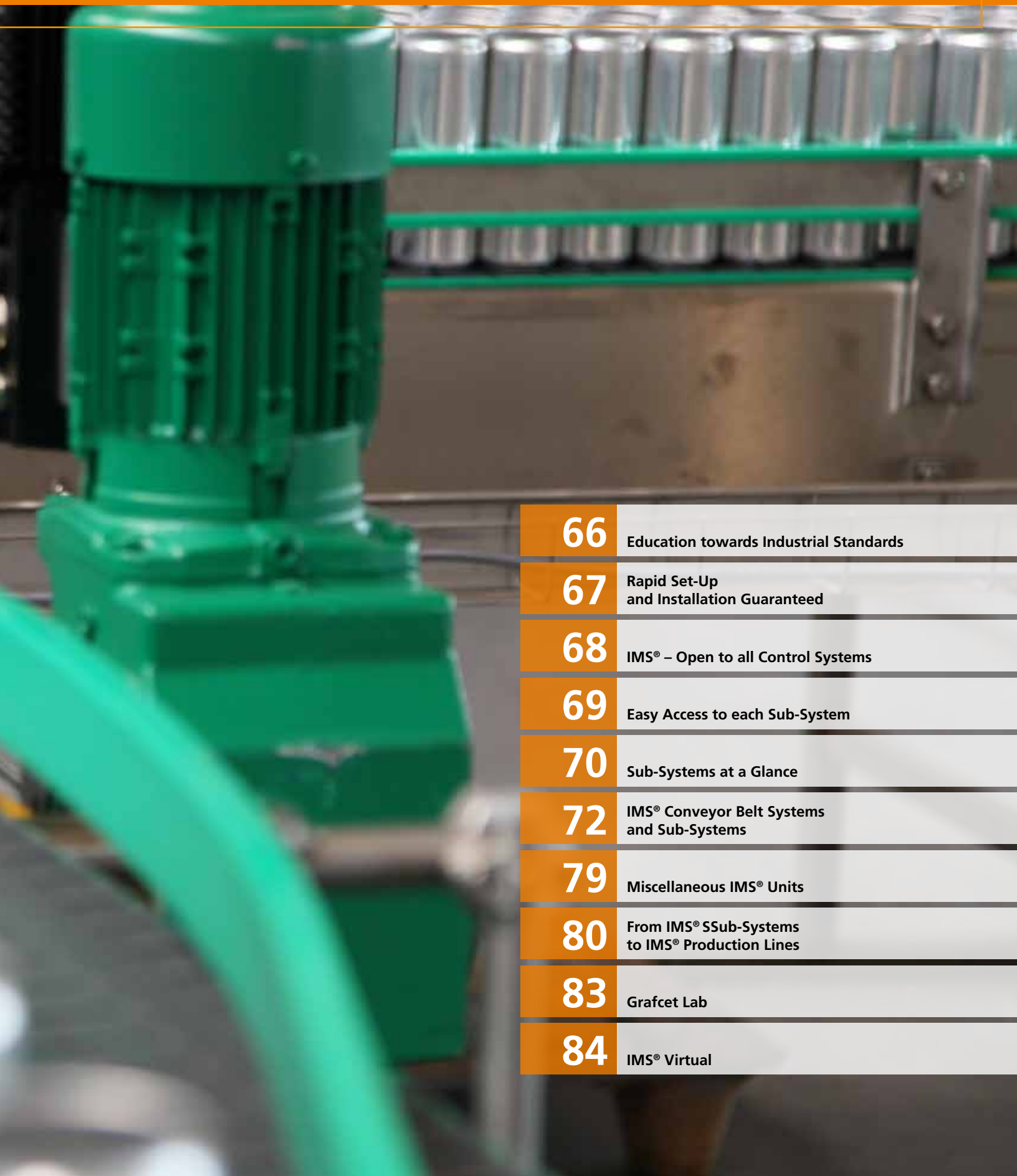
Industrial Mechatronic System IMS®



A Full-Scale Production Line “Industrial Mechatronics System“ IMS®

From Individual Mechatronics Sub-Systems All the Way to Flexible FMS Production Lines

More complex training needs

Radical changes in the way people work have revolutionised the requirements and needs of how information and skills are taught and trained. As changes occur in company and factory processes, more and more importance is being assigned to such aspects as “operational competence” and “design of individual work processes” in day-to-day practice.

