fischertechnik

LEARNING FACTORY 4.0 24V

TRAINING FACTORY INDUSTRY 4.0 24V
FÁBRICA DE FORMACIÓN INDUSTRIA 4.0 24V

Accompanying booklet

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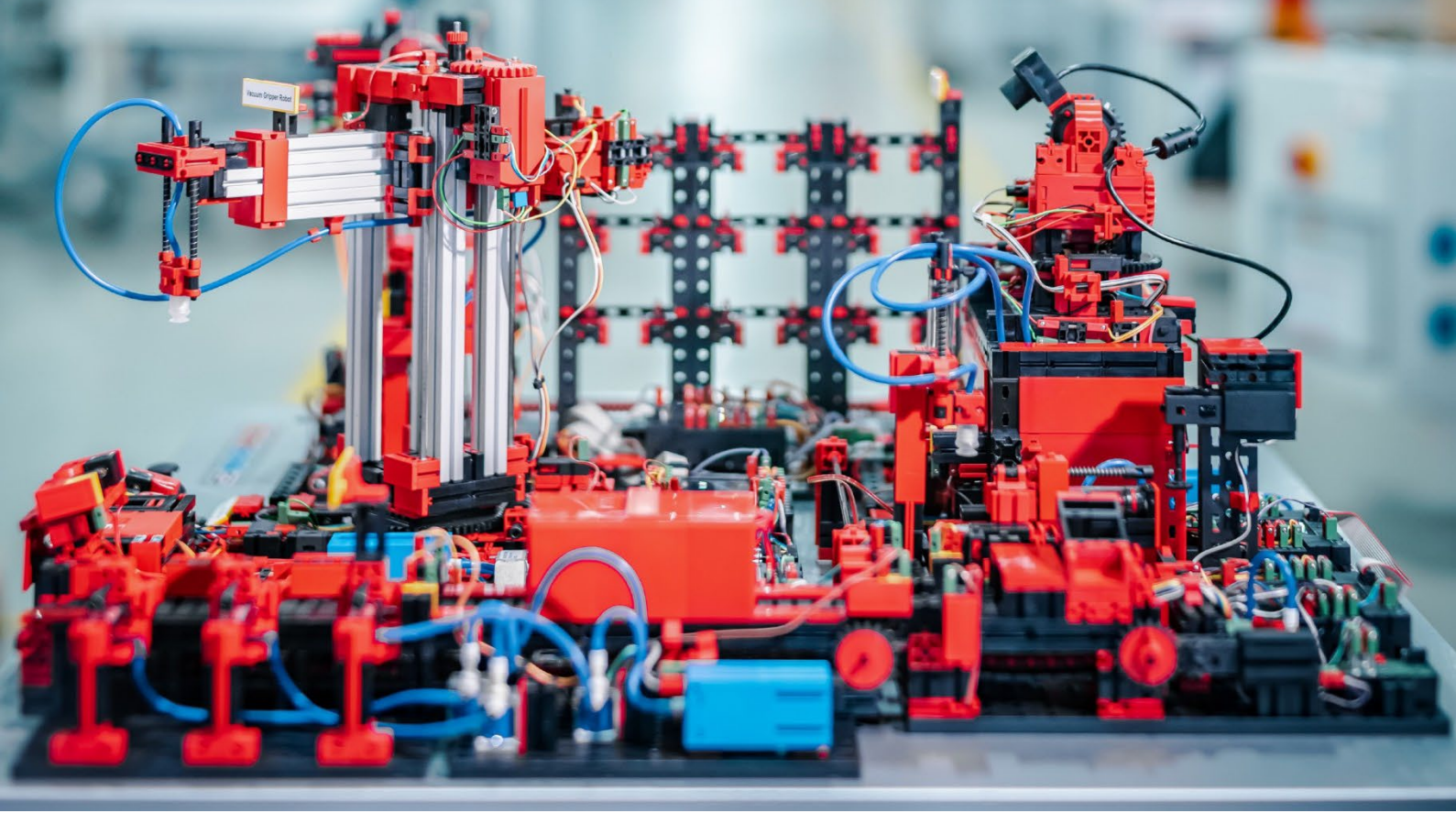

