



Studica



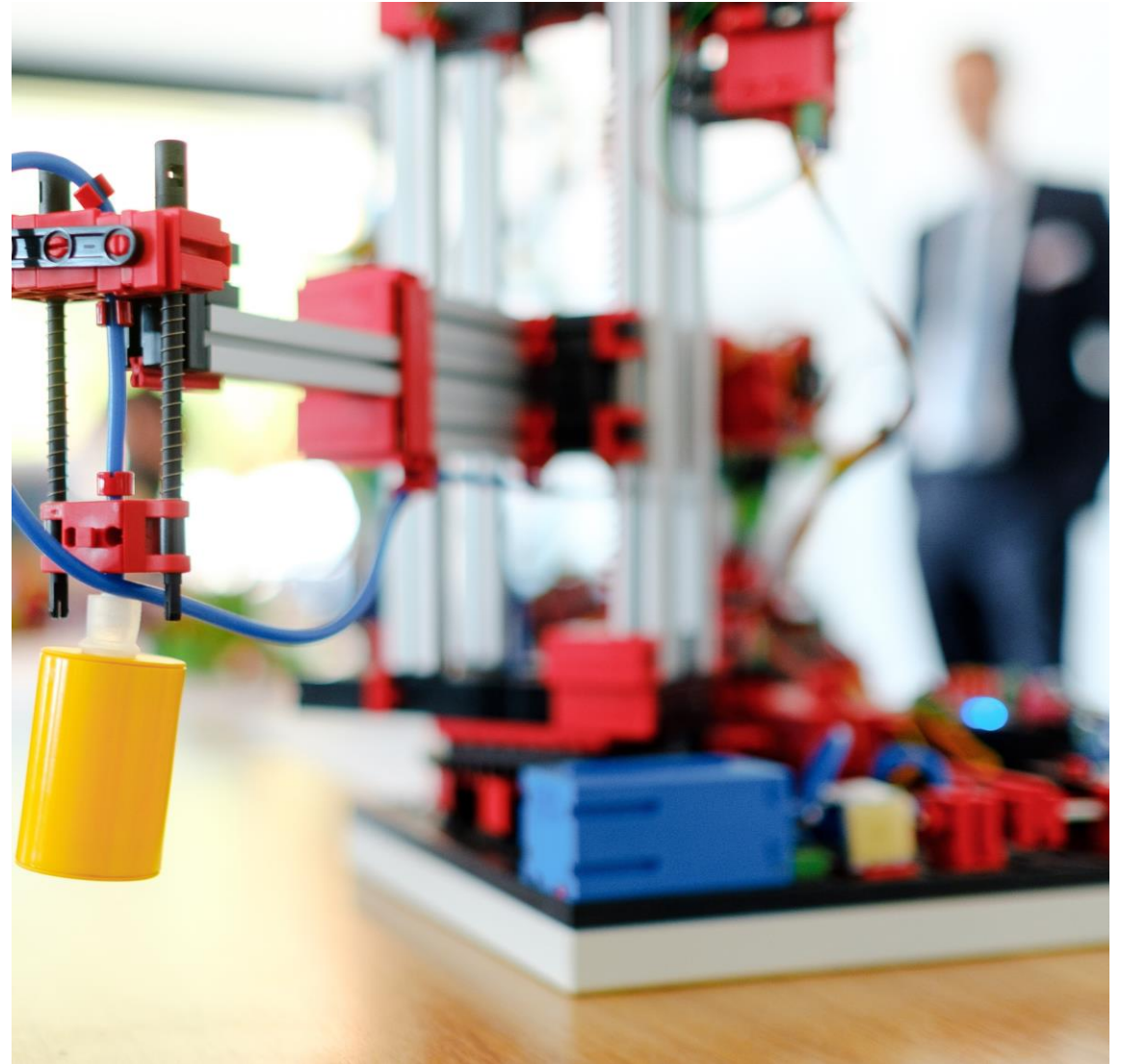
# Exploring Automation & Control Systems with FISCHERTECHNIK

Lance C Zurek  
Spring 2021

# Fischertechnik Industrial Simulation Models

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- High School CTE Training
- College & University Lab Use
- Incumbent Worker Training
- Workforce Development
- Trade Show Demonstrations
- Software Development
- Exploring and understanding IoT
- ...and more.



# The Skills Gap



STEM Skills Gap



STEM is an acronym -- Science, Technology, Engineering, and Mathematics



Probably the most discussed topic in education over past decade



Manufacturing: Then & Now |

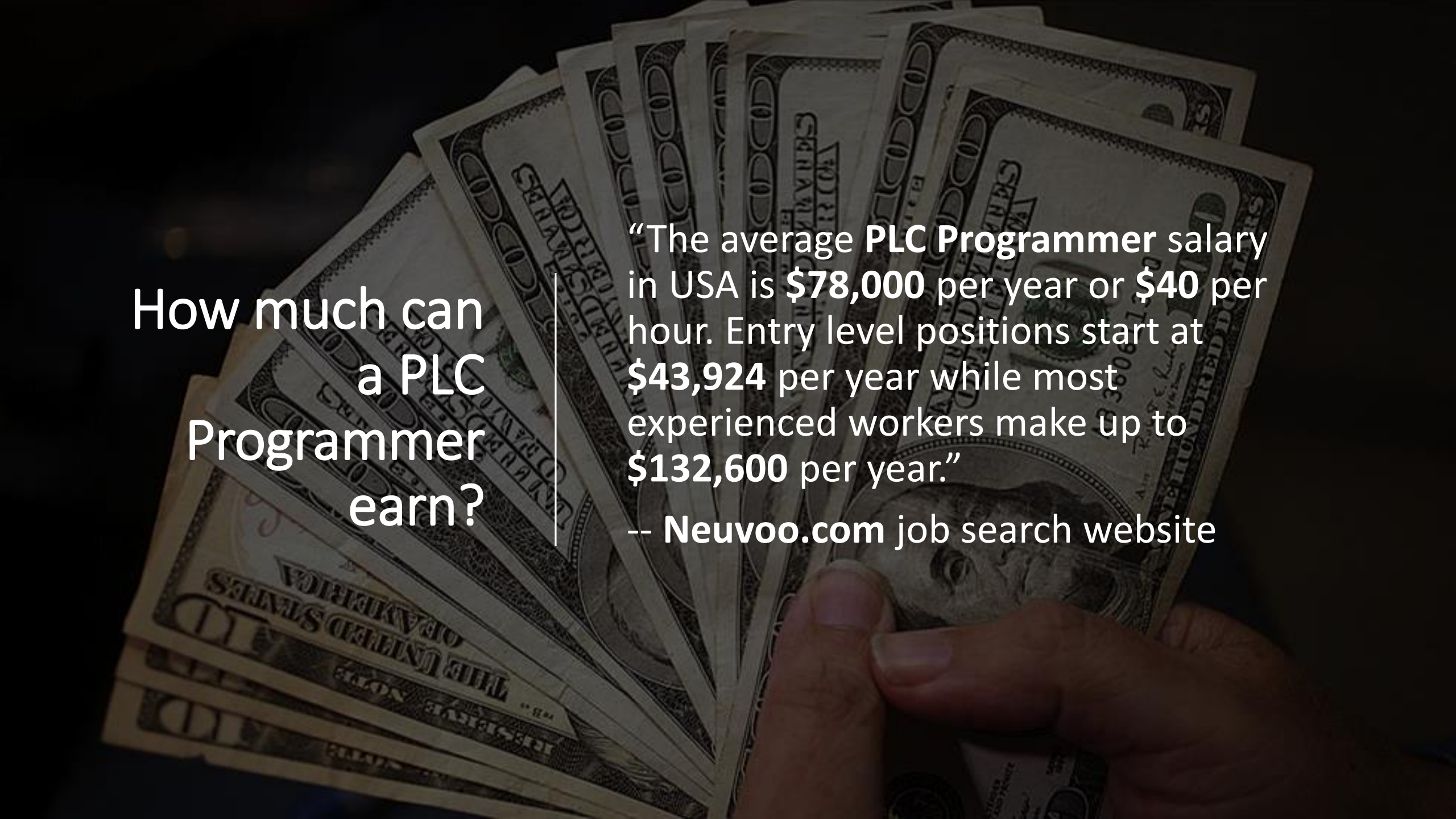


Manufacturing: Then & Now |



## PLC – Programmable Logic Controller

- PLC is a specialized computer used to control automated processes in modern manufacturing.
- As our dependence on automated control systems grows, so does the need for skilled programmers.



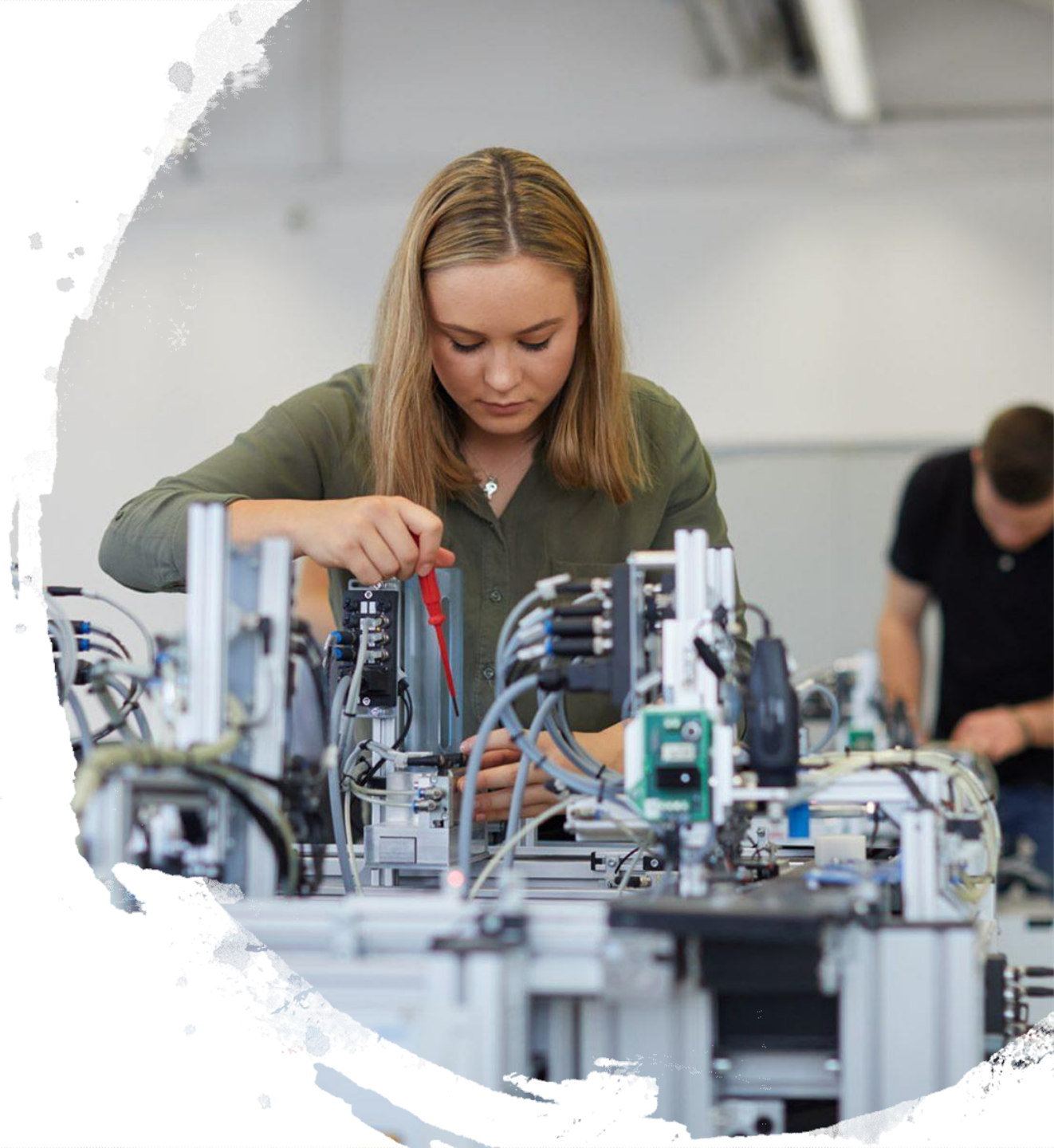
How much can  
a PLC  
Programmer  
earn?

“The average **PLC Programmer** salary in USA is **\$78,000** per year or **\$40** per hour. Entry level positions start at **\$43,924** per year while most experienced workers make up to **\$132,600** per year.”

-- [Neuvoo.com](https://www.neuvoo.com) job search website

# How Long Does It Take To Learn?

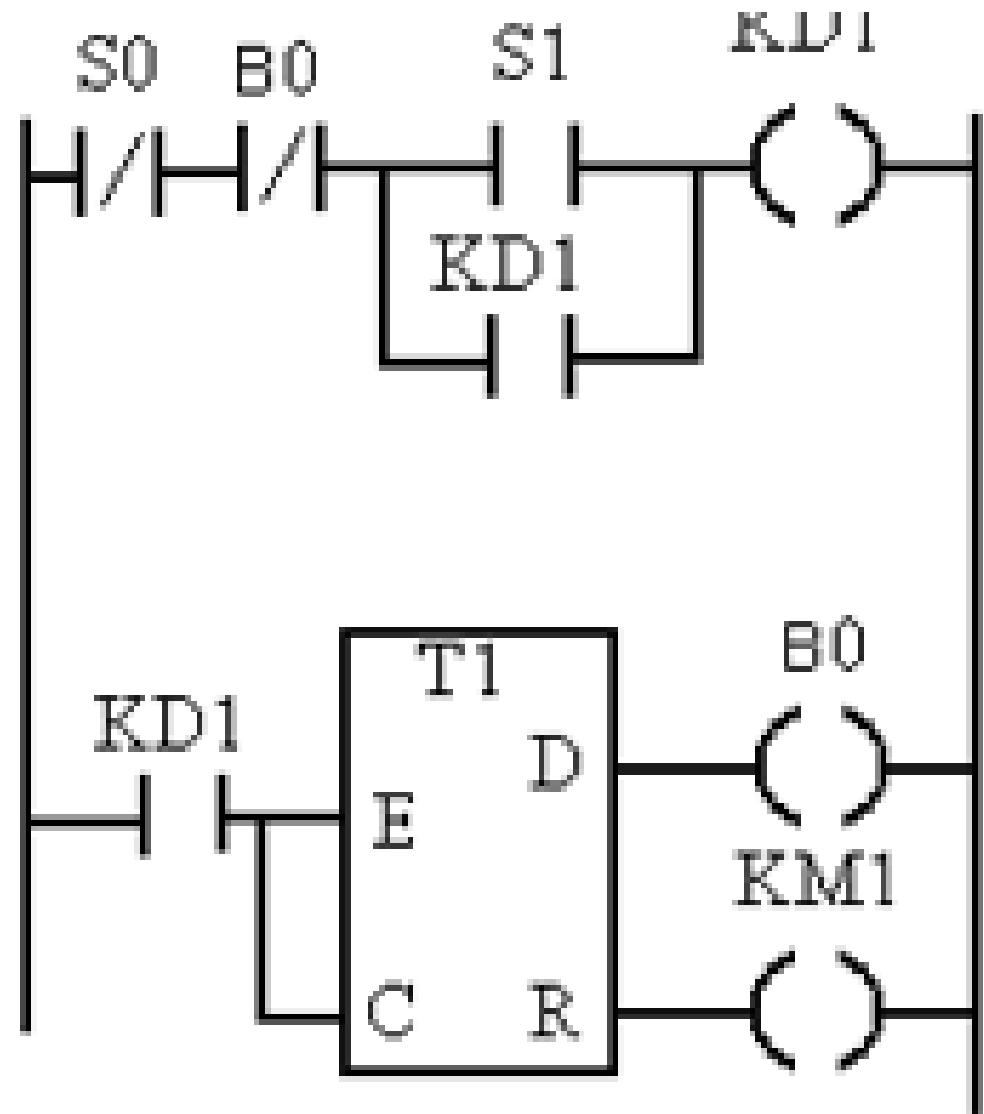
- Depending on background, *very* basic PLC skills could be learned in as little as 30 to 40 hours.
- To be truly proficient, more extensive training is required.





## Popular PLC Programming Languages:

- Ladder Diagram (**LD**)
- Sequential Function Charts (**SFC**)
- Function Block Diagram (**FBD**)
- Structured Text (**ST**)
- Instruction List (**IL**)



# PLC Training Options:

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- College and University Programs
- High School CTE (Career and Technical Education) Programs
- Adult Continuing Ed Programs
- Vocational Training
- Technical Training and Trade Schools
- Employer sponsored Incumbent Worker Training Programs



# The Dilemma for Educators:

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- How to make it relevant
- How to make it engaging
- How to make it realistic and “hands-on”



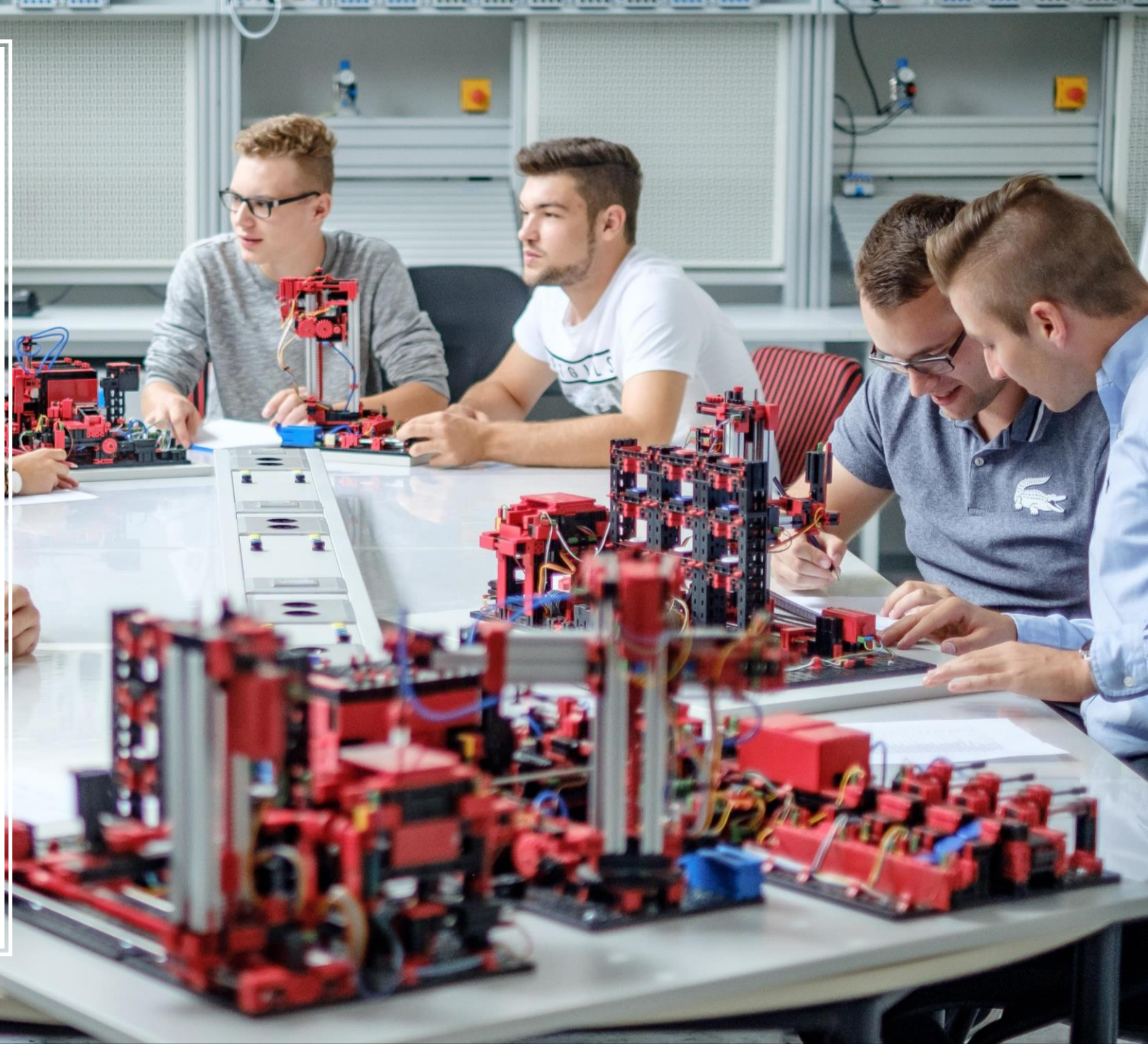


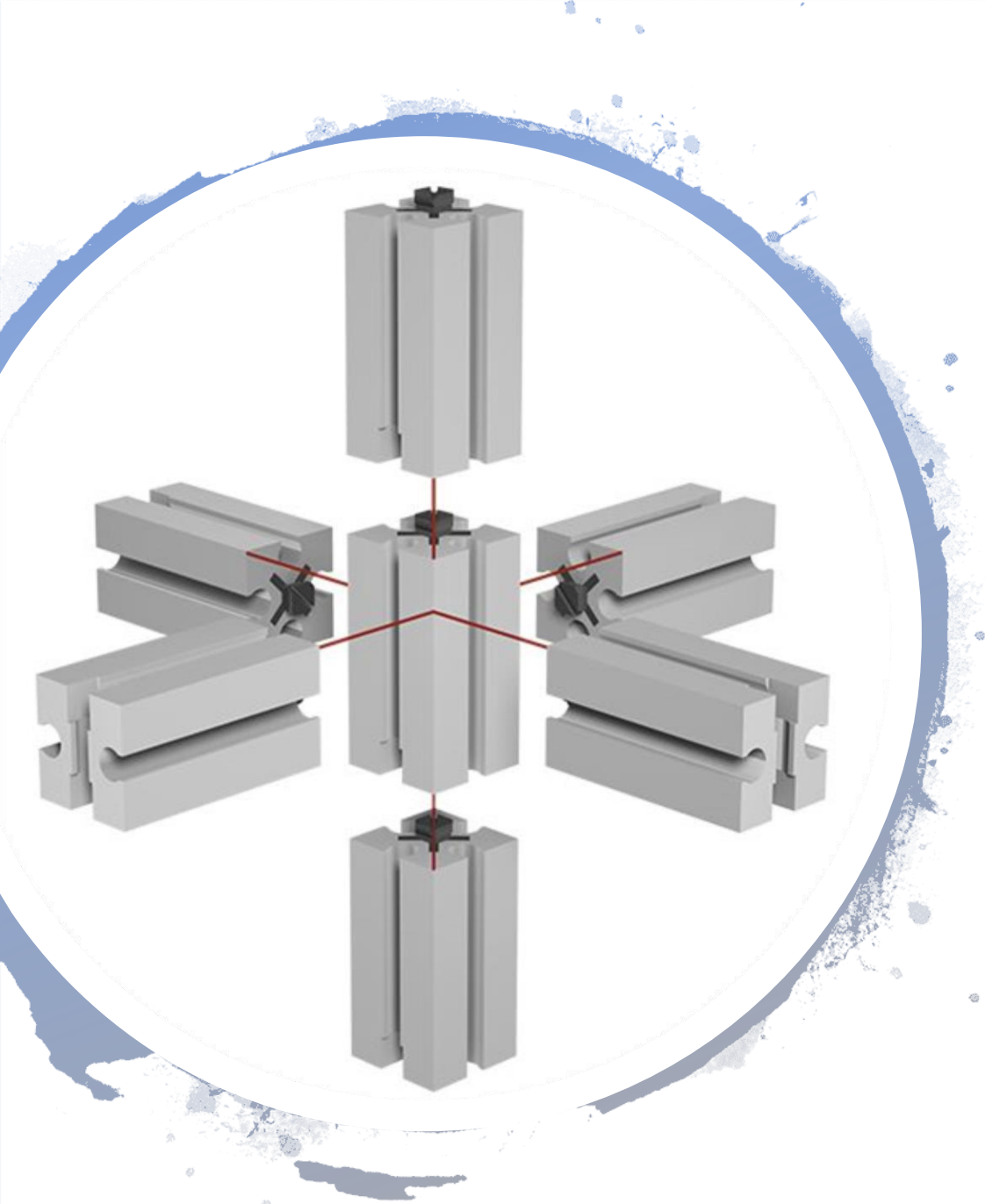
## Other Areas of Need

- Product and software development
- Logistics and production planning
- Automation and digitization
- Trade show demonstrations
- IoT (Internet of Things) and Cloud Based Control

# The fischertechnik Solution:

- A compact, engaging, and hands-on method for teaching and demonstrating high-end automated systems.
- Pre-assembled, table top models.
- Replicate in appearance and function automated systems found in commercial manufacturing.
- Highly affordable, cost-effective!