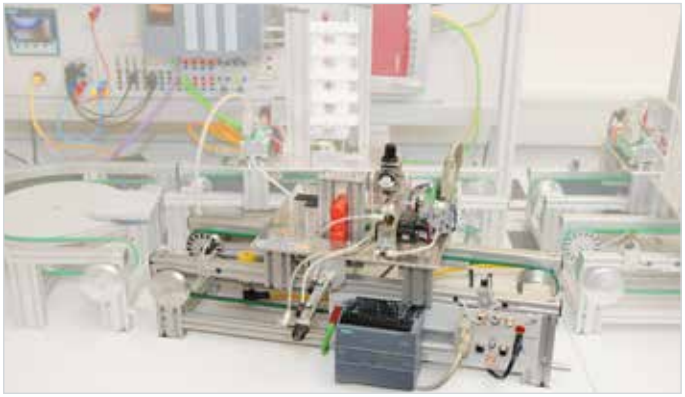
Integrating thought and action

Nowadays people being trained as automation engineers receive a broad “skills set” and qualifications in the most varied of technical disciplines. Performance objectives cover training in the assembly and mounting of system components and machinery, as well as in such practical applications as installation, operation and even maintenance of production lines, for which an understanding of the entire system is a prerequisite.

Changing educational approaches

These factors emphasise the need for a mechatronics training system to be the heart of a broad-based automation program to ensure to that theoretical technical knowledge is successfully cemented by means of realistically practical learning situations. The opportunity for students to learn using complex mechatronics training systems makes it easy for them to step up to industrial practice.

Modular design
IMS® is modularly designed so that functional systems of the most wide-ranging sizes can be designed. All of the sub-systems can be deployed individually or in any combination. For workpiece transport between individual sub-systems, a double conveyor belt system is used on which workpiece carriers travel.



Reflection or reality
With this training system, the industrial processes of a complex continuous production line are realistically simulated. The system exclusively employs industrial-type actuators and sensors. Furthermore, only industrial-type PLC systems with PROFIBUS and decentralised peripherals are used for process control.

Developing skills and expertise
The system promotes the training of skills and expertise during actual teamwork and enables the students and trainees to acquire the basics needed for the mastery of mechatronics systems in self-learning sessions. Each sub-system has been specially designed so that skills and knowledge are acquired gradually step-by-step right up to the point where a complete and sophisticated automatic production system has been created.

Education towards Industrial Standards

Simple Process Control

To control the individual work steps on a production line in order to put the entire system into operation is a process of some complexity. Therefore, achieving rapid set-up and installation is an important objective in training. By employing self-paced study using the UniTrain system and the Siemens SIMATIC S7-300 PLC, your students are optimally prepared for the task at hand. UniTrain offers a simple, didactically structured introduction to the control of each sub-system and is the preparation for integration and process control of production lines with industrial standard equipment using the Siemens SIMATIC S7-300 PLC.

- **UniTrain**
  (Course work + experimenting + process control)

  The individual sub-systems are controlled using UniTrain. This includes a fully integrated, fully fledged PLC with a PROFIBUS master. Your student will run his first PLC program within 10 minutes.

  The multimedia courses convey the fundamentals of operation, design, definition and programming of process sequences for each of the sub-systems. Theory is reinforced with practical, hands-on experimenting.

- **Siemens SIMATIC S7-300**
  (Process control with industrial standard equipment)

  An entire production line comprising individual sub-systems can be controlled using, for example, the SIMATIC S7-300 from Siemens. This level of process control precisely reflects the realities found in industry.

Your benefits

- **UniTrain**
  - Multimedia-based self-study course
  - Including control system with PROFIBUS
  - Fast progress due to extremely rapid set-up
  - Integrated development platform

- **Siemens SIMATIC S7-300**
  - Process control of the entire production line with industrial standard equipment
  - Communication via PROFIBUS, PROFINET, PROFIsafe and AS-i
  - Industrial PLC
  - Use of STEP 7 as well as decentralised peripherals
  - Touch panel operation

Rapid Set-Up and Installation Guaranteed

Perfect Understructure

In order to put the "Industrial Mechatronic System" IMS® to optimal use, there is a mobile substructure available that was designed especially for this system.

More detailed information is available in the Laboratory systems and equipment catalogue.