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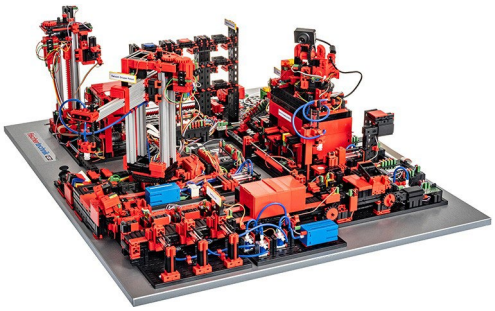
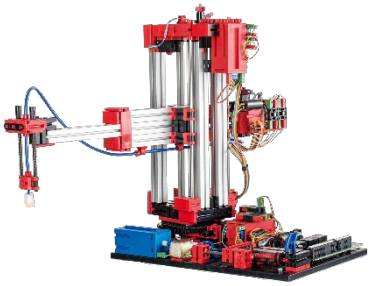
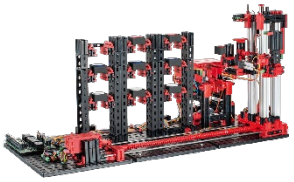
Introduction

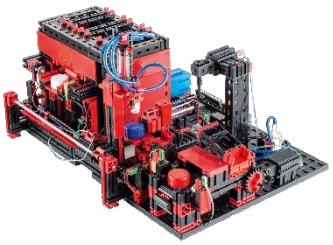


Digitalization in industrial production requires greater networking and more intelligent information at all levels of production. With the fischertechnik Learning Factory 4.0, these digitalization activities can be simulated, learned and applied on a small scale before they are implemented on a large scale.





A highly flexible, modular, cost-effective and robust training and simulation model that is extremely useful.

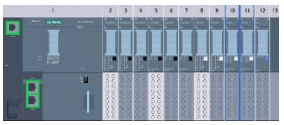


The fischertechnik learning environment is used for learning and understanding Industry 4.0 applications in vocational schools and training as well as for use in research, teaching and development at universities, in companies and IT departments. The simulation depicts the ordering process, the production process and the delivery process in digitized and networked process steps.

It consists of the factory modules storage and retrieval station, vacuum suction gripper, high-bay warehouse, multi-processing station with kiln, a sorting line with color recognition, an environmental sensor and a swiveling camera.

After ordering via the dashboard in the fischertechnik Cloud, the workpieces pass through the respective factory modules. The current status is displayed in the fischertechnik Cloud. The integrated environmental sensor reports values for temperature, humidity, air pressure and air quality. The camera sees the entire system thanks to the vertical and horizontal swivel range and can therefore be used for web-based remote monitoring.

The individual workpieces are tracked using NFC (Near Field Communication): each workpiece is given a unique identification number (ID). This enables the current status of the workpieces in the machining process to be tracked and made visible.

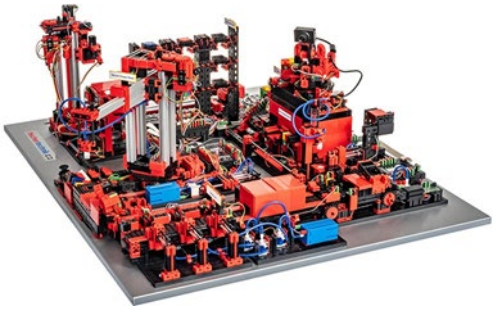


The Learning Factory 4.0 can be controlled by a SIMATIC S7-1500 programmable logic controller (PLC) from SIEMENS.

Note: Control systems from other manufacturers can also be used here. Depending on the control system, the source codes can then be imported to create the programs, which can be found under:
https://github.com/fischertechnik/plc_training_factory_24v/tree/master/PLC_SCL_sources
are available.

A TXT 4.0 controller serves as an MQTT broker and interface to the fischertechnik cloud. MQTT (Message Queuing Telemetry Transport) is an open message protocol that enables the transfer of data in the form of messages between devices.
Communication between the PLC and TXT controller takes place with the help of an IoT gateway via OPC UA. OPC UA (OPC Unified Architecture) is a standard for platform-independent data exchange.

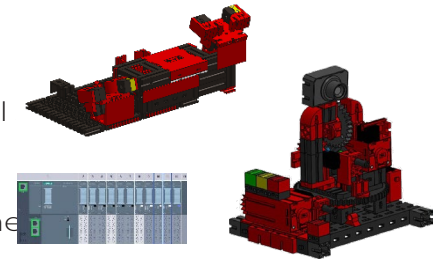
Industry 4.0 New developments for the Learning Factory 4.0



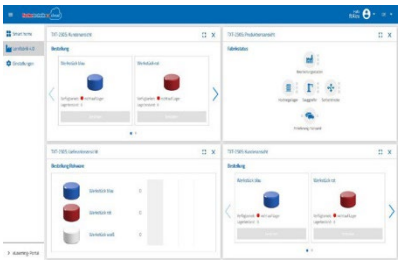
The basis for the development of the Learning Factory 4.0 is the already well-known fully automated fischertechnik factory simulation.