# What is fischertechnik?

- **fischertechnik** is the brand name for a technology-focused building system.
- Used in education for over 50 years.
- System is unique in that the core building component allows attachment from all six sides.
- Address very specific design needs.

# Artur Fischer, German Inventor

- Created fischertechnik in 1964.
- More patents than Edison (1100 total).
- Synchronized flash photography (1949).
- Expanding nylon wall plug (1958).
- Founder of fischer Group

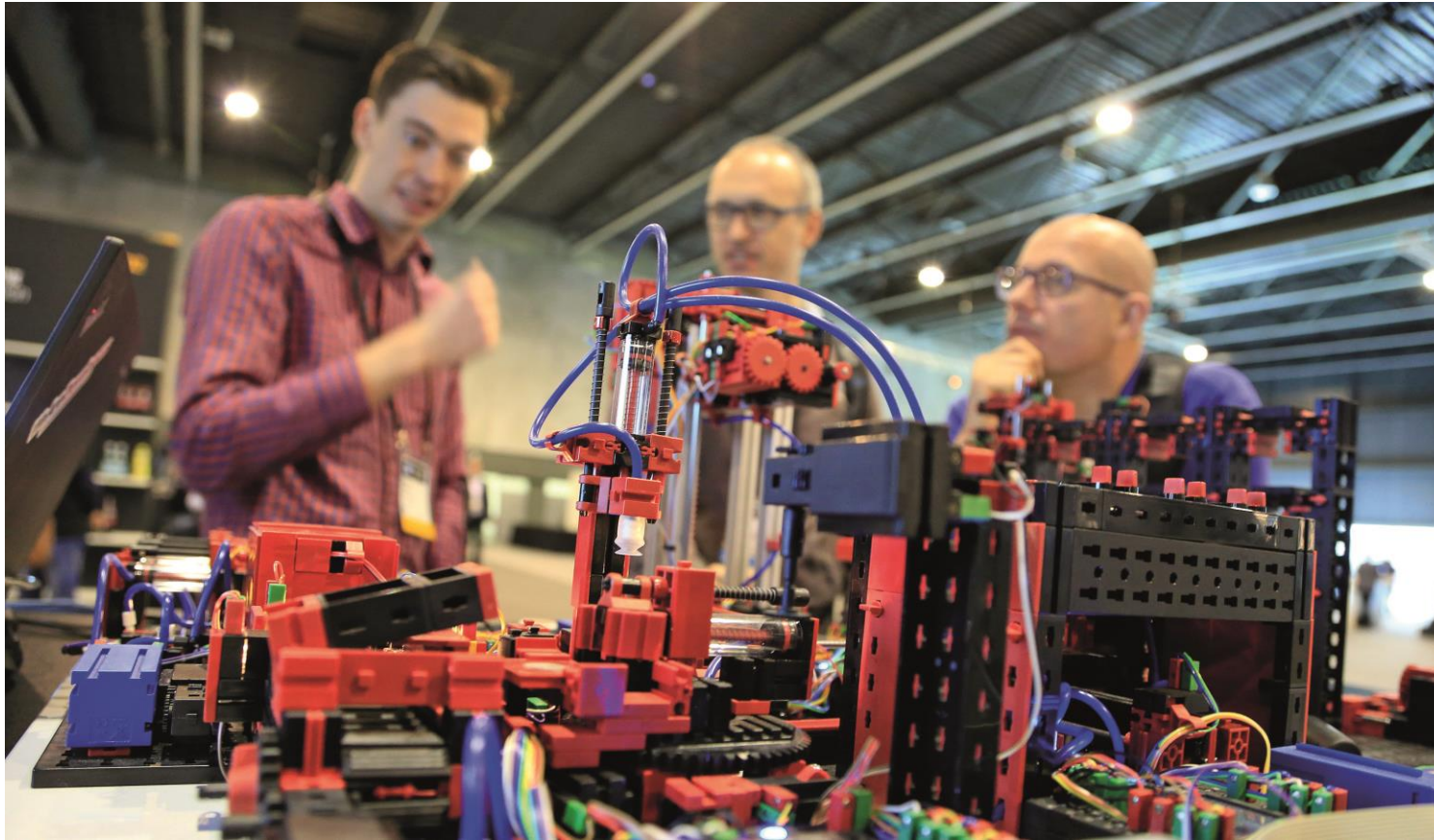




## fischertechnik and Education

- Technology focused building sets.
- STEM topics: mechanics, pneumatics, renewable energy, robotics, etc.
- Standards-focused, curriculum based classroom programs.
- Project-based learning.





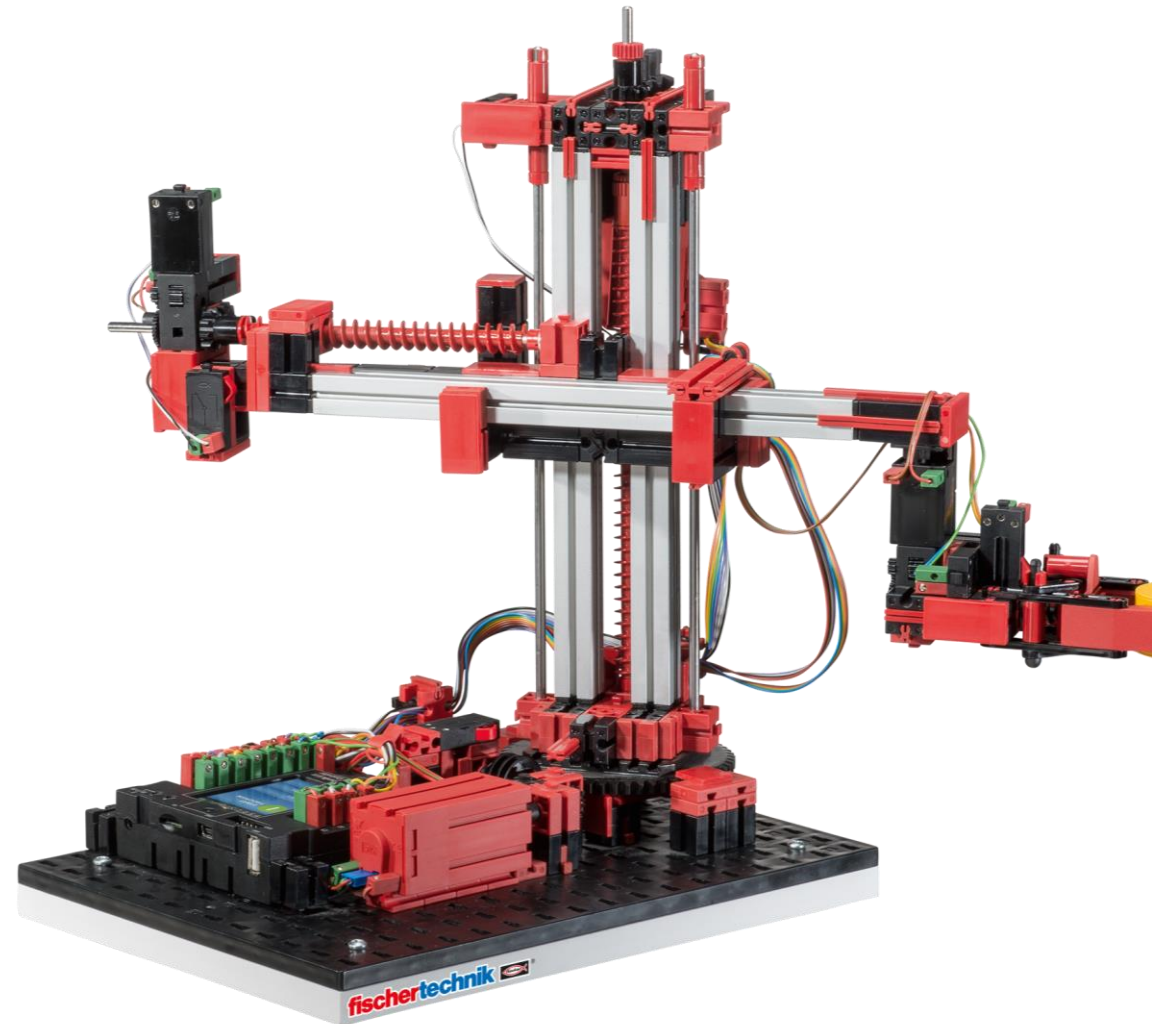
## fischertechnik Simulation Solutions

- Pre-assembled.
- Small scale, table top sized models.
- Realistically replicate—in appearance and in function—automated and robotic machines and systems.

# fischertechnik Simulation Solutions

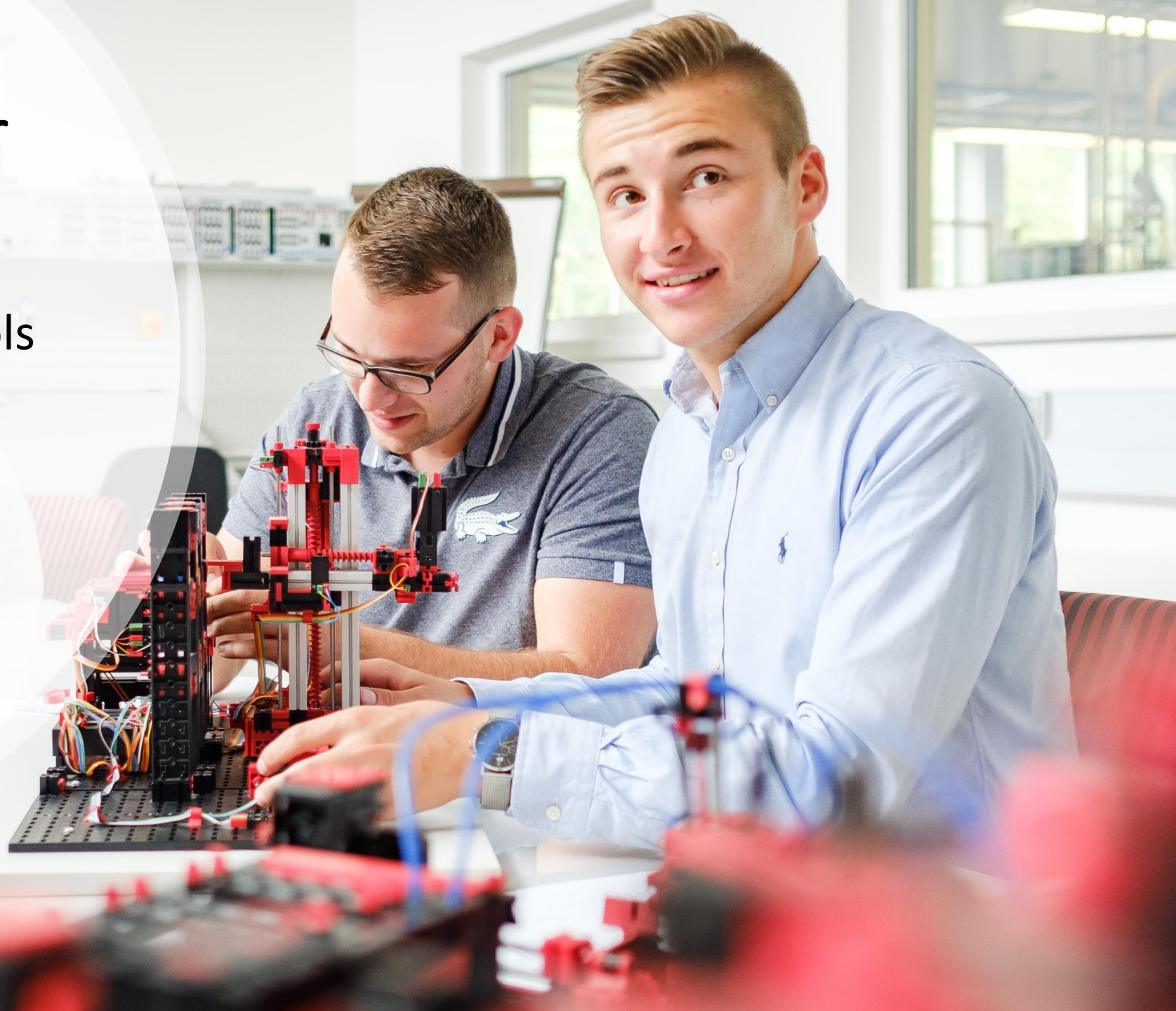
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- Conveyor belts
- Punching machines
- Three axis pick-and-place robotic arms
- Color sorting lines
- High-bay warehouse storage systems
- Complete material cycles



# Hands-On Tools for Education

- Engaging, hands-on tools for teaching, exploring, and understanding various aspects of automation and programming.



Advantages of  
fischertechnik  
Simulation  
Models



## Realistic in Appearance & Function

- Realistically replicate—in appearance and function—common automated systems such as conveyor belts, sorting machines, robotic arms, and more.





## Compact, Table -Top Size Models

- Classroom
- Office
- Trade Show



High Quality,  
German Engineered  
Products

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Assembled by hand.

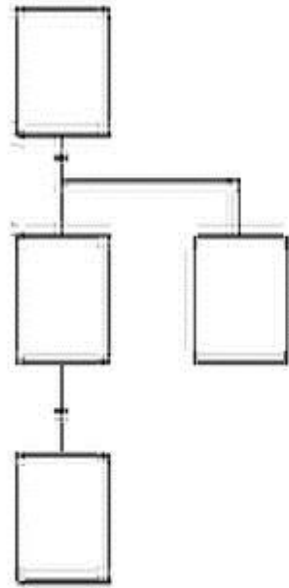
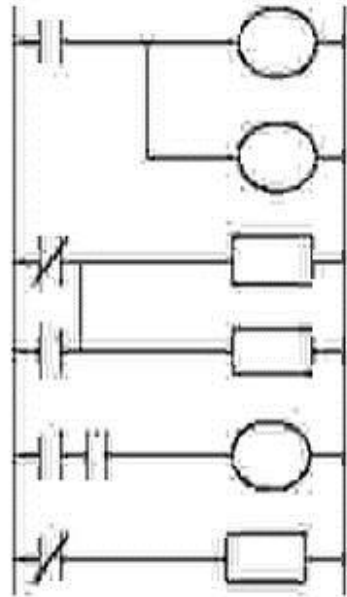


Standard 24V versions for  
use with PLC

- Allen-Bradley
- Siemens
- Honeywell
- Mitsubishi
  
- GE
- and others.



LD X10  
OUT Y7  
AND M38  
SET S5  
LD X21  
OUT T01  
K40



Instruction format

Ladder Format

SFC Format

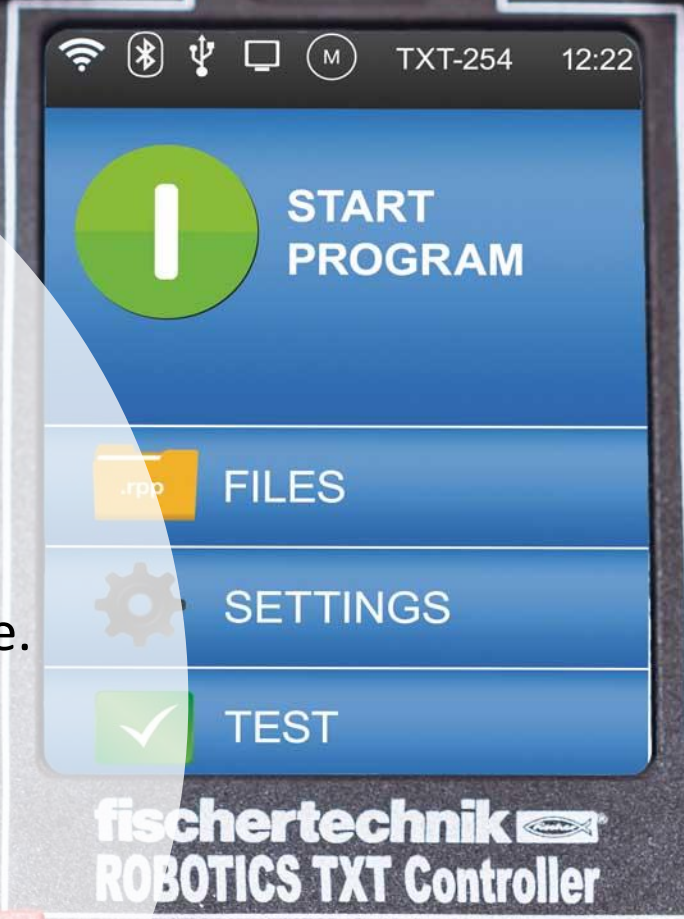
- Ladder Diagram (**LD**)
- Sequential Function Charts (**SFC**)
- Function Block Diagram (**FBD**)
- Structured Text (**ST**)
- Instruction List (**IL**)

# PLC Programming Languages

## Select 9V versions also available

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- Ideal for classroom and non-industrial use.
- ROBO Pro graphic software.
- fischertechnik ROBOTICS TXT Controllers.





# Ideal for IoT Applications

- “Internet of Things”
- Cloud-based control and monitoring of automated processes and systems.



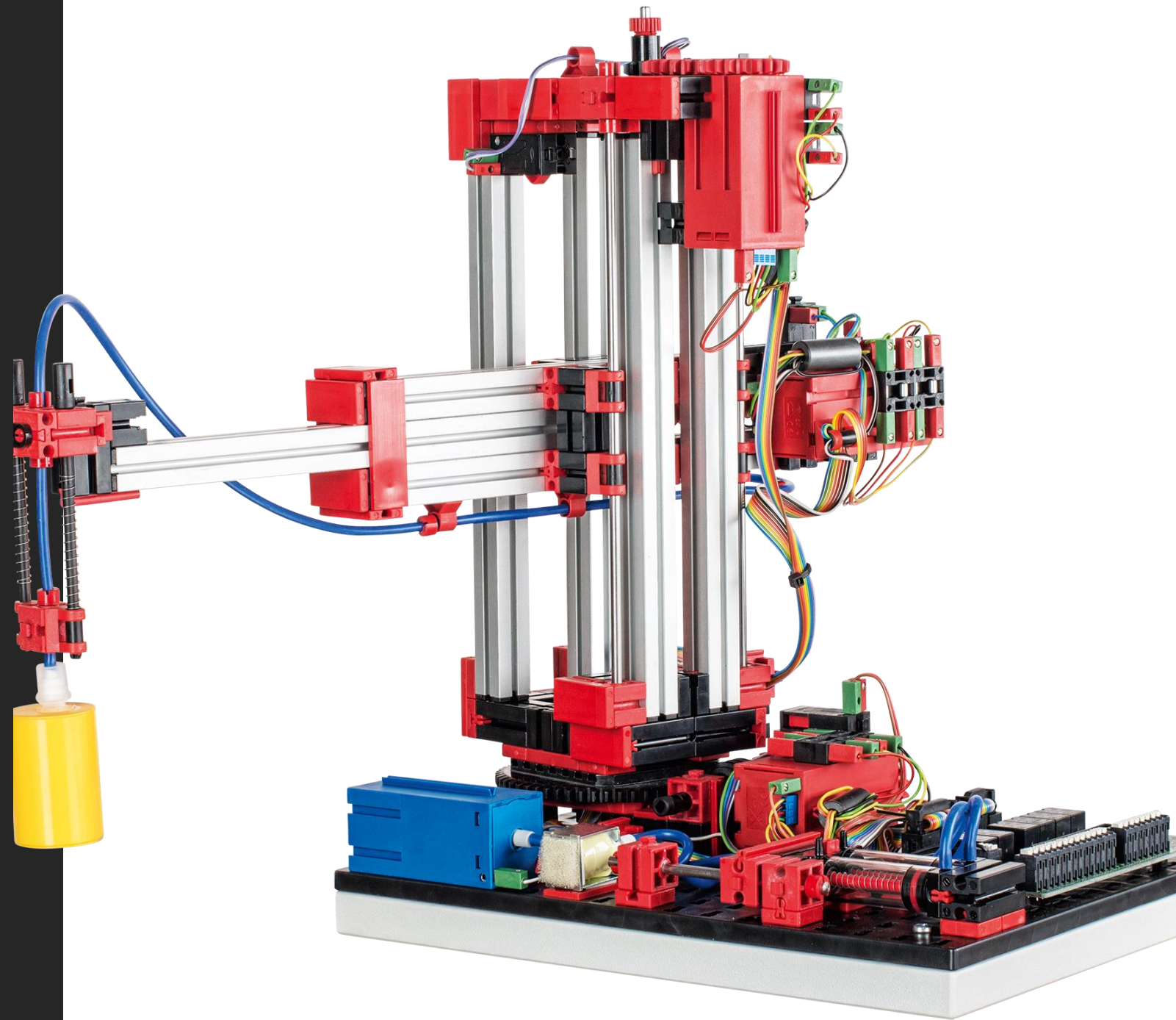
Highly Affordable and Cost-Effective

- While competing hardware based simulation solutions can easily start at \$20,000 to \$30,000...or much more, fischertechnik solutions are available for only a fraction of that price!

