Industry 4.0.

The modular project workstation I4.0 forms a solid basis for further training up to the level of Smart Factory and Industry 4.0.

In educational and functional terms, the project workstation I4.0 fits perfectly into the CP Lab and CP Factory learning environments. The knowledge acquired through the project workstation I4.0 is expanded thematically step-by-step to cover further material relevant to Industry 4.0.

CP Factory – the Cyber-Physical Factory

The basic modules of the CP Factory form the starting point for the familiar learning situations of the project workstation I4.0 and for developing these further in a plant network. Two groups of trainees work at the stations in interdisciplinary teams. Cells dealing with other important topics such as robotics, CNC, manual assembly and deflectors cover many additional training topics and ensure that the training for each subject is comprehensive.

All the topics of the CP Lab, plus:
- Storage systems and storage strategy
- Autonomous mobile robotics
- Safety engineering
- Energy monitoring and energy management
- Robot cells with camera-supported assembly, use of gripper changing systems, palletising, tracking and more
- Production, CNC machines with automatic loading, FMS (Flexible Manufacturing System)
- Additive production methods (rapid prototyping)
- Manual workstations, e.g. with pick-by-light, Andon (visual control system)
- and much more

Part No.: D10001

CP Factory
The factory as a complete system

The universal Industry 4.0 learning factory

A value chain not only includes assembly lines but also other areas such as production, lean production, logistics and quality assurance.

Our training offer for the CP Factory therefore also includes comprehensive facilities for these areas, and integrates them with an MES (Manufacturing Execution System) developed to meet the needs of Industry 4.0. This creates a comprehensive, modular and expandable factory model which can be used in many areas of teaching and research.

Production

Assembly Line

Training Area Assembly Line

One-off production and the assembly of product variants place demanding requirements on production in accordance with Industry 4.0. To meet these requirements, the CP Factory offers:

- Modularity
- Mobility
- Short setup times
- RFID technology
- Plug & produce
- Standard interfaces
- Service-oriented program architecture

Training Area Logistics

An intelligent flow of materials and networked logistics are important drivers for Industry 4.0. The CP Factory offers a versatile training and research platform for numerous different logistical problems:

- RFID
- MES
- Automatic warehouses
- Production stores and magazines
- Pallet transfer systems with deflectors
- Autonomous transport robots, including the transfer of materials