Here, the vacuum suction gripper loads the storage and retrieval unit with workpieces. This stores the workpieces in the high rack, sorted by color. The workpieces are then transported to the multi-processing station and processed there. The processed workpieces are then sorted by color in the sorting line and transported to storage locations. From there, the vacuum suction gripper transports the workpieces back to the high rack. This is an endless, repetitive cycle.

The contents of the Learning Factory 4.0 are:



- Additional input/output station with quality control
- Sensor station with integrated camera and environmental
- A SIEMENS PLC SIMATIC S7-1500 as controller (for item no. 560840 included in the scope of delivery of the Learning Factory 4.0 included)
- Sample programs written for SIMATIC S7-1500 in high-level language
- Connection to the fischertechnik Cloud
- TXT 4.0 Controller as MQTT broker and interface to the fischertechnik Cloud
- IoT gateway (Raspberry Pi 4) with Node-RED
- Identification of workpieces via NFC/RFID
- Integrated WLAN router
- Display and use of data in a dashboard in the fischertechnik Cloud
- Display of data and calibration of the stations in a Node-RED dashboard
- Display of the current system status using a traffic light



The individual innovations are explained in more detail in the following chapters.

The following variants are also available for Learning Factory 4.0 24V:

- **554868 Learning factory 4.0 24V**

  Learning Factory 4.0 24V without PLC and without PLC connection board.

- **560841 Learning factory 4.0 24V w. PLC connection board**

  Learning factory 4.0 24V without PLC but with PLC connection board and a desktop power supply 24V, 280W. Own PLC can be connected via PLC connection board.

- **560840 Learning factory 4.0 24V compl. w. PLC S7-1500**

  Learning factory 4.0 24V complete with PLC S7-1500 and with PLC connection board and a desktop power supply 24V, 280W.

Software for the SIEMENS PLC SIMATIC S7-1500

The SIMATIC S7-1500 is programmed using the TIA Portal version 18 with the Structured Text programming language (ST or SCL)

Software for TXT 4.0 Controller

The software applications are written in Python in ROBO Pro Coding and are already loaded onto the controller ready to start. The current example "GatewayPLC" can be imported directly into ROBO Pro Coding.

Software for the IoT gateway

A ready-made Node- RED application is already loaded on the IoT gateway.

Node-RED is described here as open source software from the OpenJS Foundation:

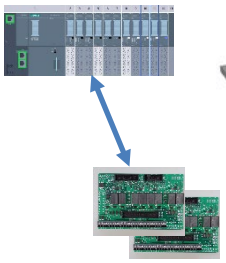
https://nodered.org.

First steps

After carefully unpacking the Learning Factory 4.0 and removing the transport lock, carry out a visual inspection to check whether any components have come loose or been damaged during transportation. If necessary, reattach any loose components in the correct position. Check that all cables and hoses are connected. You can use the wiring diagrams to correctly connect any cables that are not connected.

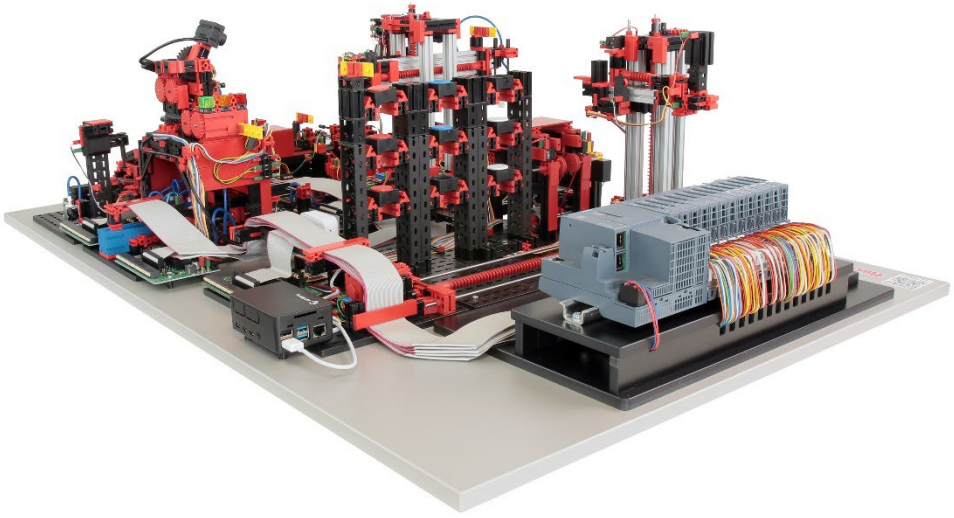
554868 Learning factory 4.0 24V

Connect the adapter boards of the learning factory to the PLC. This can be done either with ribbon cables to the corresponding 34-pin connections ST1 or via the terminals. Note: Further details on the assignment of the adapter boards can be found in the chapter Assignment diagrams of the factory modules.