Let's get started with our overview...

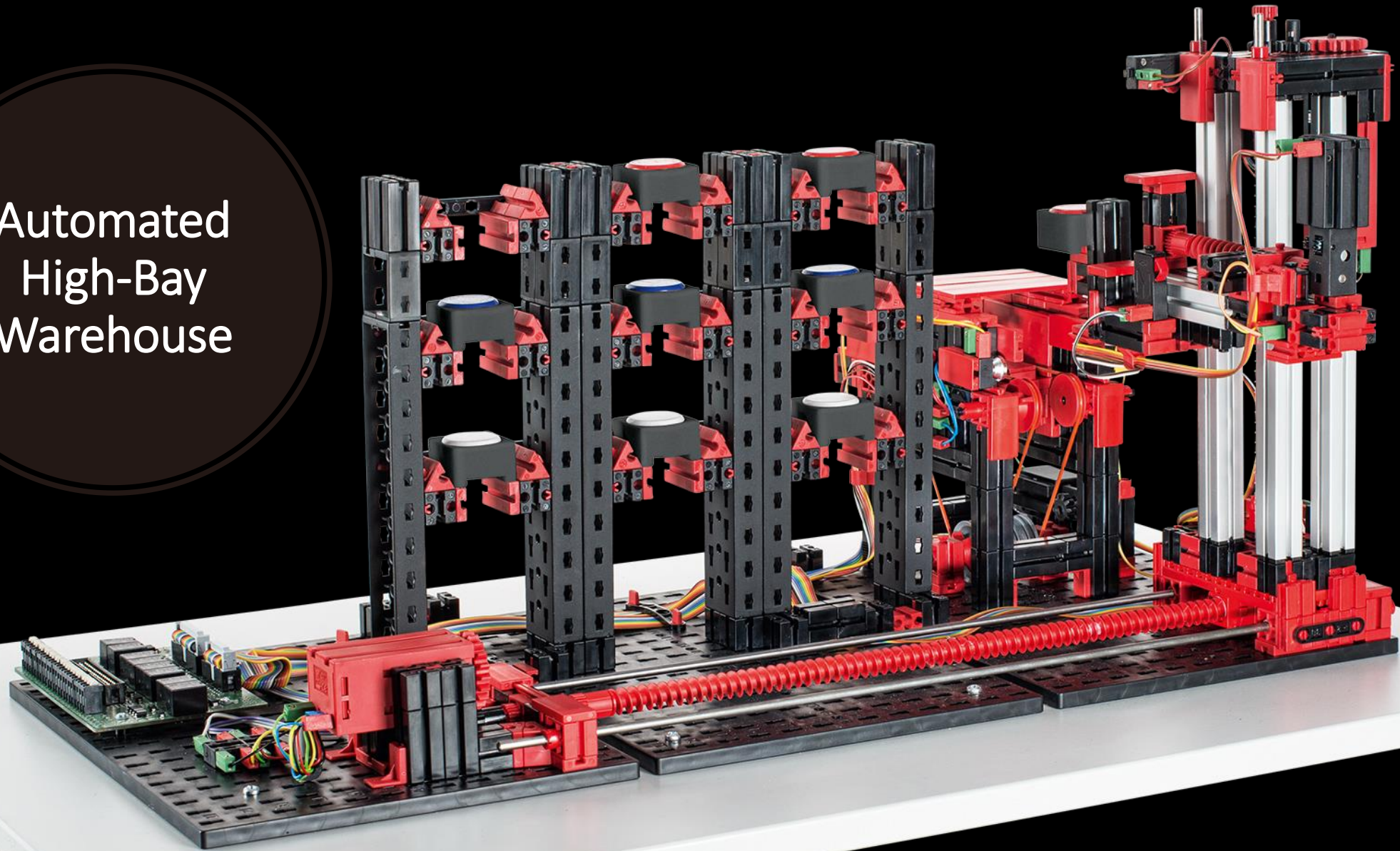


# Vacuum Gripper Robot





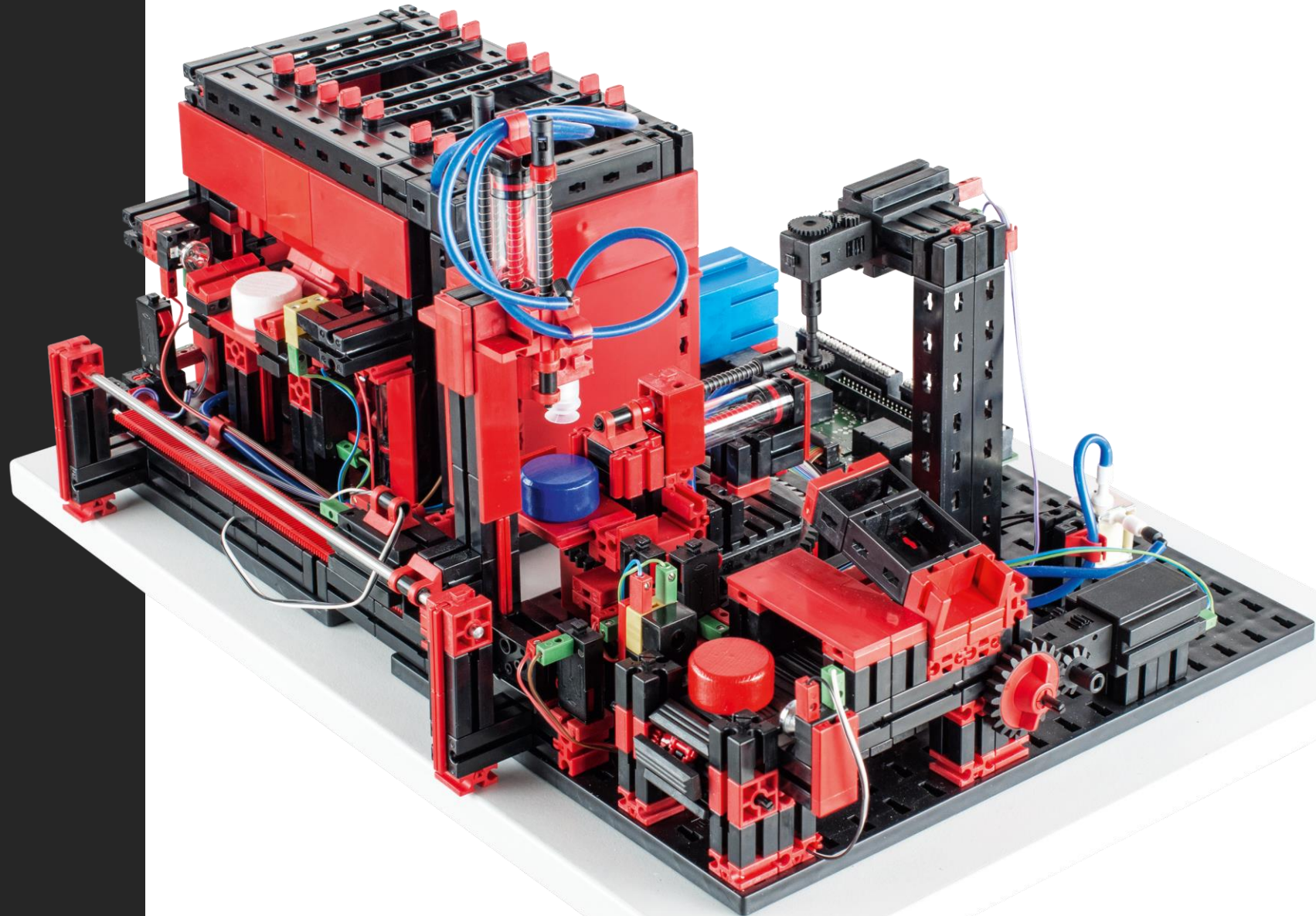
Automated  
High-Bay  
Warehouse





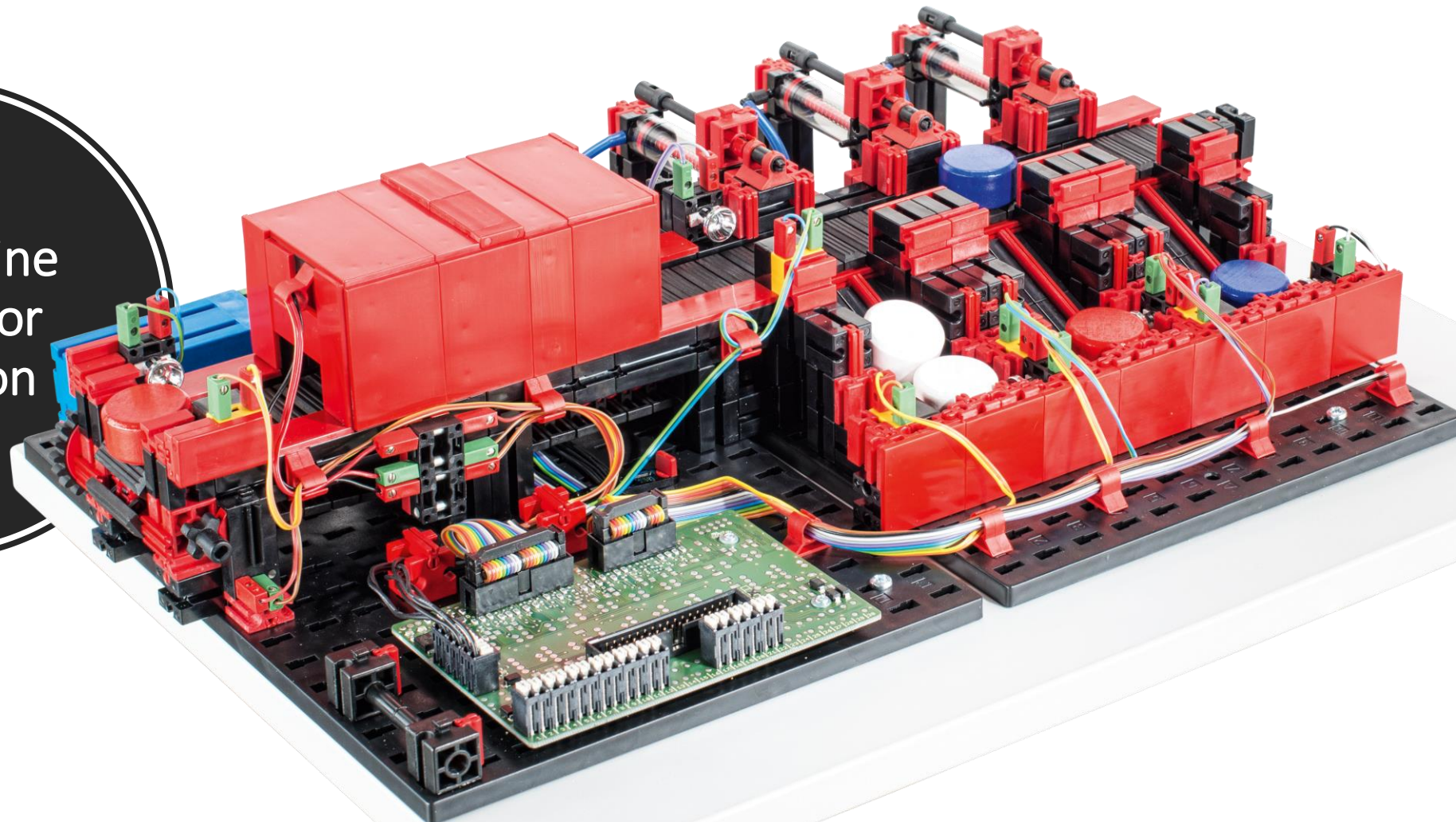


# Multi-Processing Station with Oven





Sorting Line  
with Color  
Detection

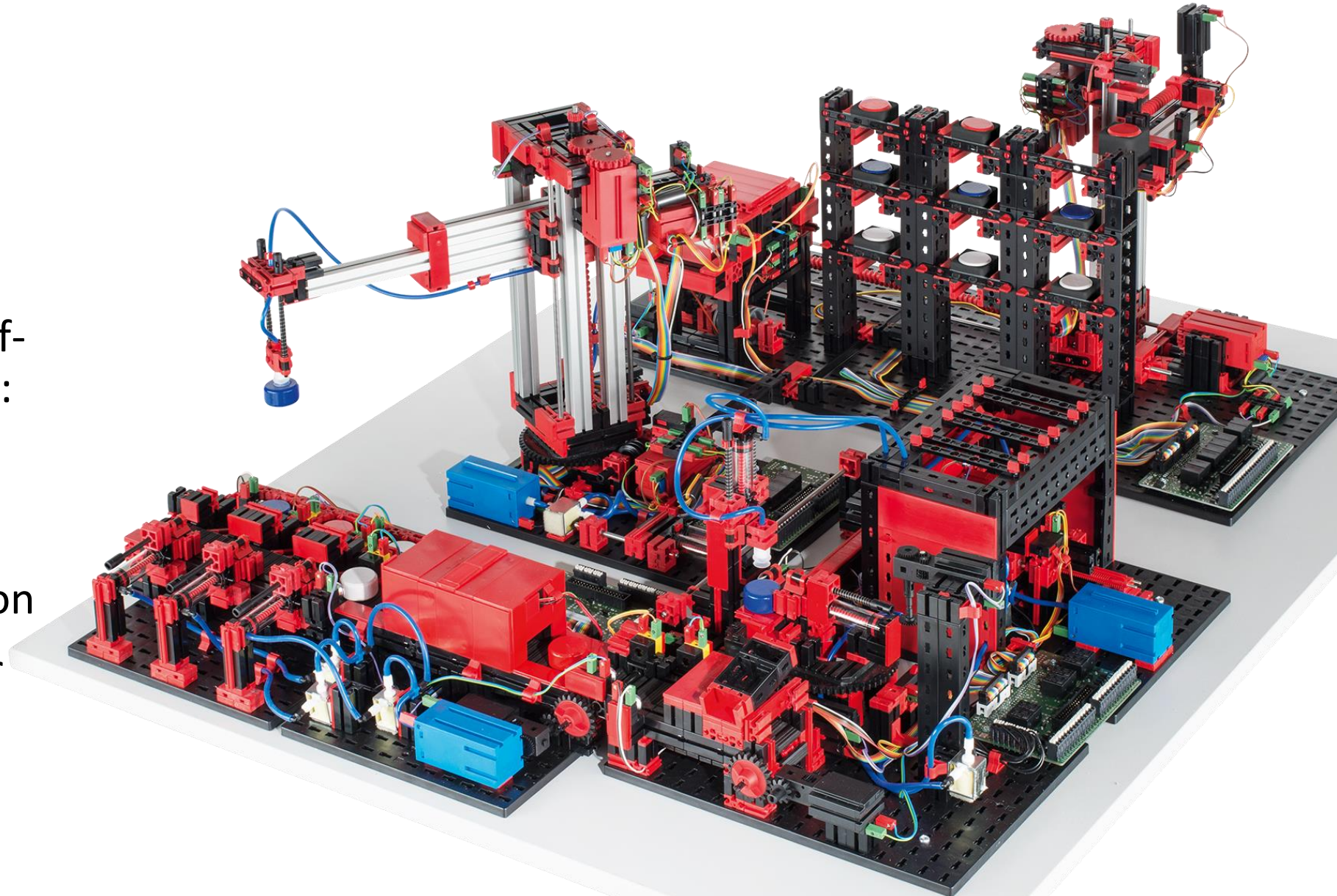




# Factory Simulation

Combines the following four models into one self-contained material cycle:

- Vacuum Gripper
- High-Bay Warehouse
- Multi-Processing Station
- Sorting Line with Color Detection





# Travel & Storage Case

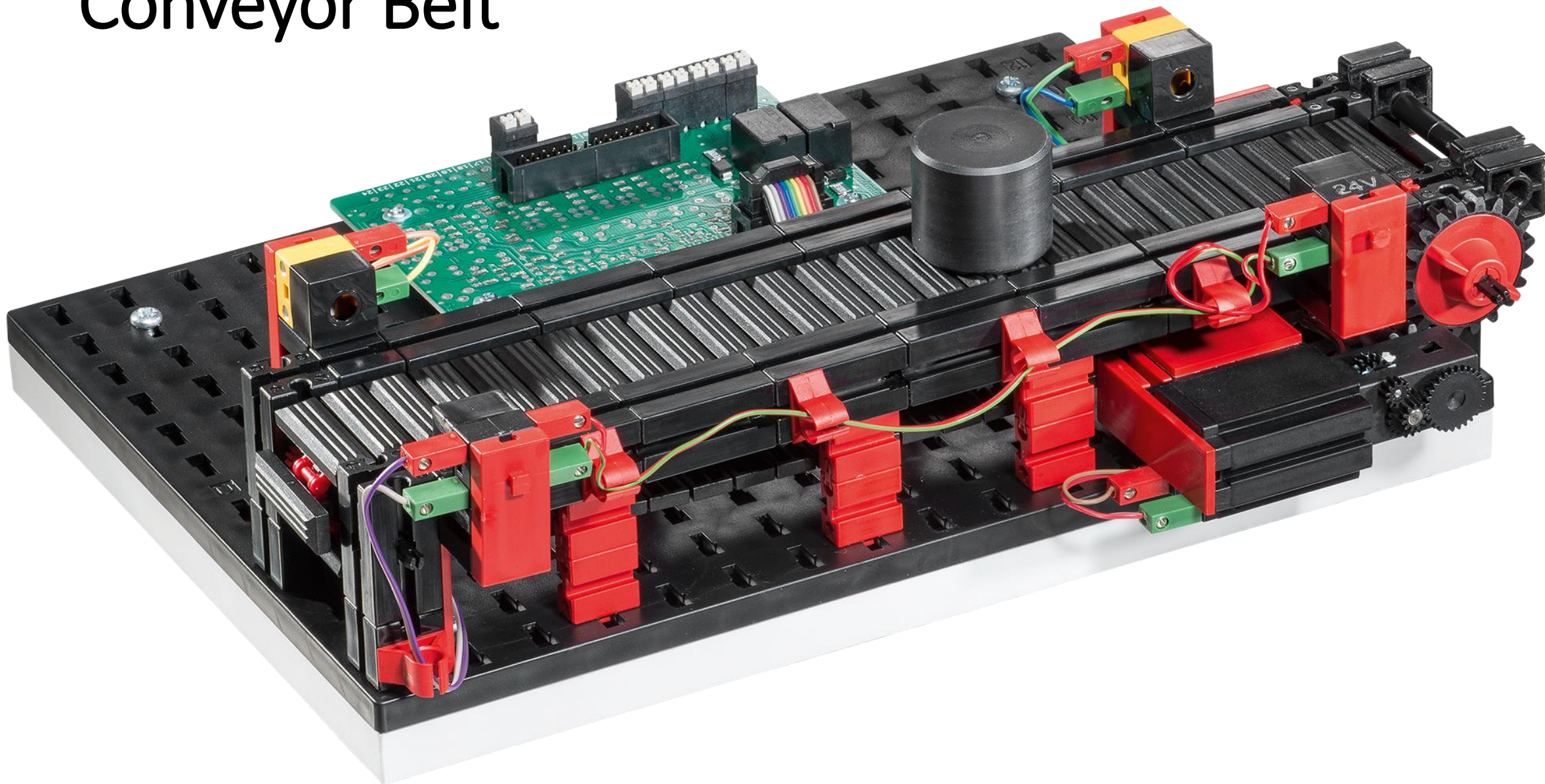
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- Designed for storing either the **24V** or **9V Factory Simulation** models.
- Also designed for storing the **Training Factory Industry 4.0** models we will examine later in this presentation.