Standard Version ST 7200-3U

Expanded Version ST 7200-3T

UniTrain self-study system

- Small groups of students each set up and learn to operate a sub-system with the UniTrain control system
- Thanks to extremely fast set-up times, the students can be implementing their **first PLC program within 10 minutes**
- By the use of the accompanying multimedia-based self-study course, the instructor has **more time to provide individual instruction** to students and groups

Siemens SIMATIC S7-300 PLC control system

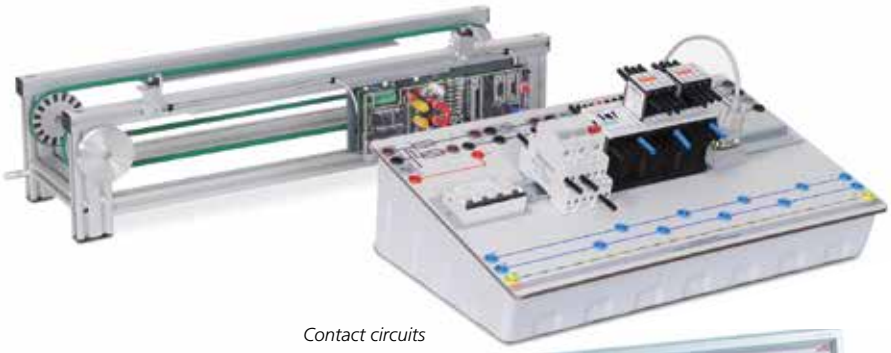
- A complete class of students can set up and operate a full-length IMS® production line with the S7 PLC control system
- Consequently the students are able to learn hands-on how to perform **process control** of production lines **with industrial standard equipment**

IMS® – Open to all Control Systems

Control via Contactor Circuits and LOGO!®

An introduction to IMS® can also be made via conventional electrical engineering. Hard-wired control techniques with the help of contactor circuits are eminently suitable for small projects using the IMS® conveyor belt. Projects employing LOGO!® also fit in splendidly and expand the range of possible control systems.

Our consultants are happy to provide the necessary information to help you.



Contact circuits

LOGO!®

Your benefits

- **Contactor circuits**
  - Conventional, hard-wired control techniques
  - Introduction to simple tasks
  - Expandable to handle complex control needs
  - Preparation and reimplementation of control projects to use programmed control techniques
- **LOGO!®**
  - First steps in programmed control techniques
  - Combination and enhancement of existing control projects
  - Use of LOGO!® Soft Comfort
  - Includes multimedia self-learning course

Easy Access to each Sub-System

Hands-On Training Guaranteed

The UniTrain multimedia experiment and training system uses informative text, graphics and animations in a clearly structured course software to guide students through the experiments. In addition to the training software, each course comes with an experiment card including a control unit on which the practical exercises can be performed.

Your benefits

- Educationally designed implementation and operation of all conveyor belts and sub-systems
- Integration of both cognitive and "hands-on" training material
- Strong linkage between theory and practice
- Rapid learning advances thanks to structured course design
- Extremely rapid set-up and assembly
- Courses structured into:
  - Training objectives/content
  - Hardware description
  - Software description
  - Basic knowledge
  - Experiments
  - Fault simulation and competency testing