560840 Learning factory 4.0 24V compl. w. PLC S7-1500

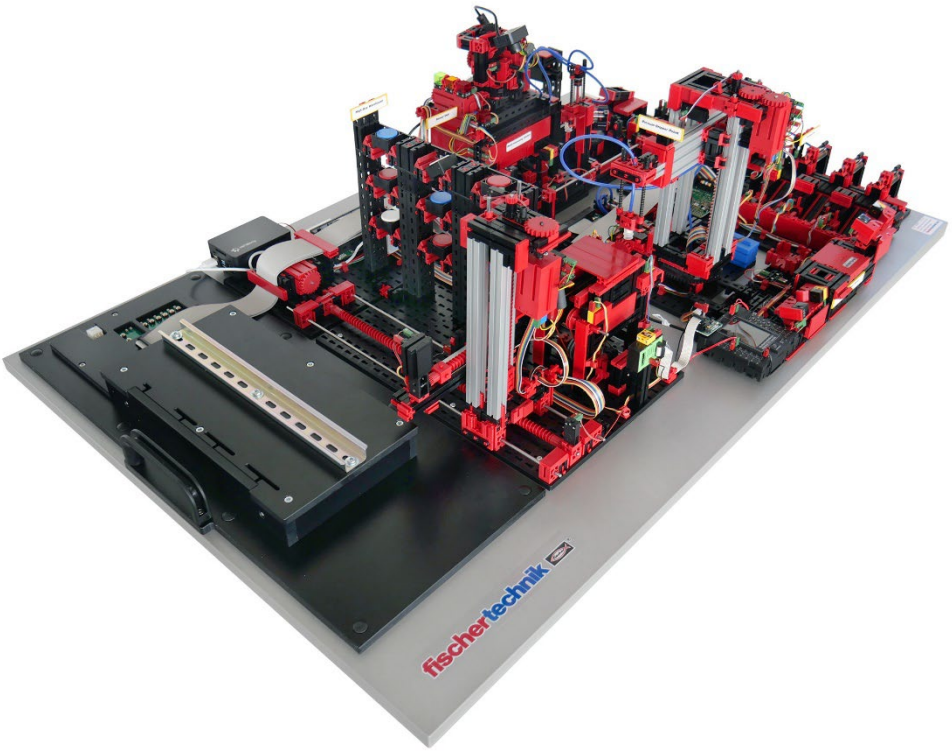
Please note that the learning factory with PLC is already calibrated on delivery.



560841 Learning factory 4.0 24V w. PLC connection board

Mount the PLC on the top-hat rail on the PLC connection board and connect the PLC to it.

Note: Further details on the assignment of the PLC connection board can be found in the chapter PLC connection board assignment diagrams and factory module assignment diagrams.



560841 Learning factory 4.0 24V w. PLC connection board and 560840 Learning factory 4.0 24V compl. w. PLC S7-1500

PLC SIMATIC S7-1500 is already connected to the TP-Link router via a supplied network cable and to the IOT gateway (Raspberry Pi 4) via a second network cable.

Note: See also the chapter Network structure of the factory installation

Now prepare the 24V power supply for the Learning Factory 4.0:

554868 Learning factory 4.0 24V

Please use an external 24V power supply unit (recommended min. 10A). This power supply unit is not included with this variant.

560841 Learning Factory 4.0 24V w. PLC connection board and
560840 Learning Factory 4.0 24V compl. w.
PLC S7-1500

The 24V power supply unit is connected via the 6-pin connector on the PLC board. Now plug the 24V power supply unit into the socket.

Check the fuses on the PLC connection board. The six LEDs on the edge of the PLC connection board must now light up green.

To test, switch on the PLC and the TXT 4.0 Controller (ON/OFF). If everything works, the display should light up, the PLC and the TXT 4.0 Controller should start up and the indicator lights should light up.

Finally, fill the high-bay warehouse with the 9 empty black containers supplied.

560840 Learning factory 4.0 24V compl. w. PLC S7-1500:

With this variant, the following chapters can be skipped and the factory can be put into operation as described in the chapter Connecting the Learning Factory 4.0 to the Internet.