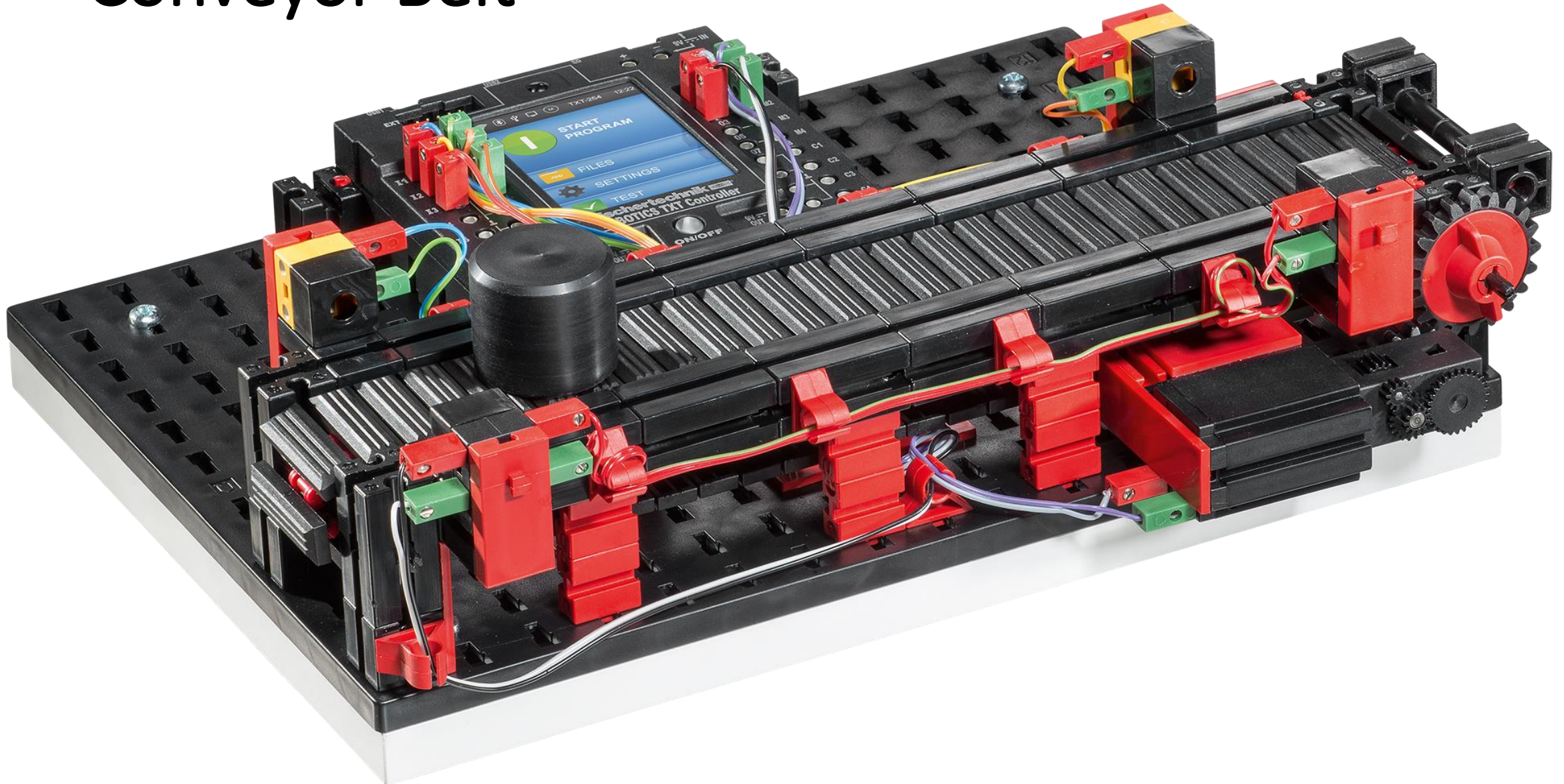




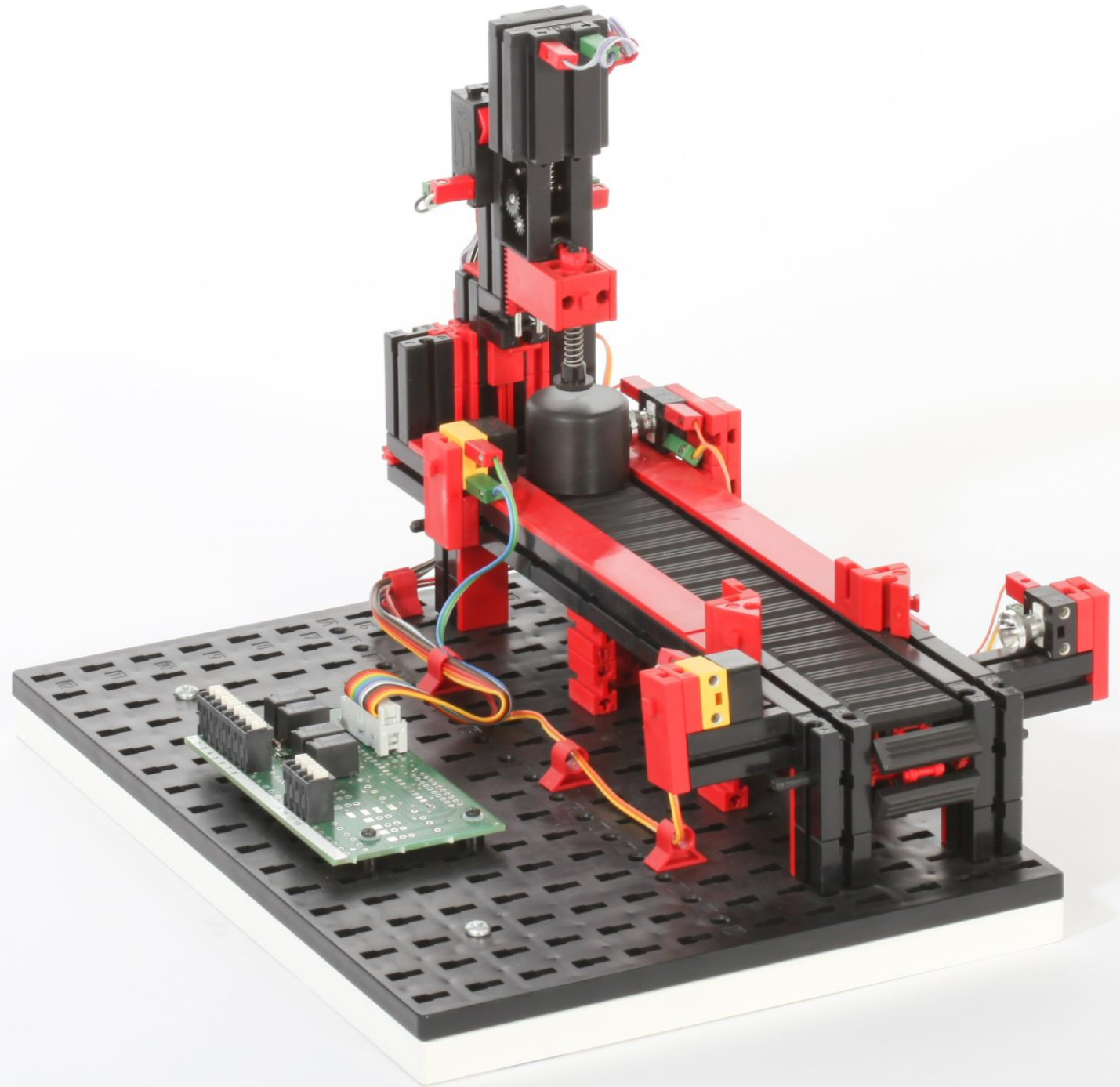
# Conveyor Belt



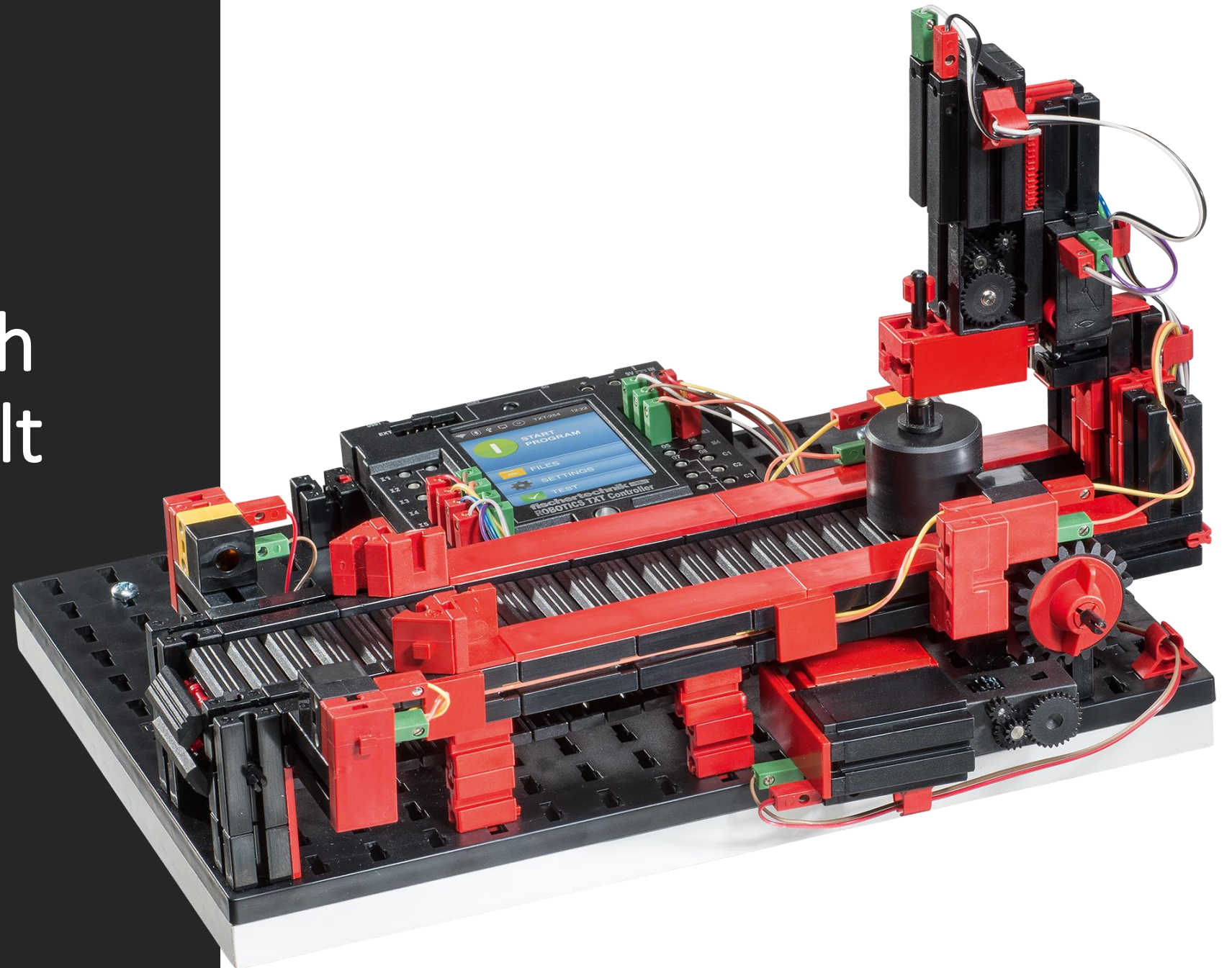
# Conveyor Belt

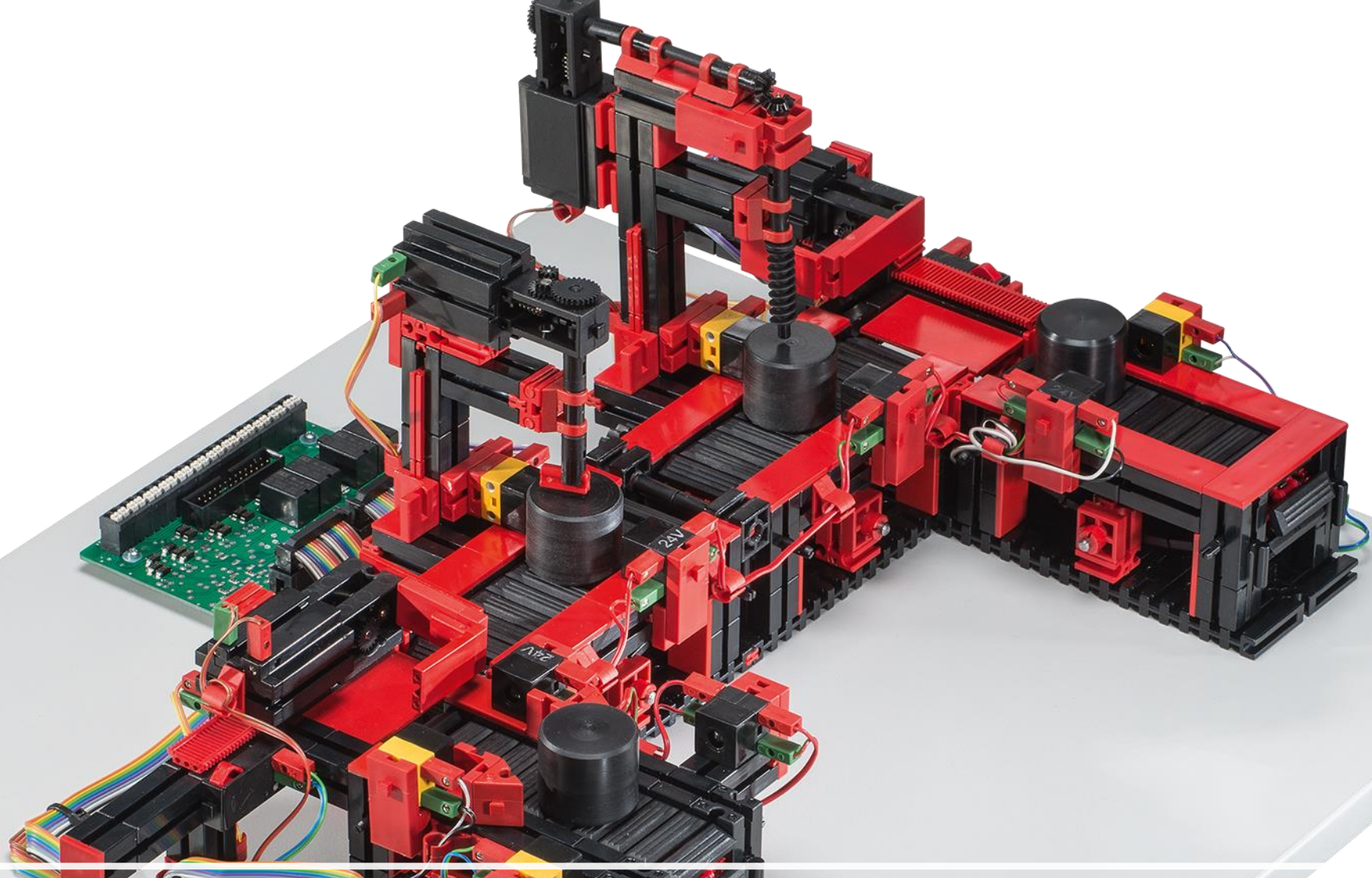


# Punching Machine with Conveyor Belt

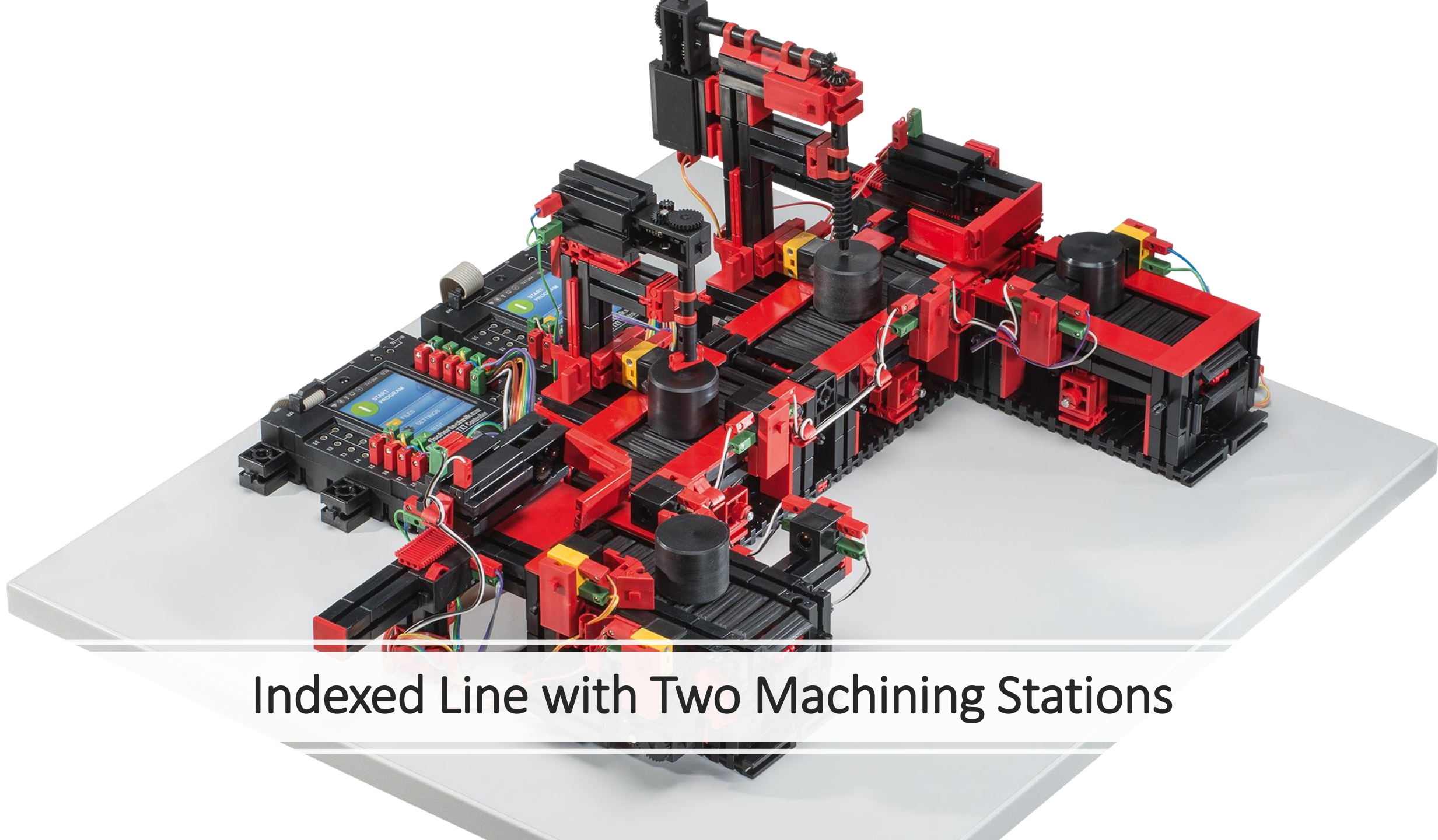


# Punching Machine with Conveyor Belt



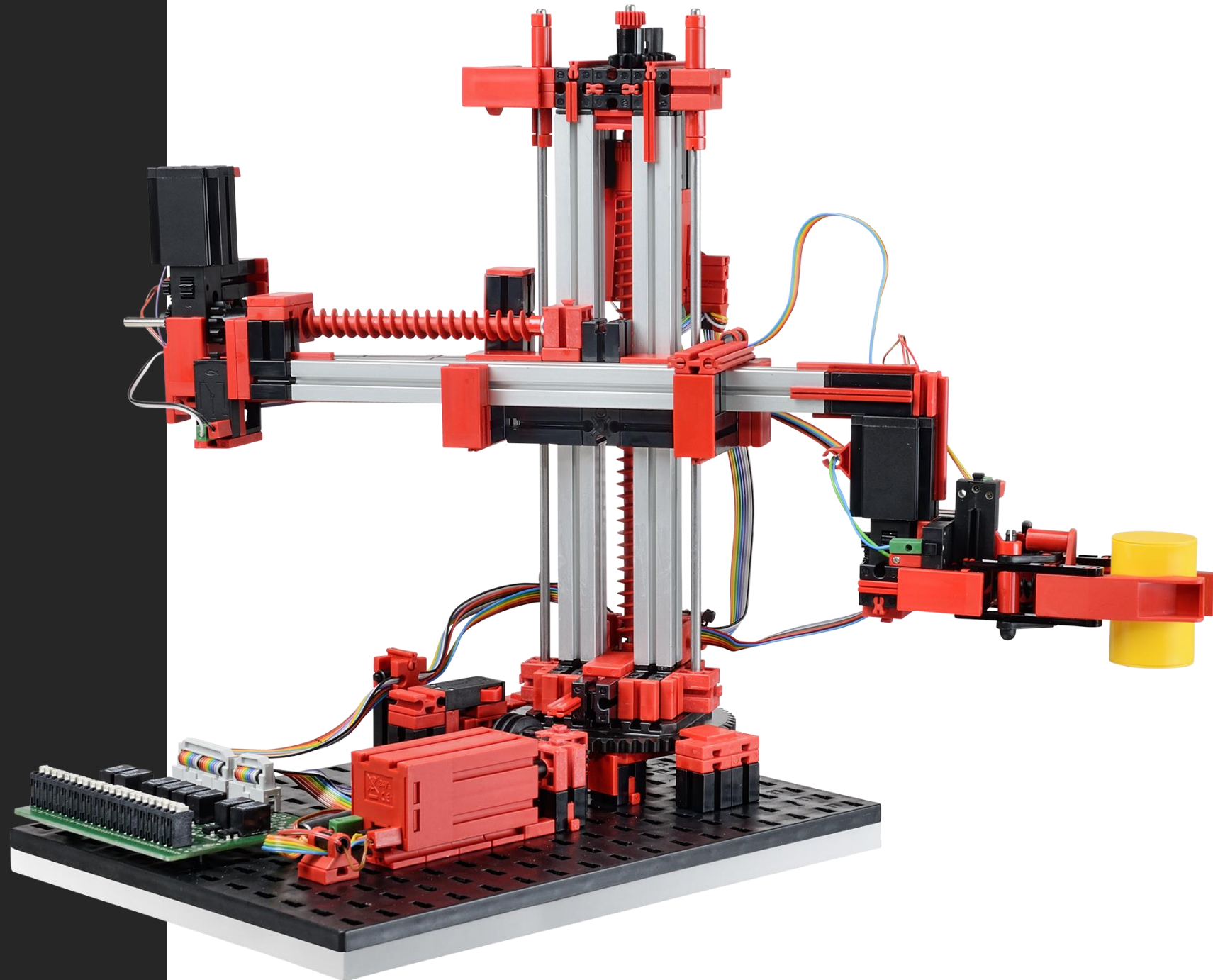
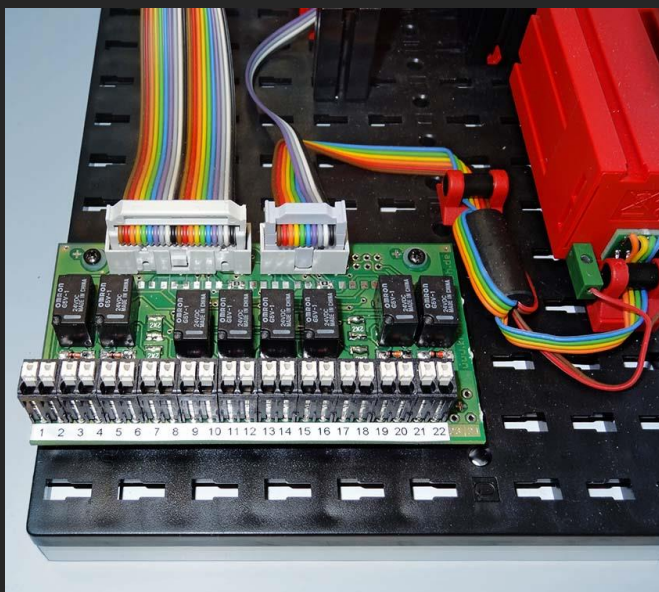