ERP/MES

Logistics

Lean Production

Quality Assurance
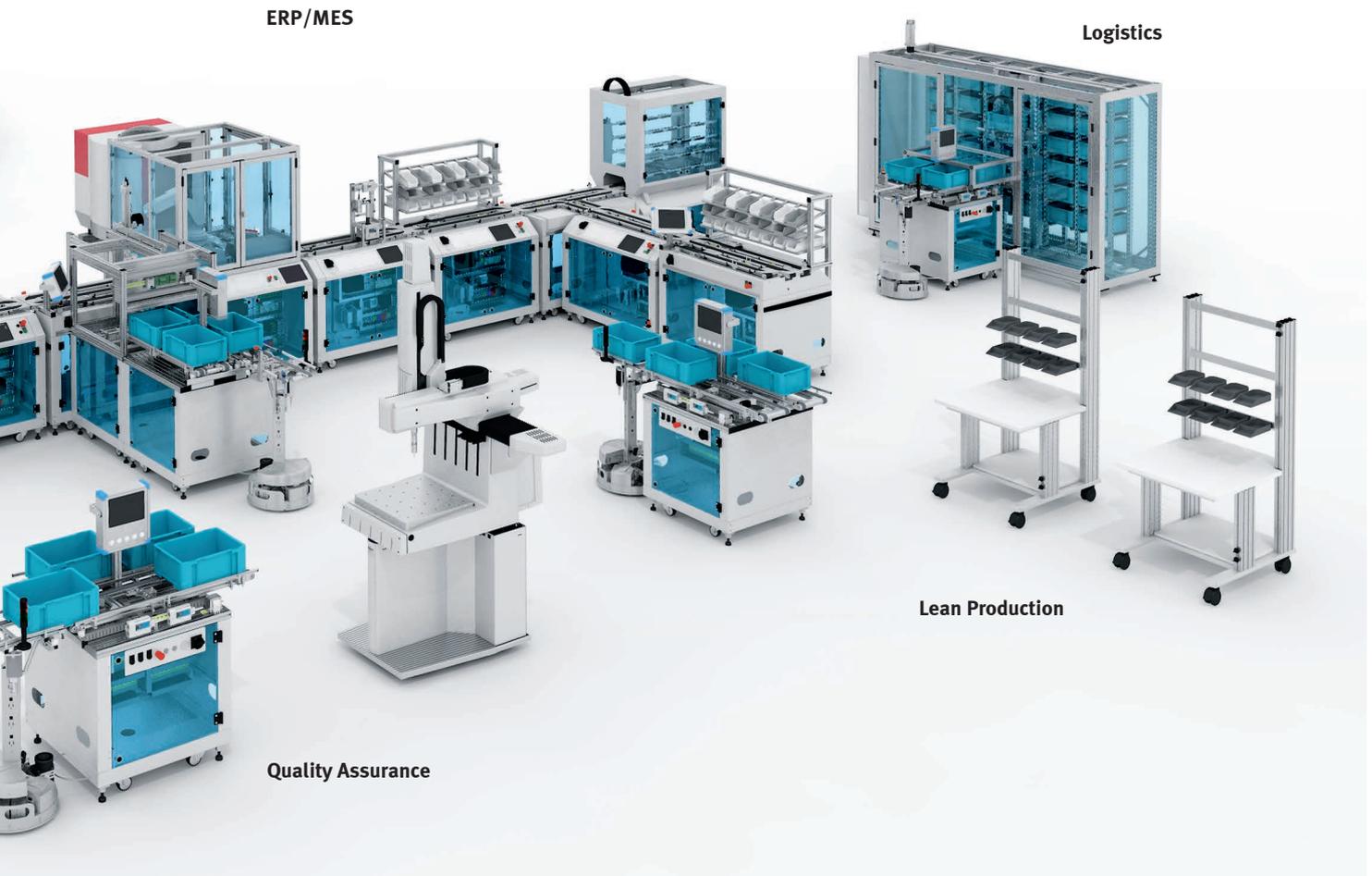
Training Area Production

CNC machines and flexible production systems play a major part in the creation of customised products down to the level of one-off production.

The CP Factory integrates CNC technologies for use in industrial training projects and scenarios. It therefore adds:

- Robot integration
- CAD/CAM products
- Simulation

Training Area Production Planning and Control/MES

In a modern factory, intelligent machines and workpieces communicate with each other and with the IT systems ERP (enterprise resource planning) and MES (manufacturing execution system) both inside and outside the factory, up to cloud level.

MES4 is Festo's MES for a smart factory, working with an Access database. For SAP users, the learning factory can be connected to SAP ME in a customised form. We are able to produce further MES and ERP links on request.

Training Area Lean Production

Industry 4.0 is also gaining ground in the field of lean production. Based on your requirements, we can offer facilities for producing anything from assembly cells to a supermarket with a "milkrun":

- Automated supply of materials to workstations
- RFID technology
- Avoiding errors through intelligent assembly monitoring
- Link to MES4
- Visualisation

Training Area Quality Assurance

From a caliper gauge to a fully-automatic 3-D measuring machine – all standard measuring devices can be integrated into the CP Factory as a quality laboratory.

The SPC module in the MES4 is used both to enter setpoints and carry out evaluations.