Systematic arrangement of training objectives

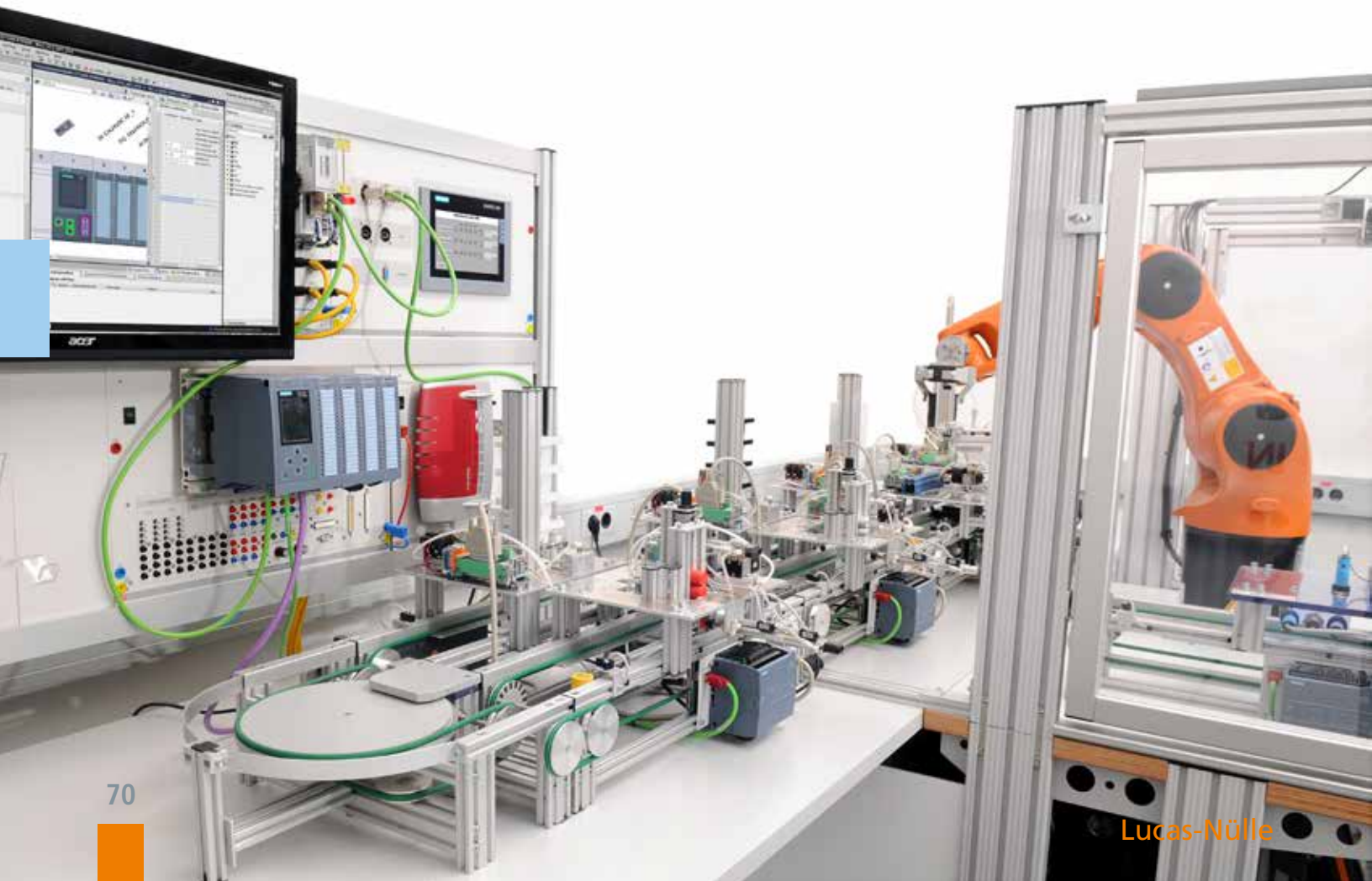
Sub-Systems at a Glance

Practical Hands-On Training Guaranteed

Modularity
Thanks to the modularity of the system it is possible to implement a large number of combinations and project variants . You can match the system design and complexity to your individual needs.

Adjustments in a matter of minutes
Going from instruction with a whole complex system to just single stations. Switching from one training situation to the other can be done in a matter of minutes without screwing and unscrewing of components or complicated shifting of tables and benches. The entire system can be assembled and disassembled easily thanks to the robust construction of the stations.

Industrial and authentic to modern practice
Virtually every component is a genuine industrial one. For that reason student s can easily transition to the real world of work.



Processing Stations

Transport (conveyor belt)

Processing

Routing

Intelligent transport system

Testing

Buffering

Sorting

Handling

Disassembly

Assembly

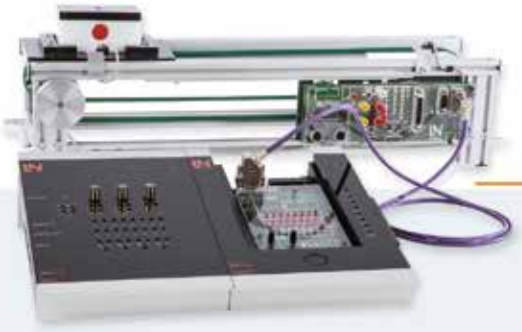
Storage

Drilling and milling

IMS® Conveyor Belt Systems and Sub-Systems

IMS® conveyor belt systems

The conveyor belt system is the element that connects all of the sub-systems and thus forms the backbone of the entire production line.