Indexed Line with Two Machining Stations

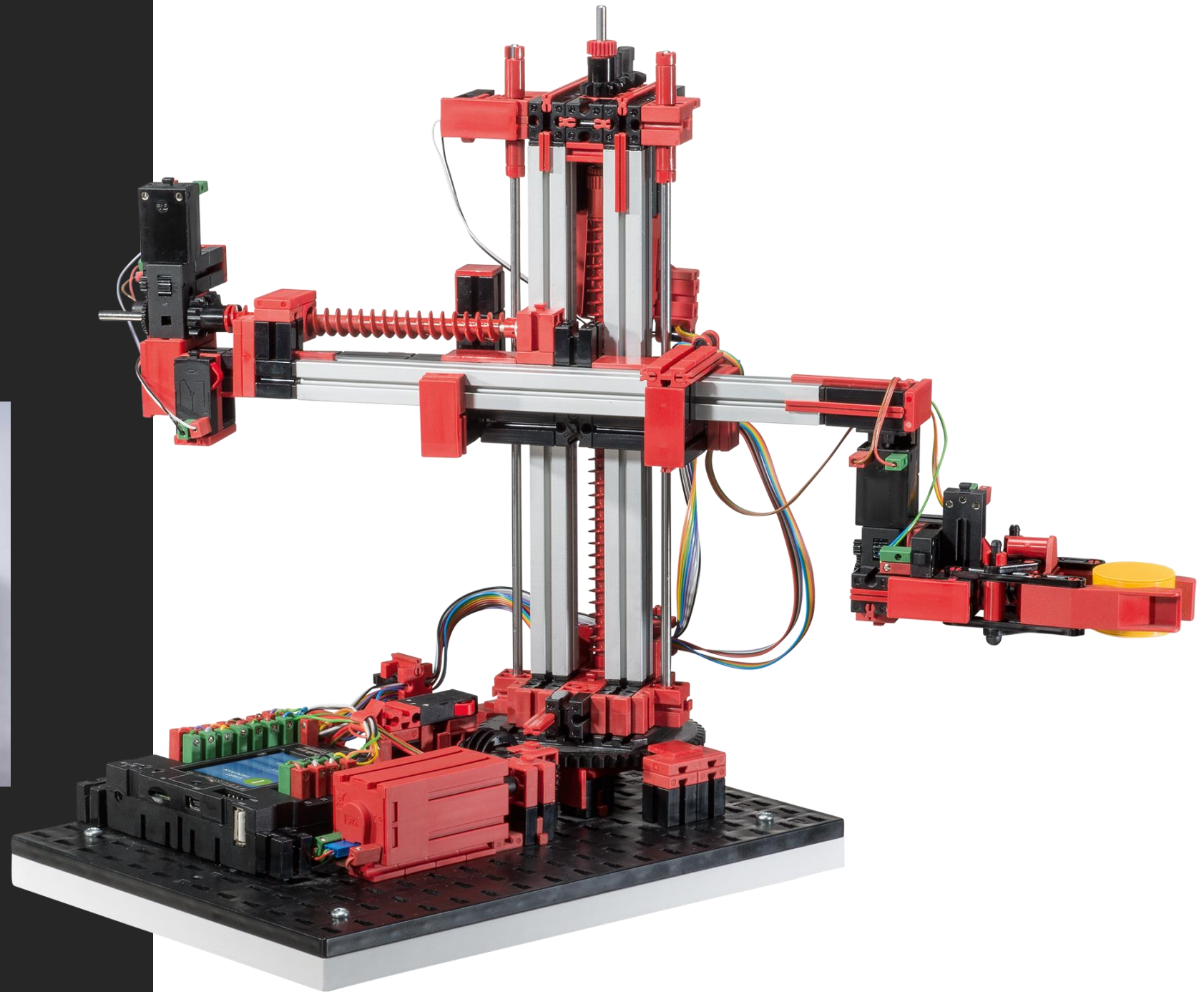


**Indexed Line with Two Machining Stations**

# 3-D Robot (Three Axis)



# 3-D Robot (Three Axis)

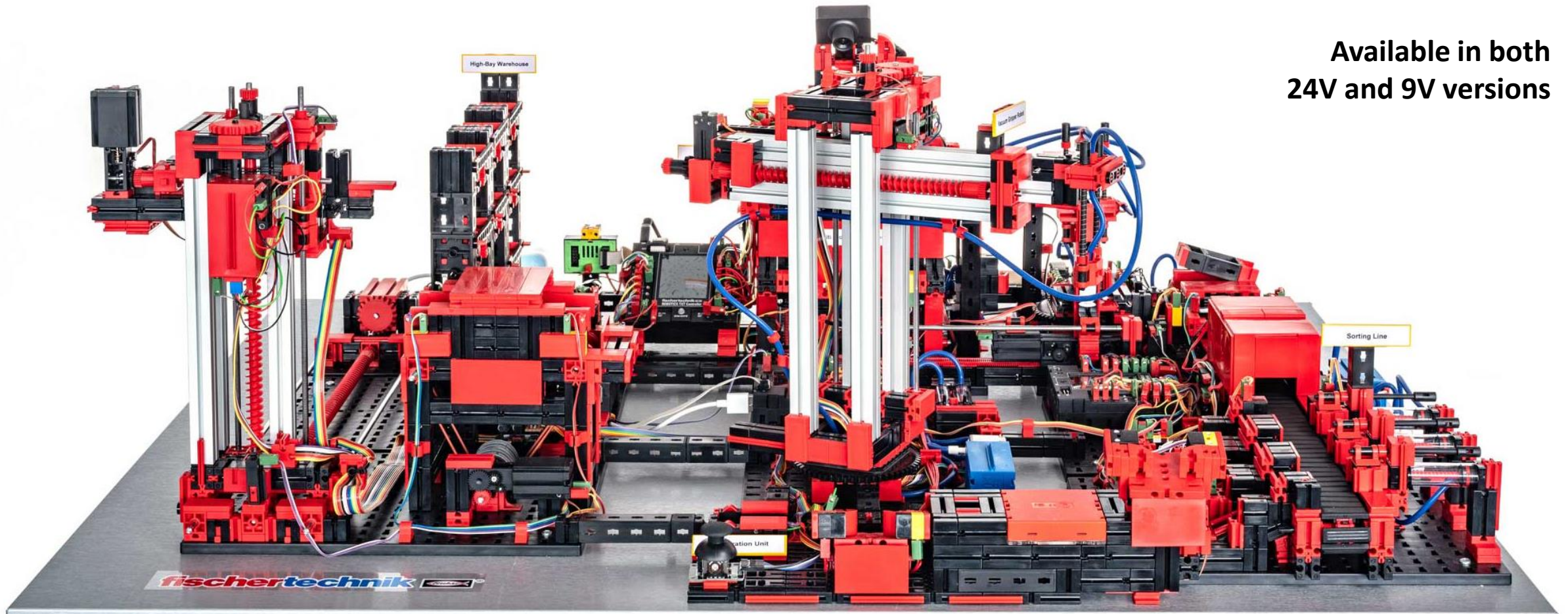




# The Main Industrial Simulation Line

- All models available in 24V versions for use with industry standard PLCs and programming.
- Select models are also available in 9V versions—pre-programmed with ROBOTIC TXT Controllers-- for classroom and non-industry users.





Available in both  
24V and 9V versions

# Training Factory Industry 4.0

Designed for exploring,  
teaching and  
understanding digitization,  
networking, and IoT.



Technik

Vacuum Gripper Robot

Vacuum Gripper Robot

Sorting Line

Calibration Unit

Delivery and Pickup Station

# Training Factory Industry 4.0

- Training and simulation on a realistic production model
- In-depth learning through haptic comprehension
- Optical and sensory applications
- Digital traceability with NFC/RFID

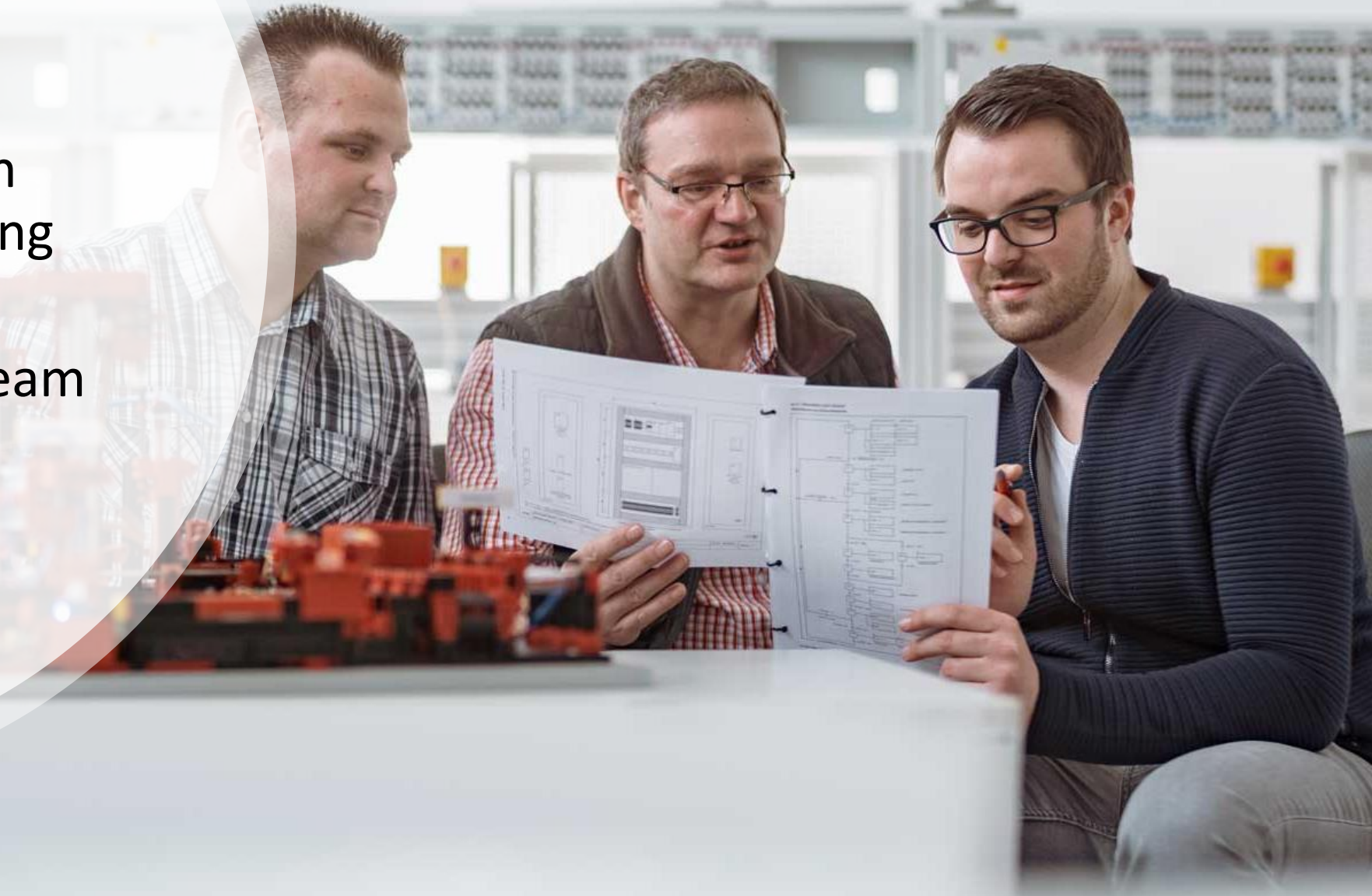


## Training Factory Industry 4.0

- Customised production in lot size 1
- Integrated cloud connection, control via smart devices
- Using and operating dashboards
- Web-based remote maintenance

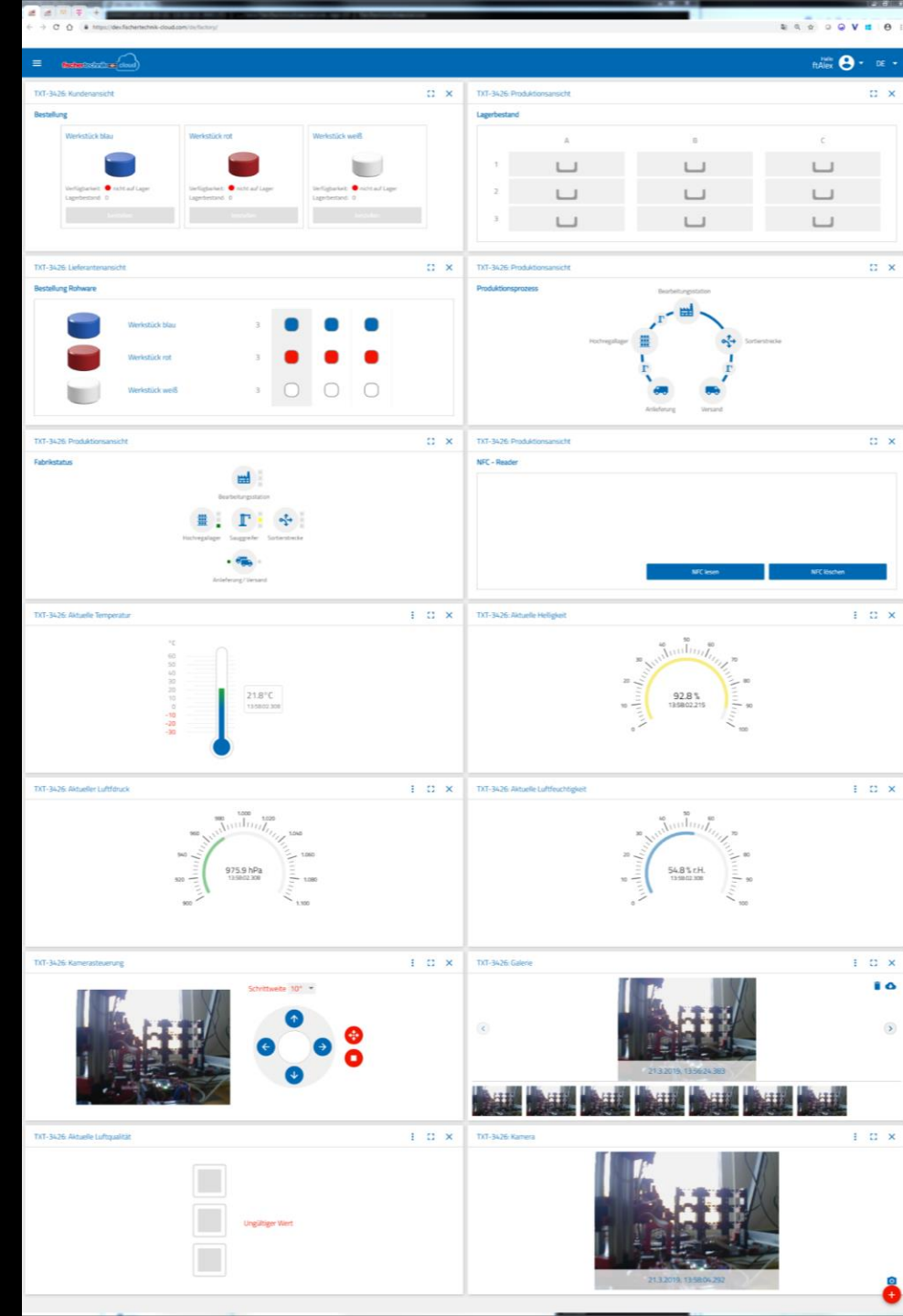
# Training Factory Industry 4.0

- Linking of production and materials planning data
- Connection of upstream and downstream logistics processes



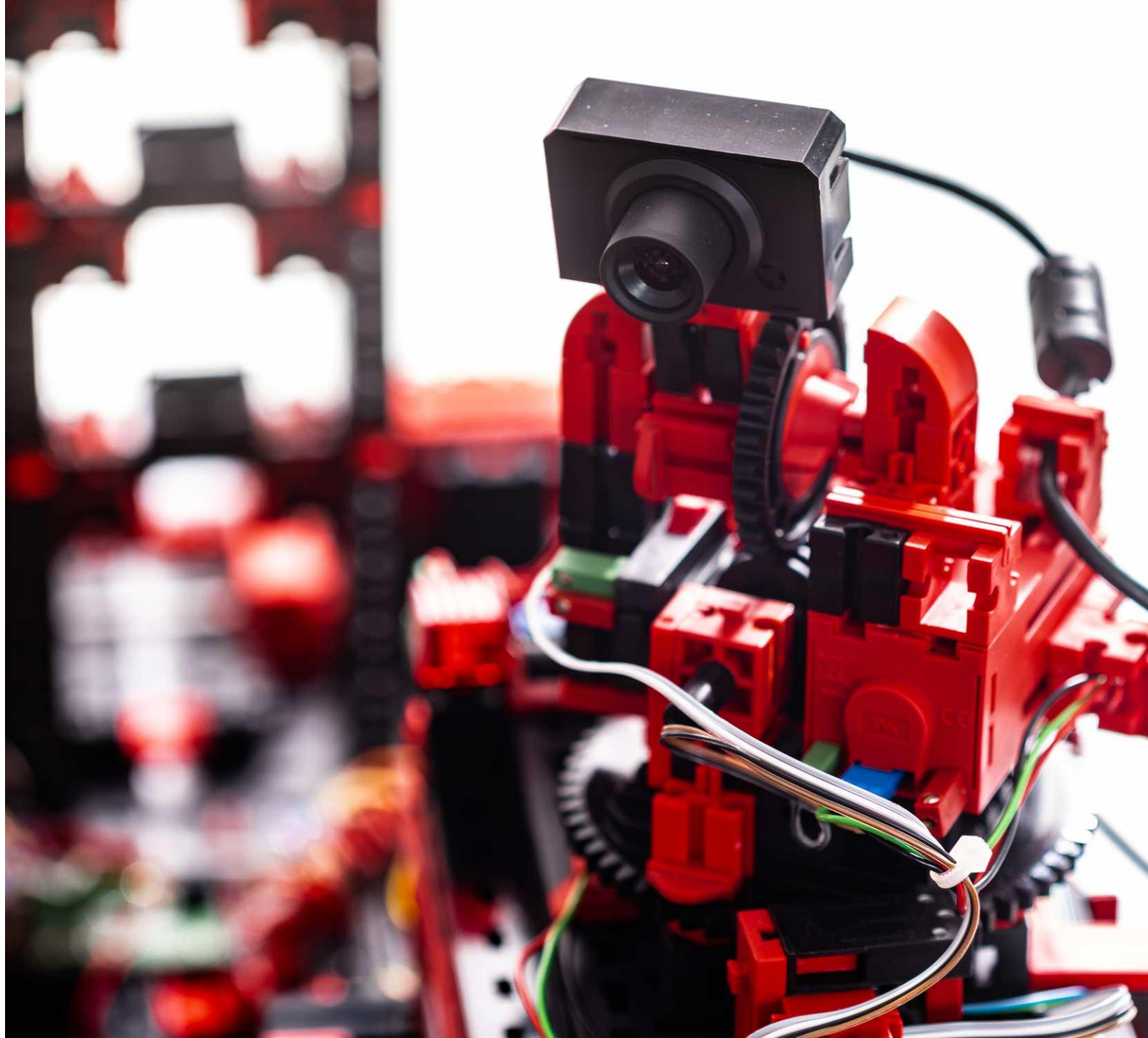
# Training Factory Industry 4.0

- **Cloud-Based Dashboard**—for remote control and monitoring of model.
- Offers three different views - **Customer View, Supplier View, and Production View.**



# Training Factory Industry 4.0

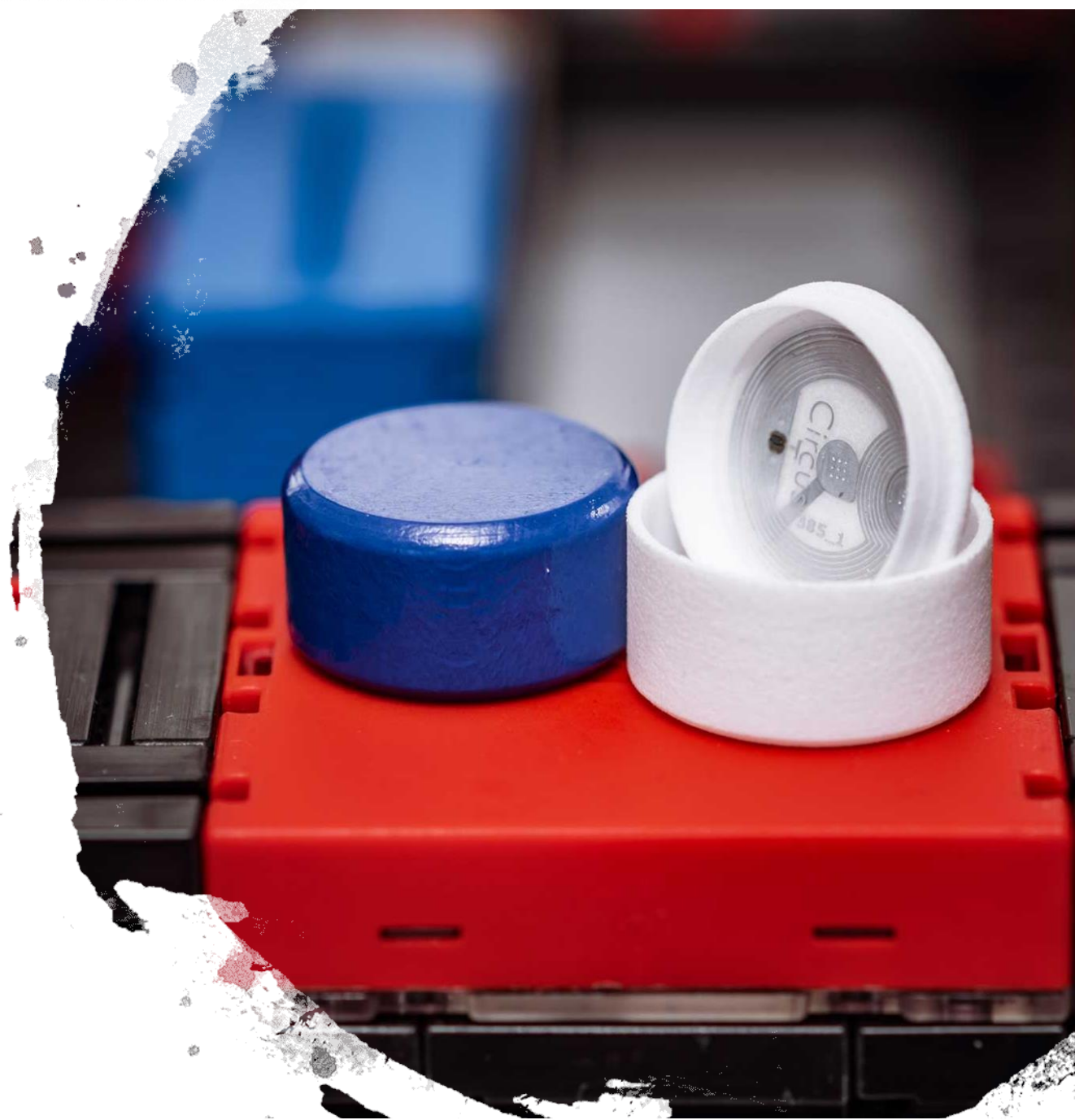
- **Camera**—for remotely viewing all processes on the dashboard.