CP Factory
Versatile production for training and research

The smart (learning) factory

Flexibility, agility, openness to change and efficiency – these are the demands made on the production of the future. The CP Factory meets this demand with:

- Standardised and mobile factory modules
- Open interfaces which conform to industrial standards
- Plug & produce methods

As a learning platform for Industry 4.0, the CP Factory has the following valuable features:

- Motivating, practical project exercises
- Information on Industry 4.0 relevant to the training topic in question
- Key topics such as RFID, NFC and cloud computing
- Step-by-step introduction of CPS
- Fast conversion for various training scenarios
- Internal differentiation thanks to different application modules
- Versatility demonstrated by the autonomous Robotino®
- Flexible robot cells with cameras to industry standard
- Solid introduction to reliable machine networking

RFID

One of the major objectives of Industry 4.0 is to produce individualised products on a one-off basis for the same costs as series-produced products. To achieve this, each individual workpiece needs to be clearly identified and tracked.

In the CP Factory, the digital product memory based on RFID technology is used to control the transport of individual products to the processing stations. These react to the RFID data and carry out the appropriate production step.

Versatility

The basic modules can be equipped with a number of application modules. Thanks to the use of standard interfaces, application modules can be interchanged in just a few minutes. Uniform pre-assembled system cables permit fast layout changes and commissioning operations. The production cell with transport branching facilitates the creation of many different layout variants.

The autonomous robot system Robotino® supports this intralogistical versatility through its self-navigation facility and free selection of destinations at the click of a mouse.

Energy monitoring

Integrated energy monitoring permits the acquisition of electrical and flow-rate data. The focus of the training can thus be extended to current topics such as energy-efficient and energy-flexible production.

With web-based visualisation the energy flows at various terminal devices can be displayed and assessed.

The "Smart Grid" learning software EiSLab® enables the CP Factory to be reintegrated into a virtual smart grid and displays the relationships between the various load devices, storage devices and power generators.

Production control systems

The production control system MES4, which has been developed specially for use in learning factories, brings together all the most important production data. Open databases and transparent interfaces form the ideal basis for learning and experimentation.

With the "Service Oriented Architecture" (SOA) of the MES4 production cells can be called up as necessary – a major advantage in comparison with conventional and hierarchically structured software architectures.

Simulation

Simulation and virtual commissioning save time and money during machine construction and offer a clear and effective training tool. Trainees can work in groups to program and simulate models using real programming languages and then use these in the hardware environment provided. We supply CIROS®, which is a powerful, industry-tested platform for 3D simulation modules in automation technology.

Gaining qualifications for the production of the future
Industry 4.0 in a worldwide network

Global networking

Each factory and its components form part of a large network. This applies to both physical objects such as semi-finished and finished products and also a variety of data.

Industry 4.0 delivers a clear benefit by optimising and intensifying networking at all levels. What's more, networking and data management generate additional business opportunities based on big data and non-location-specific cloud applications.

Our CP Factory offers many interesting project exercises for this and other Industry 4.0 topics such as:

- Logistics
- IT systems
- Networking
- IT security
- CP Factory Cloud

Teleservice Remote Expert

Cloud

WLAN NFC

Supply Chain   Logistics and Distribution   Intra Logistics
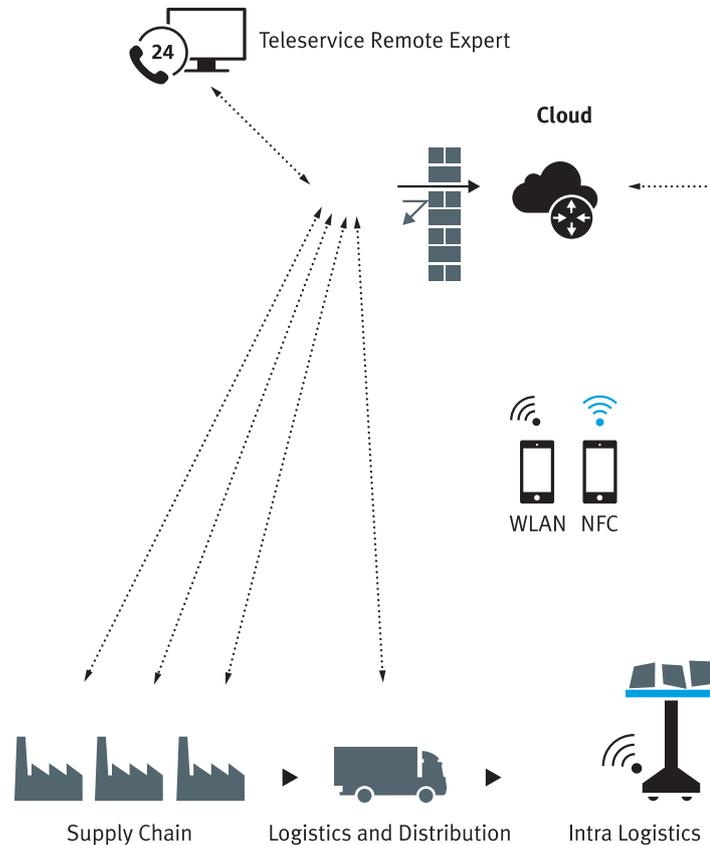
Logistics

When combined with the CP Factory, the proven mobile robotic platform Robotino® is a universal, highly-flexible logistics component with the following characteristics:

- Intelligence
- Autonomy
- Networking

Robotino® is used for internal transport functions within the CP Factory but also represents a logistics system with worldwide networking.

IT systems

IT systems such as SAP are widely used in many companies. For the CP Factory, a direct interface for SAP ME (SAP's MES) was created in consultation with SAP. This extends the possible applications of the CP Factory to cover business management topics.

Festo and SAP offer a curriculum for Industry 4.0 and SAP ME which is available via the SAP University Alliance and Festo Didactic.