Your benefits

- In the IMS® production line the conveyor belt systems are self-contained modules, which can be integrated with the sub-systems as needed
- Each conveyor belt module is supplied with its own UniTrain course
- Basic processes like "positioning" and "speed" can be demonstrated with just this simple system

IMS® sub-systems

Every step of a manufacturing process can be emulated by the "Industrial Mechatronics System" IMS® and its sub-systems.

Your benefits

Lessons can be designed to suit your needs

- Practice on a specific sub-system or
- Practice on a set of individually selected sub-systems:
  - Subject matter can be adapted to varying degrees of trainees' existing knowledge
  - Particular sub-systems can be extended into custom assembled production lines
  - Each sub-system already possesses the control units, development environment and relevant multimedia training courses for self-paced study by students

IMS® 1.1 - Conveyor belt, unpowered
(For extensions to IMS® 1.2 and IMS® 1.3)

IMS® 1.2 - Conveyor belt, DC
(24 volt DC motor with variable speeds)

IMS® 1.3 - Conveyor belt, AC
(Three-phase frequency-controlled motor with frequency converter permits continuously variable speed)

IMS 180° curve

IMS 90° curve

Training contents

- Generating controlled movements along an axis
- Incremental positioning of a workpiece carrier
- Interlocking of forward motion and reverse motion
- Programming slip and standstill monitoring
- Working with different safety and interlocking circuits
- Understanding how sensors function and operate
- Connecting and using a PROFIBUS DP field bus system

IMS® 1.4 - Intelligent transport system

Situation

A Siemens PLC systems on the front end is freely programmable and is responsible for controlling the module. The processing stations attached to the conveyor belt can be controlled via PLC using the 25-pin D-Sub connector. The conveyor belt and its control unit form a single compact unit. Without any major reconfiguring measures or modification to the wiring the system can be disconnected from the overall production process and operated as a single operating station. Thus any difficult retrofitting or disassembly is done away with.

Training contents

- Conveyor belt control with variable speed via PWM signal from PLC
- Incremental encoder disc for the purpose of position detection and speed measurement via optical sensor
- Measurement of energy consumption for the sake of energy management
- Top-hat rail for enhancing the PLC by adding analog or digital IO modules
- Expansion of PLC by adding a PROFIBUS master module or IO-link master module

IMS® Sub-Systems

IMS® 2 - Industrial sensors

Situation
Placed on the conveyor belt is a workpiece carrier with a machined workpiece.

- The conveyor belt transports the workpiece to the test station,
- Where various sensors and attachments are used to determine the workpiece's colour and material.
- Select the sensor most suited for the required application.
- The IMS sensor case is meant for experiments with industrial sensors in the IMS-System.

Training contents

- Assembly, setting and testing of various proximity switches
- Examining the sensors' operating principles using various experimental setups
- Assembly and functionality of the following sensors:
  - Inductive proximity switch
  - Capacitive proximity switch
  - Reflection light sensor
  - Reflection light barrier

IMS® 3 - Sorting

Example
A workpiece carrier is located on the conveyor belt

- The carrier is positioned under the shaft for the gravity-feed magazine
- The sorting station has a magazine that accommodates six top or bottom pieces
- The sorting station has a stack magazine for six workpiece substructures
- One piece is selected and placed in the carrier
- The carrier and its load are then conveyed to the end of the belt to be passed on to the next sub-system

Training contents

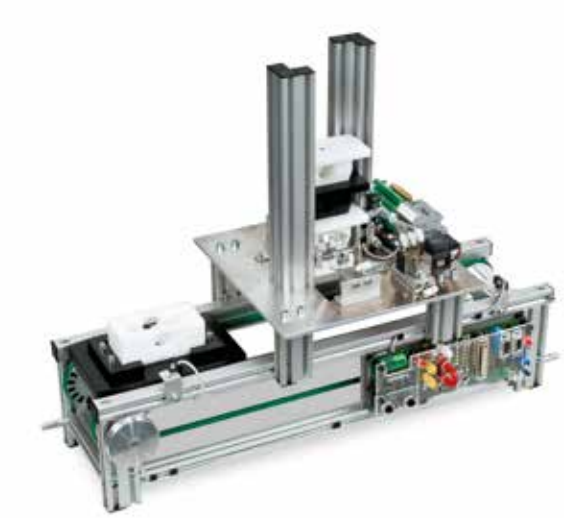
- Assembly, set-up and testing of pneumatic cylinders and valves
- Introduction to subsystems for workpiece substructures
- Defining processes for sorting
- Programming of production sequences in manual and automatic modes