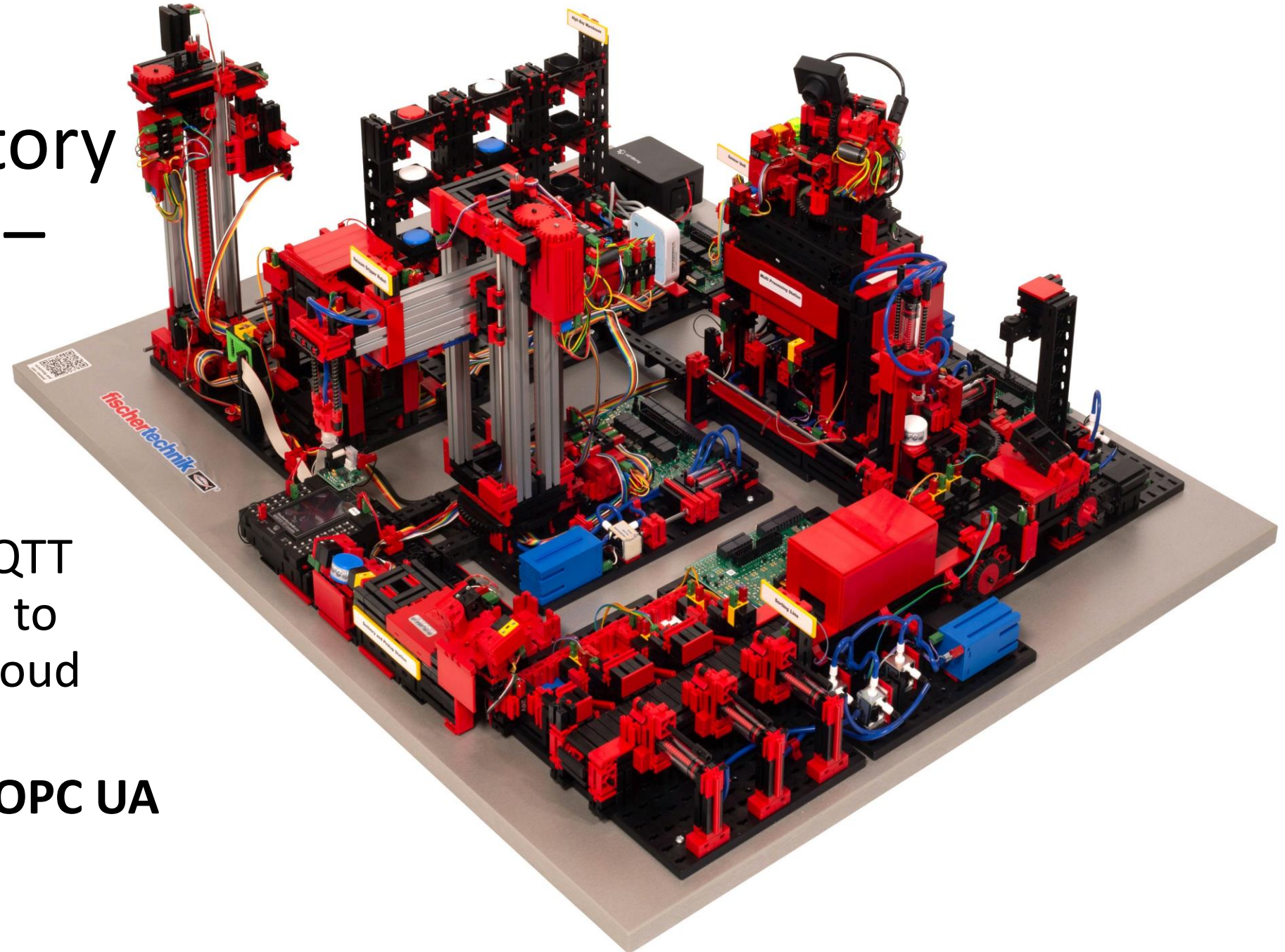


# Training Factory Industry 4.0

- **NFC Chips** in each workpiece
- **NFC Reader**
- **MQTT**—Message Queuing Telemetry Transport



# Training Factory Industry 4.0 – 24V version



- **Robotics TXT Controller** as MQTT broker/interface to fischertechnik cloud
- IoT gateway via **OPC UA**

# Additional Dashboard Option

- IoT Gateway using **Raspberry Pi**
- Display data and calibrate stations in a **Node-RED** dashboard.

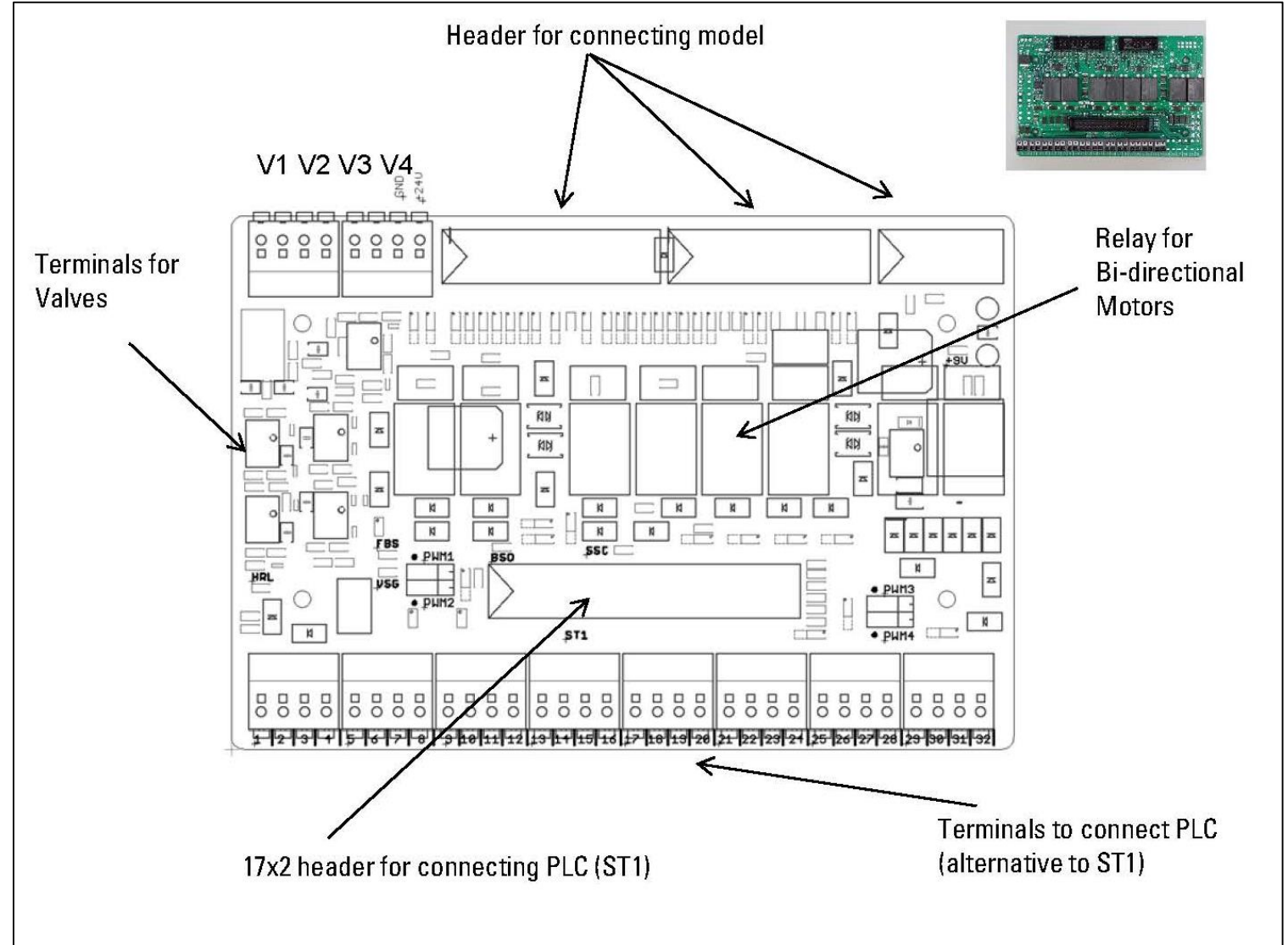
The screenshot displays a Node-RED dashboard titled "fischertechnik Node-RED Dashboard". On the left is a sidebar menu with the following items: HMI - Main, HMI - HBW Positions, HMI - VGR Positions, IIMI - SSC Positions, IIMI - Calibration, HMI - Config Data, ft Cloud, Lernfabrik 4.0 - Overview (highlighted), and Lernfabrik 4.0 - Graph.

The main dashboard area is divided into several panels:

- Camera:** Shows a live video feed of a factory floor with a worker. The timestamp is "2020-6-9 14:28:45".
- Camera Control:** Contains a grid of blue buttons for camera movement: left, right, vertical, and horizontal. It also includes "HOME" and "STOP" buttons.
- Order:** Features three blue buttons labeled "WHITE", "RED", and "BLUE".
- Factory Control:** Includes buttons for "ACK", "NFC READ", "NFC READ UID", "NFC WRITE", and "NFC DELETE".
- Monitoring - Sensors:** A list of sensor data with the following values:
  - timestamp BMF680: 2020-6-9 15:47:33
  - Temperatur: 21.6 °C
  - Luftfeuchtigkeit: 60.6 % r.H.
  - Luftdruck: 979.3 hPa
  - Luftqualität: 54
  - Luftqualität Genauigkeit: 3
  - timestamp LDR: 2020-6-9 15:48:02
  - HELLigkeit: 78.7 %

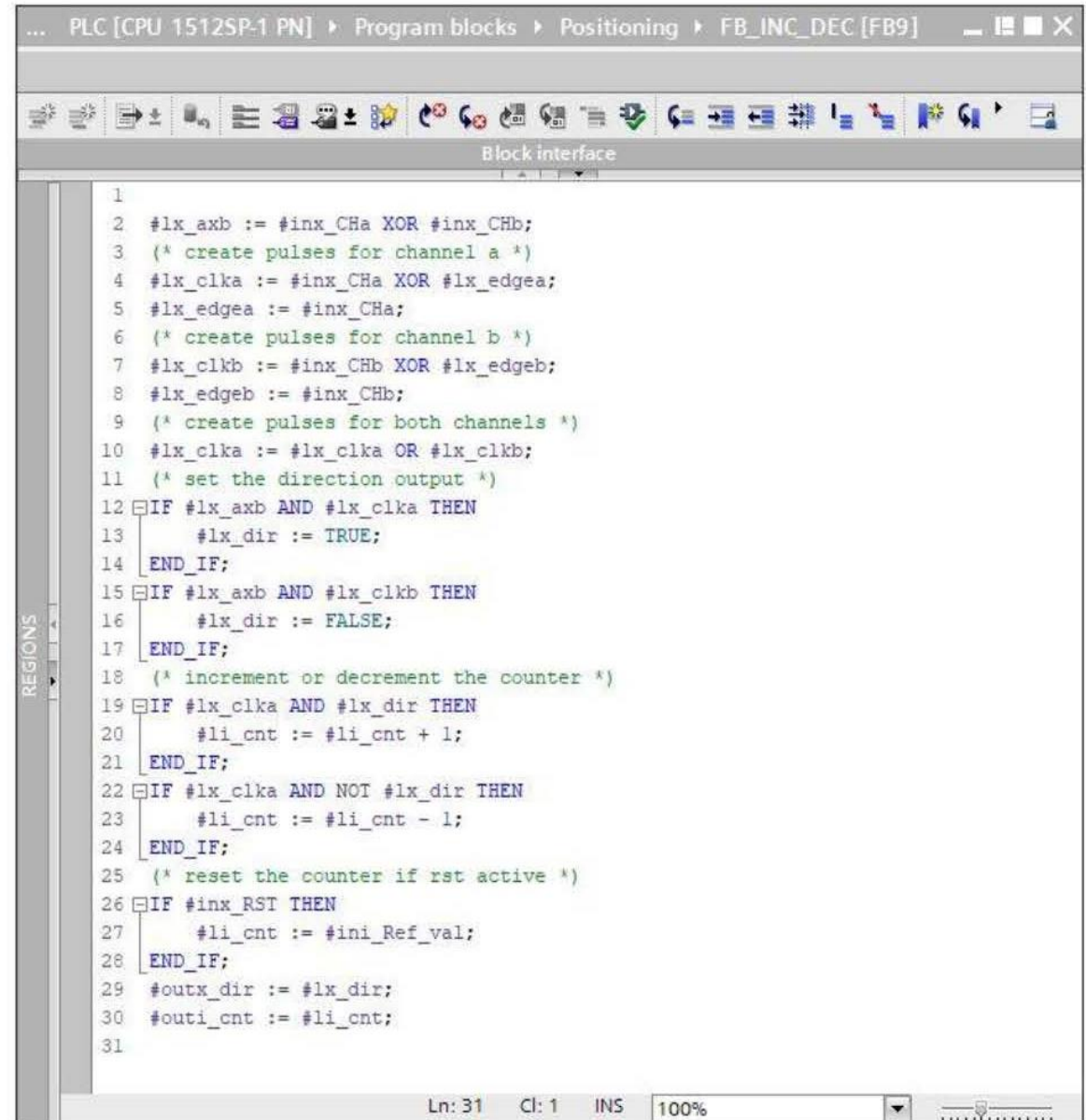
# New 24V Adapter Board

- Control speed of encoder motors via **PWM** (Pulse Width Modulation)
- Push/Pull output stages for phototransistors and buttons



# Includes Sample Program

- **Structured Text (ST)** program, for use with **Siemens S7-1500 PLC**
- Easily modified for other PLC makes and models
- Program and source codes available for download from **Github**



The screenshot displays the Siemens STEP 7 software interface for a PLC program. The title bar indicates the project is 'PLC [CPU 1512SP-1 PN]' and the current block is 'Positioning > FB\_INC\_DEC [FB9]'. The main window shows the 'Block interface' with a list of 31 lines of Structured Text (ST) code. The code defines variables for channel A and B, calculates direction based on input signals, and increments or decrements a counter based on the direction and input signals. The status bar at the bottom shows 'Ln: 31 Cl: 1 INS 100%'.

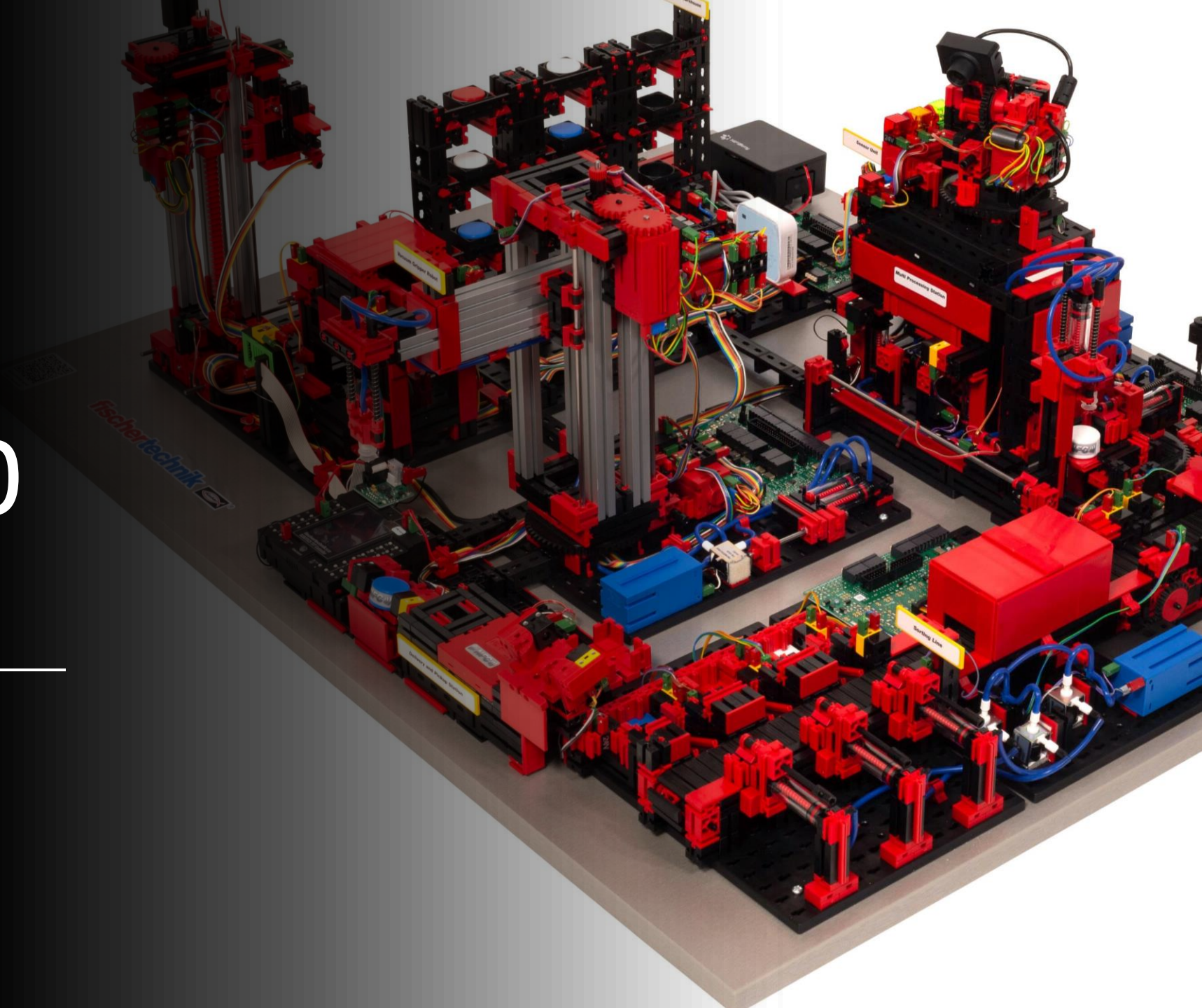
```
1
2 #lx_axb := #inx_CHa XOR #inx_CHb;
3 (* create pulses for channel a *)
4 #lx_clka := #inx_CHa XOR #lx_edghea;
5 #lx_edghea := #inx_CHa;
6 (* create pulses for channel b *)
7 #lx_clkb := #inx_CHb XOR #lx_edgeb;
8 #lx_edgeb := #inx_CHb;
9 (* create pulses for both channels *)
10 #lx_clka := #lx_clka OR #lx_clkb;
11 (* set the direction output *)
12 IF #lx_axb AND #lx_clka THEN
13     #lx_dir := TRUE;
14 END_IF;
15 IF #lx_axb AND #lx_clkb THEN
16     #lx_dir := FALSE;
17 END_IF;
18 (* increment or decrement the counter *)
19 IF #lx_clka AND #lx_dir THEN
20     #li_cnt := #li_cnt + 1;
21 END_IF;
22 IF #lx_clka AND NOT #lx_dir THEN
23     #li_cnt := #li_cnt - 1;
24 END_IF;
25 (* reset the counter if rst active *)
26 IF #inx_RST THEN
27     #li_cnt := #ini_Ref_val;
28 END_IF;
29 #outx_dir := #lx_dir;
30 #outi_cnt := #li_cnt;
31
```



# Training Factory Industry 4.0 9V version

- **9V version** ships pre-wired to six **ROBOTICS TXT Controllers**.
- Pre-Programmed with **C/C++**
- Requires **three 120V power adaptors**.