SAP
University
Alliances

24 Remote Services

Intranet

ERP   MES

VPN

CP Factory Partner Facility

Router

Secure WLAN

Switch

Automation Network

RFID

Internet

Fieldbus/DeviceNet   Intra Logistics   Shipping and Delivery   Customers

CP Factory Local Facility
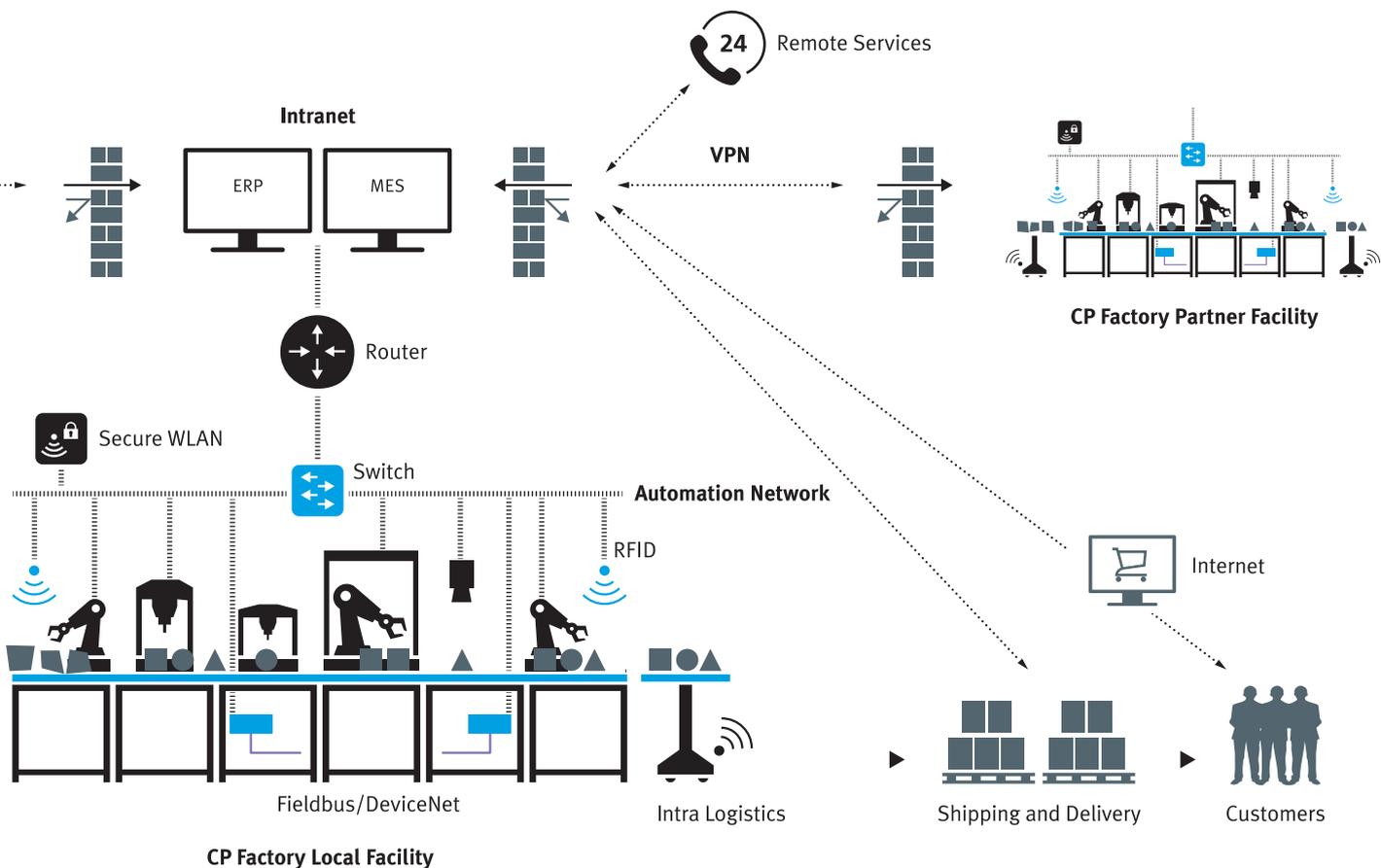
Networking

A major prerequisite for the implementation of Industry 4.0 is the seamless networking of machines and plants together with all relevant IT systems up to and including the Internet.

The CP Factory covers all relevant communications systems and thus allows a comprehensive simulation of industrial reality:

- Fieldbus
  (sensor/actuator level)
- Automation Network
- LAN
  (local area network/MES)
- WLAN (wireless local area network/mobile devices, Robotino®)

IT security

Machines and plants must be protected against unauthorised access. As requirements are constantly increasing, a successful implementation of Industry 4.0 also necessitates comprehensive training for all skilled staff.

Trainees learn about protective measures and put these into practice in the learning factory using the products of Cisco:

- VPN for non-location specific communication
- Network security
  (layer 2 and layer 3)
- WLAN security

CP Factory Cloud

The facility for connecting to a professional cloud computing system offers new possibilities for data exchange, storage and analysis.

CP Factory Cloud is a way of introducing trainees and students to the topic of cloud computing in a protected environment and also encourages collaborative projects across different sites.

CISCO ™

We will make you ready!

Our contribution to your teaching

Forum

With our Industry 4.0 Forum, we provide you with a comprehensive platform for exchanging ideas.

You can search for answers to questions about topical subjects and start discussions with colleagues. There is also a library for training materials where you can download documents or upload your own documents.

This forum is moderated and maintained by us.

Courseware

A wide range of different teaching materials is available to ensure the training is effective. We offer suitable courseware documentation for everything from project descriptions through to individual working situations and complex interdisciplinary tasks.

**E-learning
(Web Based Training)**

Training programs from Festo Didactic are flexible and offer tutors room to be creative and increase students' motivation. Our many familiar training programs are being expanded with newly-developed material for Industry 4.0.