Training  
Factory  
Industry 4.0

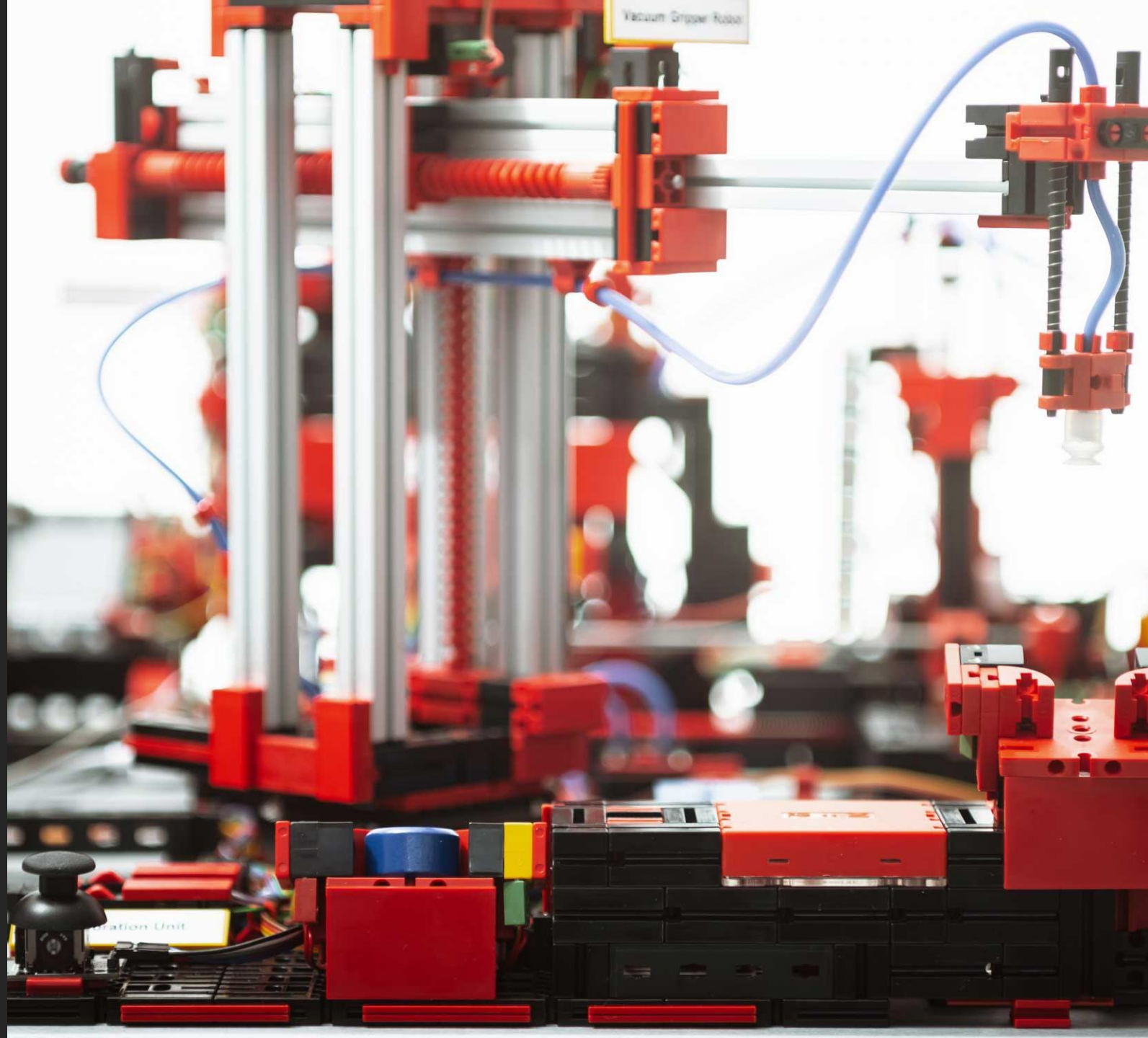




So...how much do they cost?

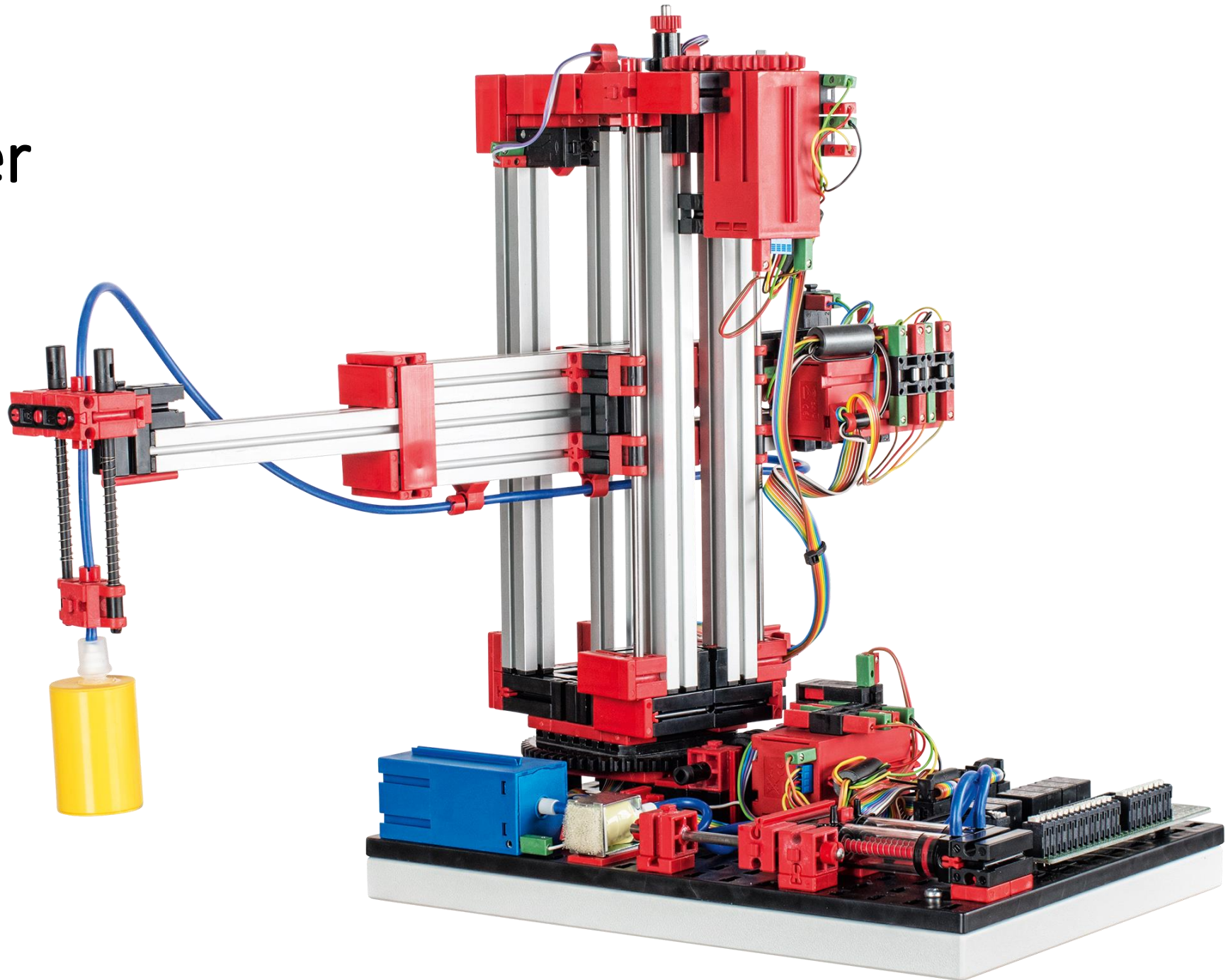


Let's  
review  
with  
pricing...



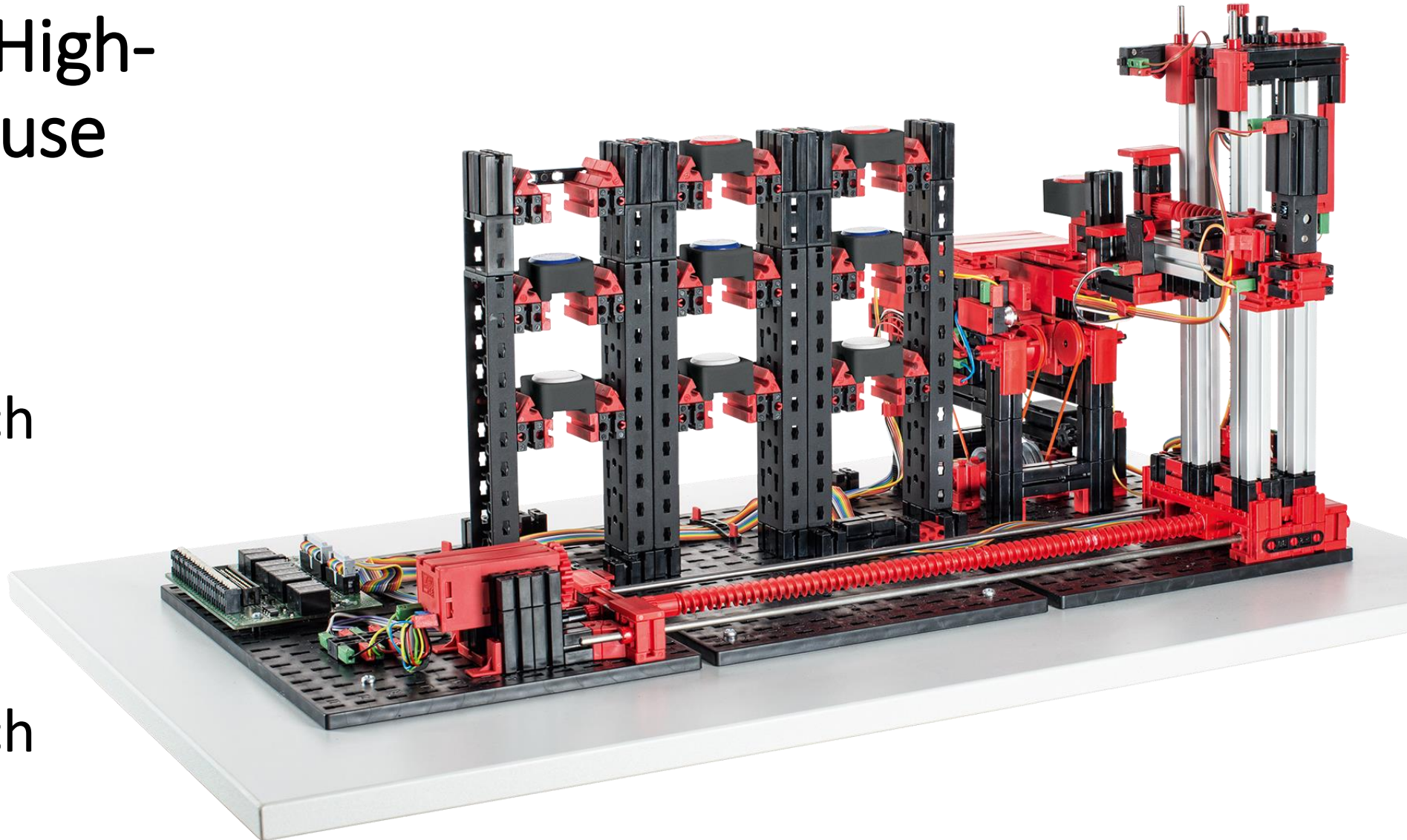
# Vacuum Gripper Robot

- 24V version -  
#536630  
**\$974.00** each
- 9V version -  
#536625  
**\$1199.00** each



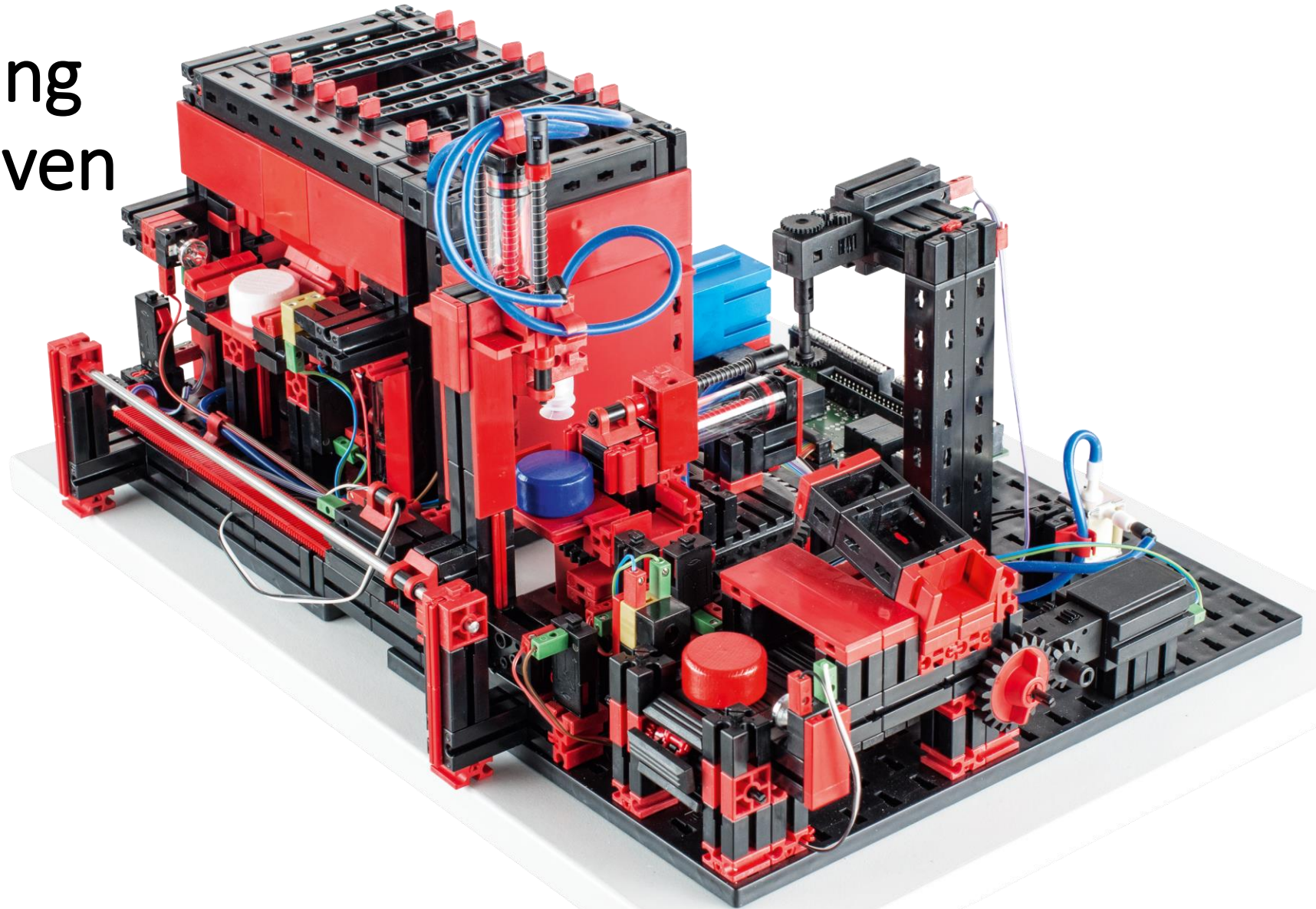
# Automated High-Bay Warehouse

- 24V version -  
#536631  
**\$1099.00** each
- 9V version -  
#536626  
**\$1319.00** each



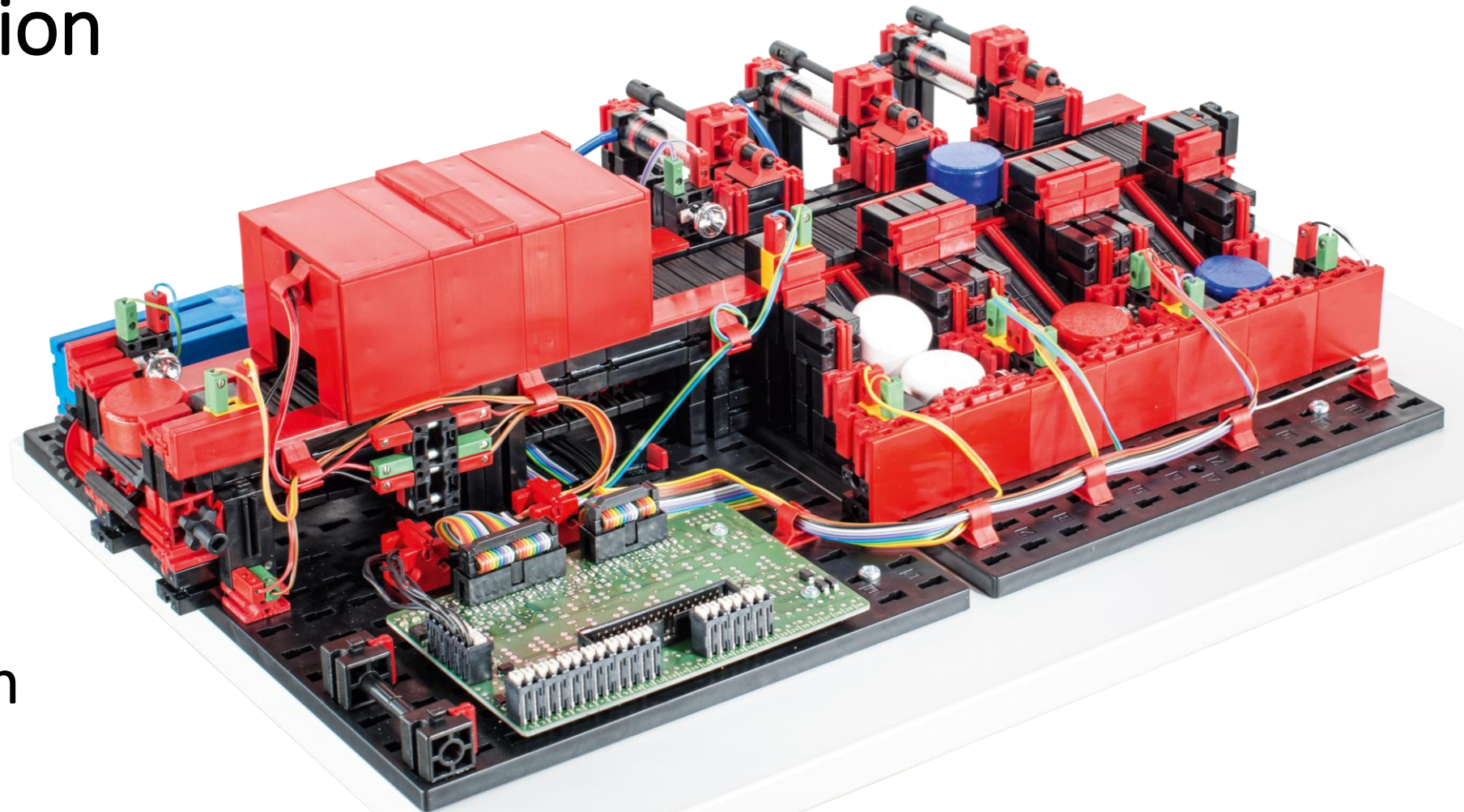
# Multi-Processing Station with Oven

- 24V version -  
#536632  
**\$999.00** each
- 9V version -  
#536627  
**\$1479.00** each



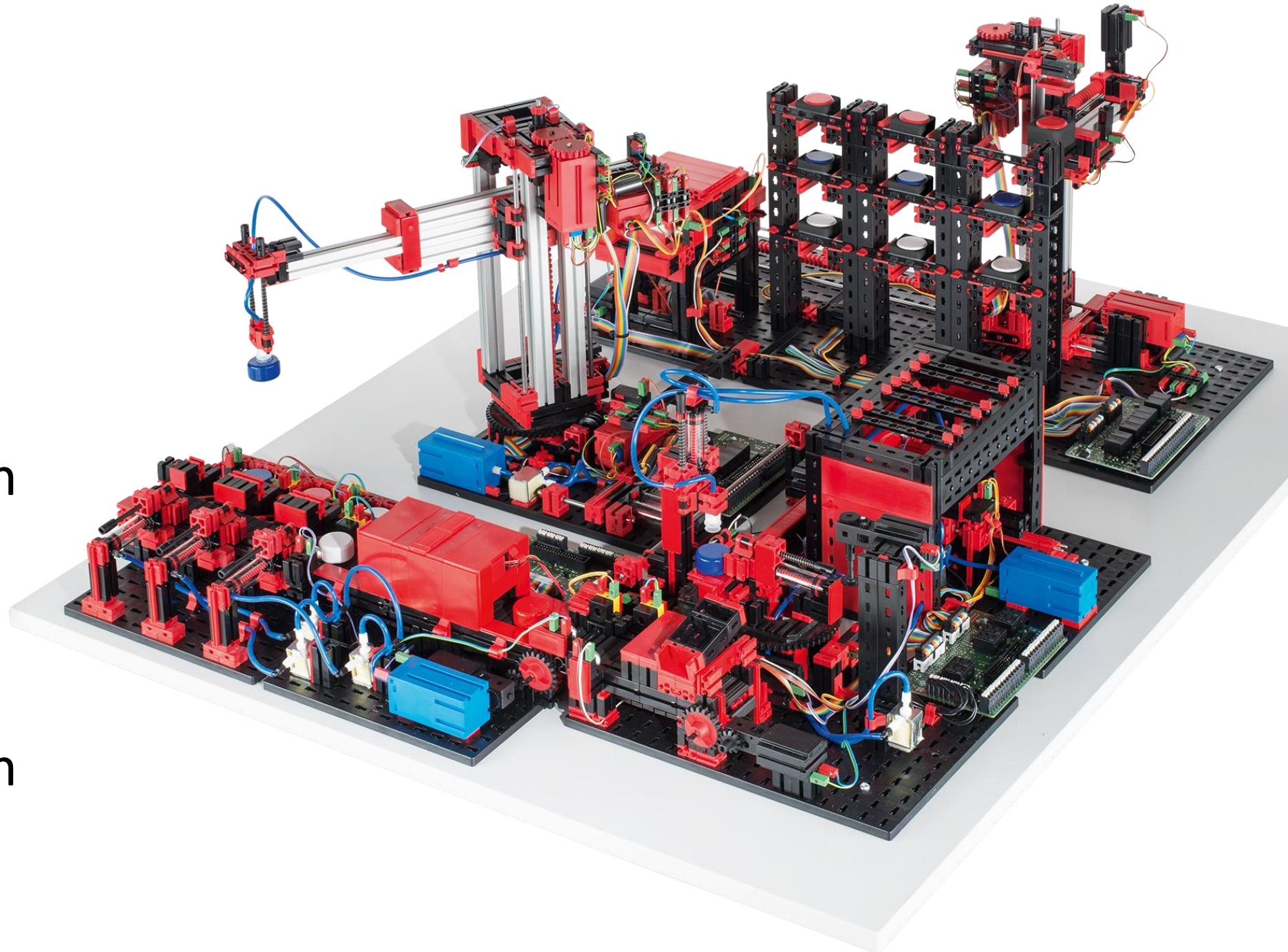
# Sorting Line with Color Detection

- 24V version -  
#536633  
**\$836.00** each
- 9V version -  
#536628  
**\$1129.00** each



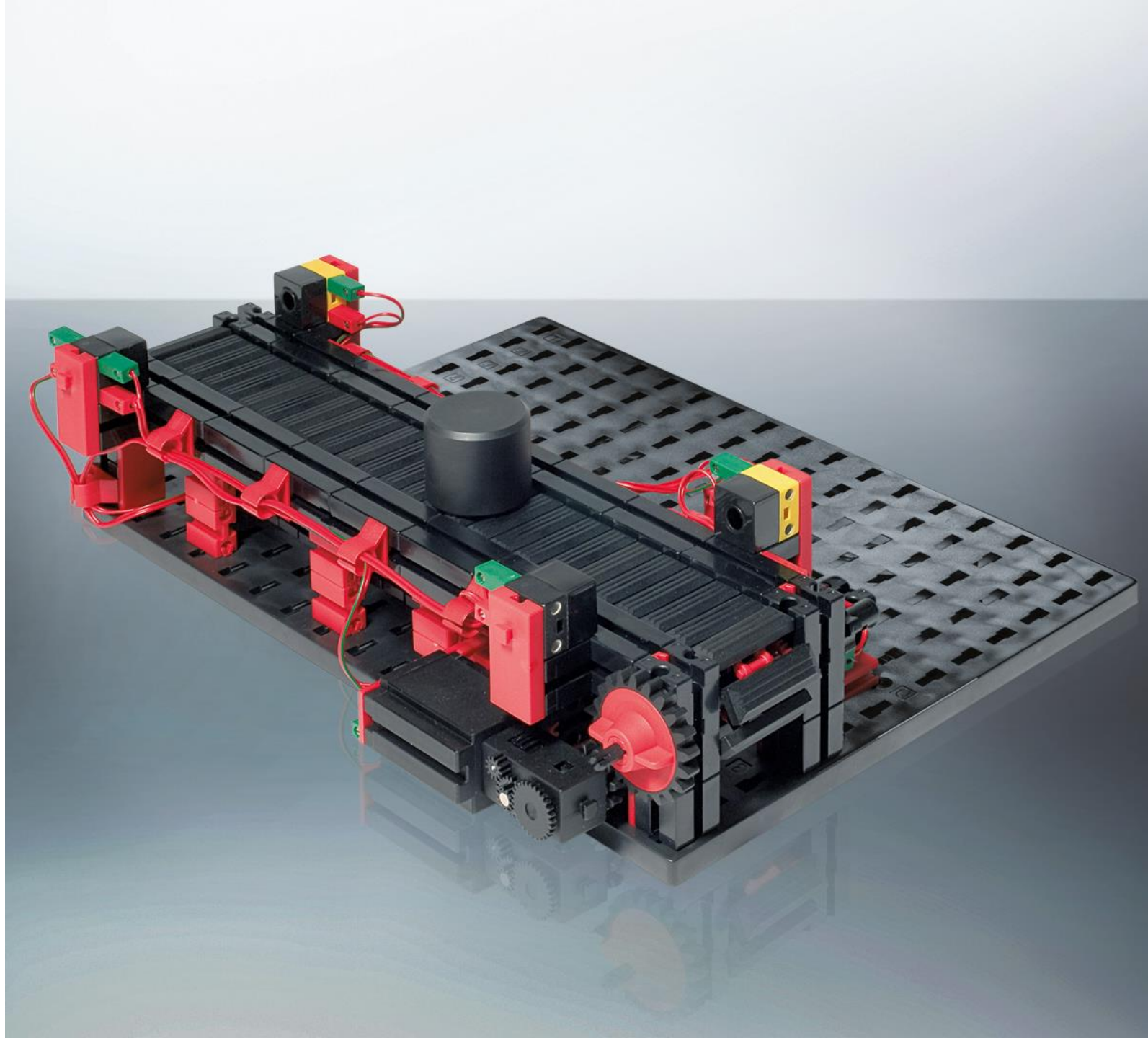
# Factory Simulation

- 24V version -  
#536634  
**\$4029.00** each
- 9V version -  
#536625  
**\$5239.00** each



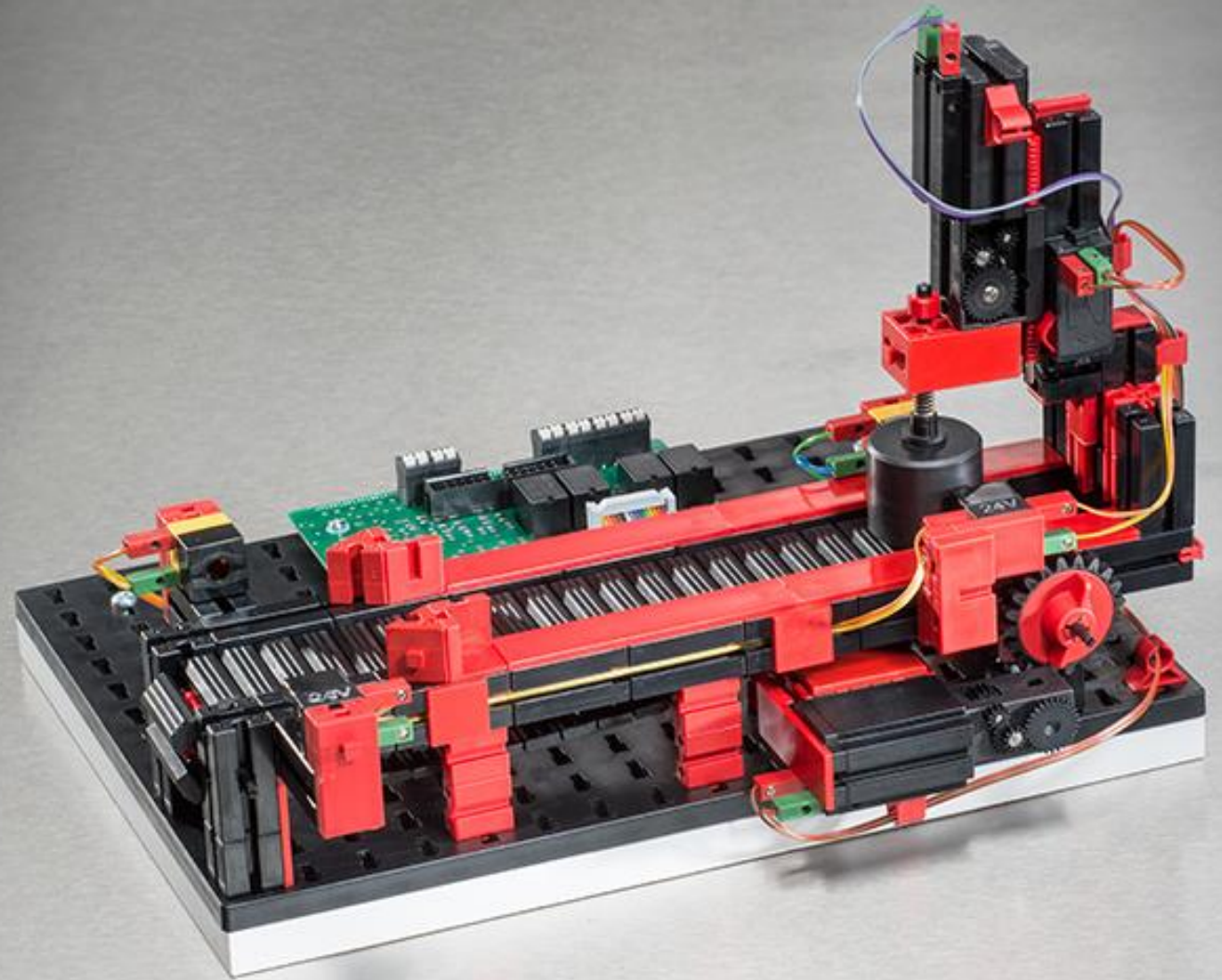
# Conveyor Belt

- 24V version -  
#50464  
**\$226.00** each
- 9V version -  
#50463  
**\$519.00** each



# Punching Machine with Conveyor Belt

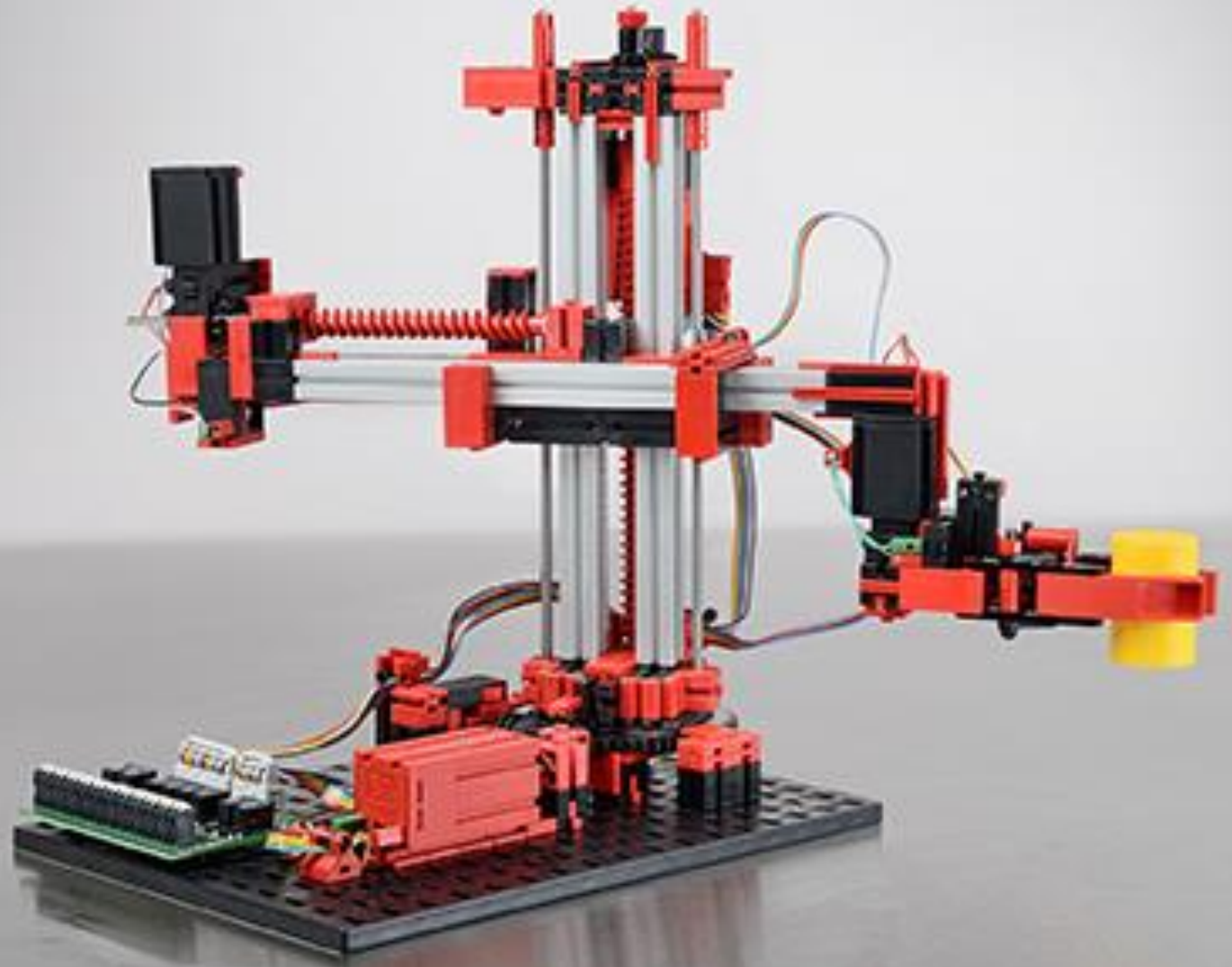
- 24V version -  
#96785  
**\$299.00** each
- 9V version -  
#51663  
**\$599.00** each





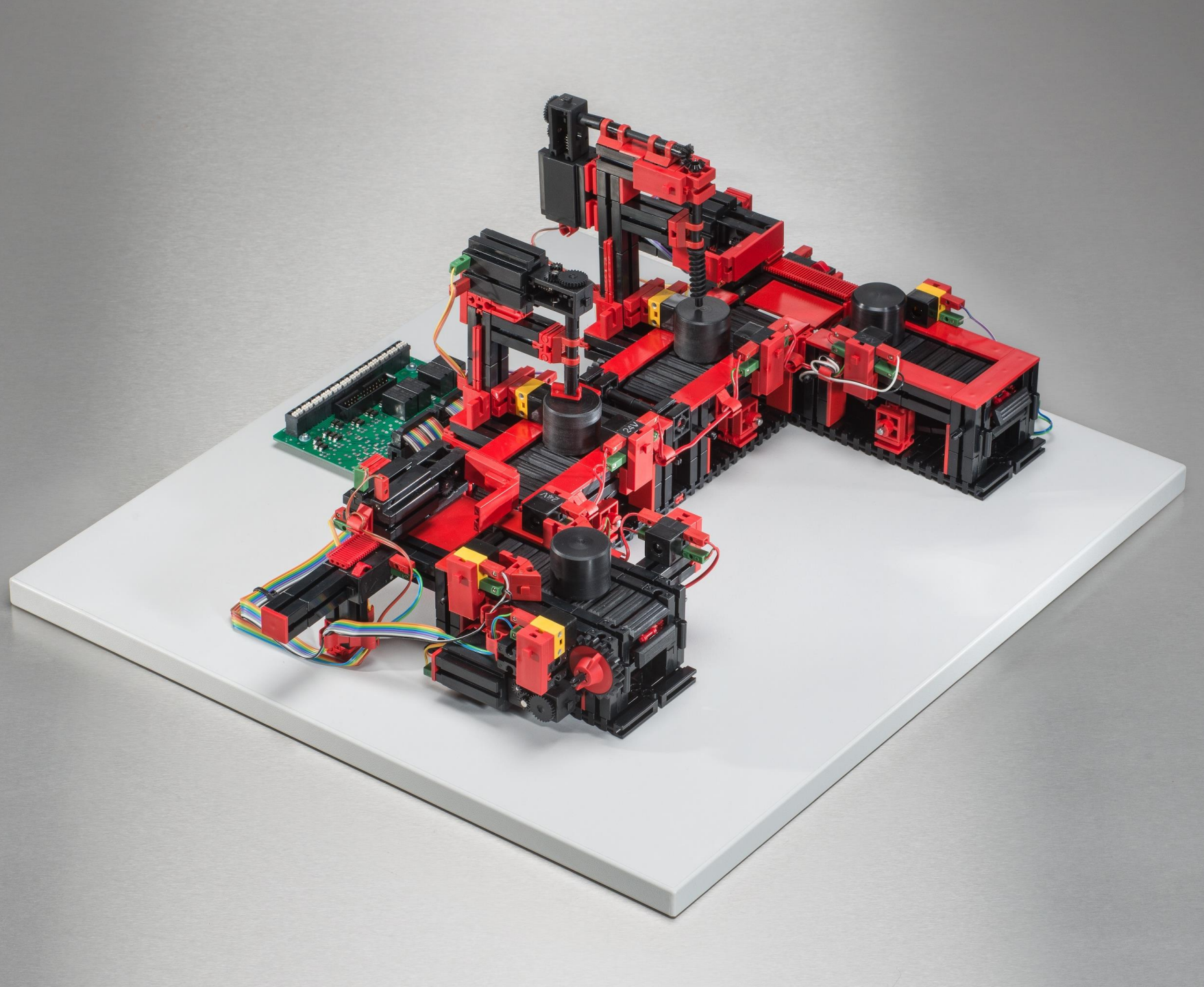
# 3-D Robot

- 24V version -  
#511938  
**\$865.00** each
- 9V version -  
#511937  
**\$1169.00** each



# Indexed Line with Two Machining Stations

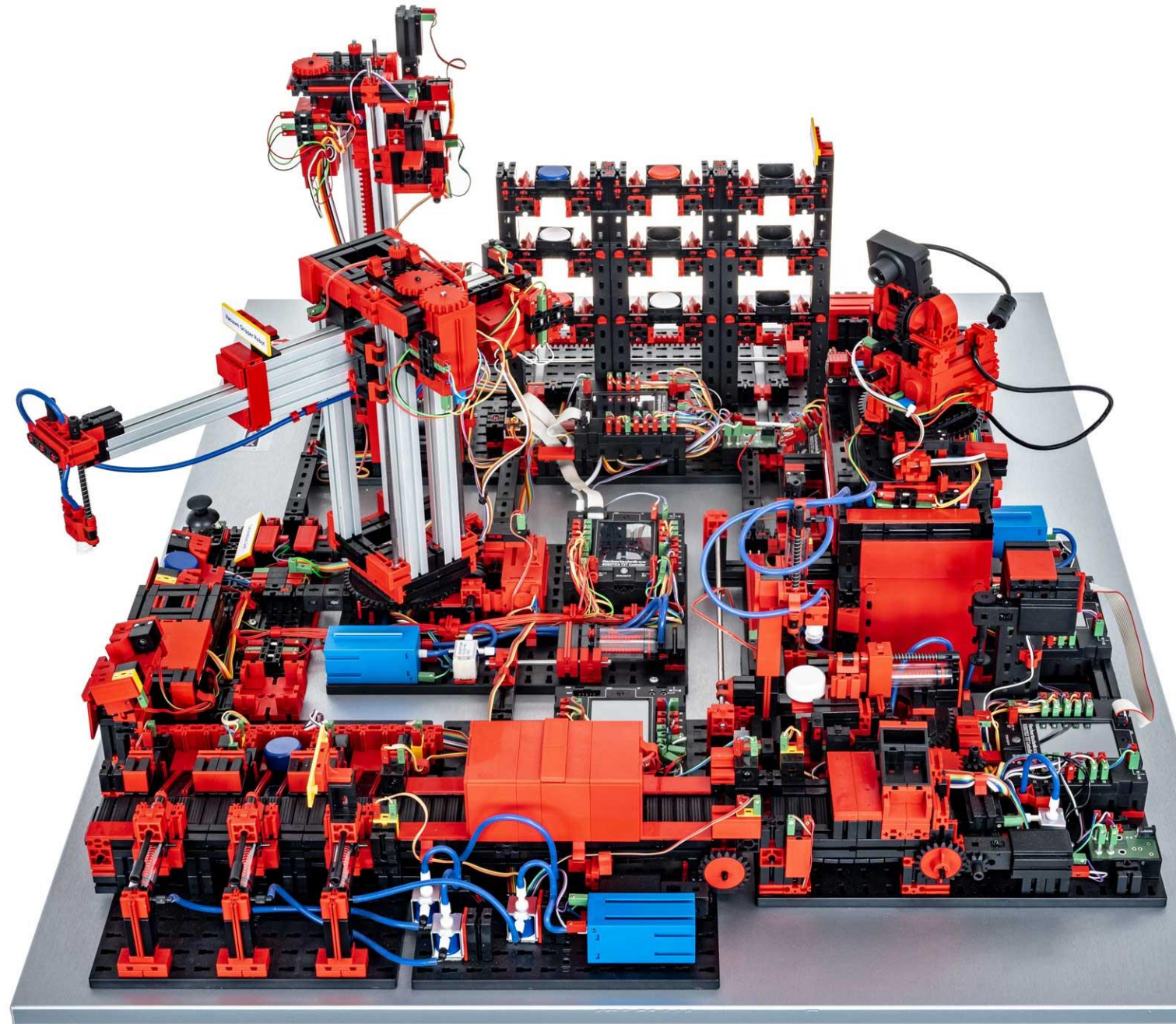
- 24V version -  
#96790  
**\$869.00** each
- 9V version -  
#51664  
**\$1399.00** each





# Training Factory Industry 4.0

- 24V version –  
#554868  
**\$7896.00** each
- 9V version -  
#551584  
**\$7560.00** each



## Other Items:

- **120V Power Adaptors**  
(for 9V models) - **\$12.99** each
- **Travel and Storage Case** – for all  
**Factory Simulation and Training**  
**Factory Industry 4.0** models--  
#551587 - **\$1000.00** each



ANY  
QUESTIONS  
?

Please use the ZOOM Chat Window or Question Window

# Taking the Next Step:

- Request a **full-color brochure** and **current pricing**.
- Ask **questions** directly.
- Request a **quote**.
- Speak with your **dedicated educational representative**.
- And more!
- **Studica US (888) 561-7521**
- **Info@Studica.com**
- **Lance.Zurek@studica.com**

**WHAT'S  
NEXT?**



*Thank you for attending  
today's presentation!*