IMS® 4 - Assembly

Example

A workpiece carrier is located on the conveyor belt with a substructure

- The carrier is positioned under the shaft for the gravity-feed magazine
- The sorting station has a stack magazine for six workpiece superstructures
- One piece is selected and placed in the carrier mounted on the substructure
- The carrier and its load are then conveyed to the end of the belt to be passed on to the next sub-system



Training contents

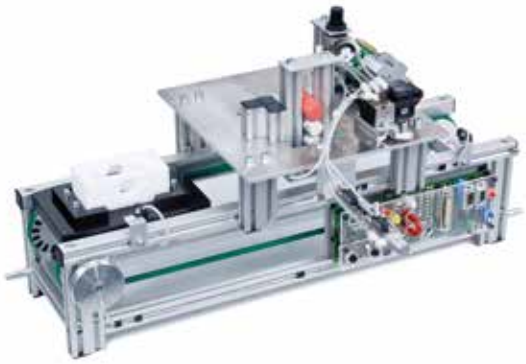
- Assembly, set-up and testing of pneumatic cylinders and valves
- Introduction to subsystems for workpiece superstructures
- Defining processes for assembly
- Programming of production sequences in manual and automatic modes

IMS® 5 - Processing

Example

A workpiece carrier is located on the conveyor belt. It is loaded with a fully assembled two-component workpiece (top and bottom pieces)

- The carrier and its load are positioned beneath the process module
- The workpiece is clamped for processing
- A bolt from the gravity-feed magazine is pressed into the hole in the workpiece
- The clamp opens and the carrier and load are conveyed to the end of the belt to be passed on to the next sub-system



Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Identification of workpieces
- Monitoring of a process sequence
- Definition of a process sequence for simple processing
- Programming of production sequence in manual and automatic modes

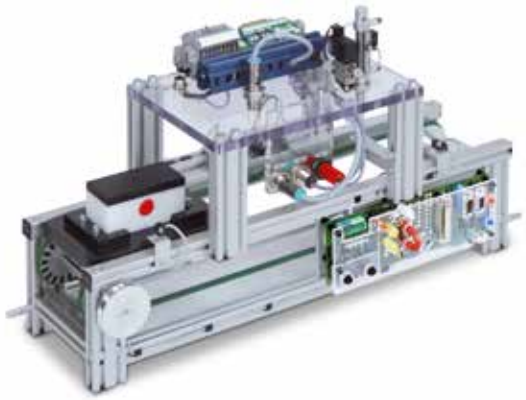
IMS® Sub-Systems

IMS® 6 - Testing

Example

A carrier with a fully assembled workpiece is located on the conveyor belt

- A stopper positions the piece alongside the sensors
- The sensors detect the colour of the piece, its material and optionally its height
- Test data will be saved for subsequent processes
- After each successfully completed test the carrier is conveyed to the end of the belt to be passed on to the next sub-system



Training contents

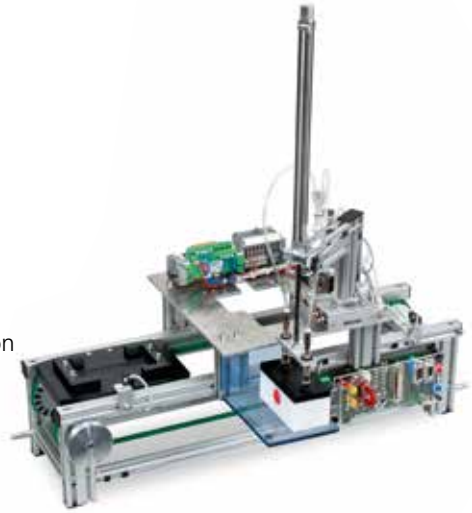
- Assembly, set-up and testing of pneumatic cylinders and valves
- Optical, inductive, capacitive and magnetic test sensors
- Definition of process sequence for simple testing
- Programming of testing sequence in manual and automatic modes

IMS® 7 - Handling

Example

A carrier with a fully assembled and tested workpiece is located on the conveyor belt

- A handling station is located above the middle of the conveyor belt
- The carrier is stopped at the removal position
- The handling module lifts up the workpiece and transfers it to a different position
- The empty carrier is conveyed to the end of the belt to be passed on to the next sub-system



Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Vacuum generator, suction mechanism with sensors
- Definition of process sequence for simple workpiece sorting
- Set-up and control of a pneumatic linear unit
- Programming of sorting sequence in manual and automatic modes

IMS® 8 - Storage

Example
A carrier with a fully assembled and tested workpiece is located on the conveyor belt

- The carrier is stopped at the removal position
- The handling module lifts up the workpiece and transfers it to one of twenty possible storage positions
- The storage positions can be chosen according to the production task and test results
- The empty carrier is conveyed to the end of the belt to be passed on to the next sub-system

Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Definition of process sequence for automated storage and retrieval systems
- Detection of storage coordinate by means of incremental sensors
- Programming of a process chain
- Programming of complete warehousing process in manual and automatic modes

IMS® 9 - Routing

Example
A workpiece carrier is located on the conveyor belt

- The routing unit receives the carrier and transfers it to a revolving transport unit
- The revolving unit can determine the further routing of the carrier
- The carrier can be picked up and passed on in any one of three positions

Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Introduction to a conveyor routing unit
- Definition of process sequence
- Programming of production sequence in manual and automatic modes

IMS® Sub-Systems

IMS® 10 - Buffering

Example

The conveyor belt is equipped with two lifting units for buffering or queuing workpieces in complex mechatronics systems

- The buffer controls the flow of materials
- The carrier is lifted from the conveyor belt by a lifting unit and deposited in a magazine, while the belt continues moving with other pieces
- Up to four laden or 10 unladen workpiece carriers can be held in store
- The lifting unit can set the workpiece back onto the conveyor when necessary

Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Introduction to a buffering unit
- Definition of process sequence
- Programming of production sequence in manual and automatic modes

IMS® 13 - Drilling and milling

Situation

There is a workpiece carrier on the conveyor belt with a workpiece bottom section.

- The drilling and milling station is equipped with a controllable milling head which glides along the interior contour of the bottom section of the workpiece.
- The milling head can move in three different axes to process the workpiece.
- The loaded workpiece carrier proceeds to the end of the conveyor belt where it moves onto for processing by the next sub-system.

Training contents

- Mounting, adjusting and testing of pneumatic cylinders and valves
- Defining the process sequence for drilling and milling
- Programming the production process for drilling and milling
- Commissioning and control of the milling unit

Miscellaneous IMS® Units

IMS® Transfer nodes

Up to four conveyor belts can be plugged into the IMS® transfer nodes featuring 90° curves. This allows materials to flow in a variety of directions.

IMS® Lifting platform

A lifting platform is integrated into a conveyor belt system. With this platform a workpiece carrier can be lifted, thus permitting the conveyor belt to continue to operate without having the workpiece carrier moved away.

Sensors for **IMS®**

Expand your IMS system by adding more sensors to permit even more options.

Reed contact

Used to detect the magnetic field of the positioning magnet on the workpiece carrier. Detects the precise position under a processing station.

Incremental sensor

Detects markings of the incremental encoder discs on the conveyor belt. This permits precise positioning.

Capacitive sensor

Detects whether or not a workpiece is located on the carrier. Acts as an additional production monitoring mechanism to ensure that the stations are operating properly.

From IMS® Sub-Systems to IMS® Production Lines

Advanced Teaching Structure

By assembling a variety of sub-systems, the "Industrial Mechatronics System" IMS® can integrate individual process steps to form a complete production line. This allows a realistic demonstration of interdependent production processes.

IMS® 23 - Production line with 3 sub-systems

IMS® 3 - Sorting, IMS® 6 - Testing, IMS® 7 - Handling

IMS® 3 - Sorting

An empty carrier is conveyed into the station and positioned under a gravity-feed magazine where a bottom section for a workpiece is selected and loaded onto the carrier.

IMS® 6 - Testing

A carrier with a separate bottom component is conveyed into the testing station. Sensors are used to detect the material of the workpiece and store the information for subsequent processes.

IMS® 7 - Handling

After testing, the workpiece is transported to a removal station. The component is then placed in one of two locations according to the results of the testing.

Your benefits

- Mix and match sub-systems to assemble custom production lines based on your design, available budget, and space
- One production line can be skilfully used to teach fundamentals and advanced applications
- Modular design allows future expansion
- Add conveyor belt system to create a continuous, self-repeating production process

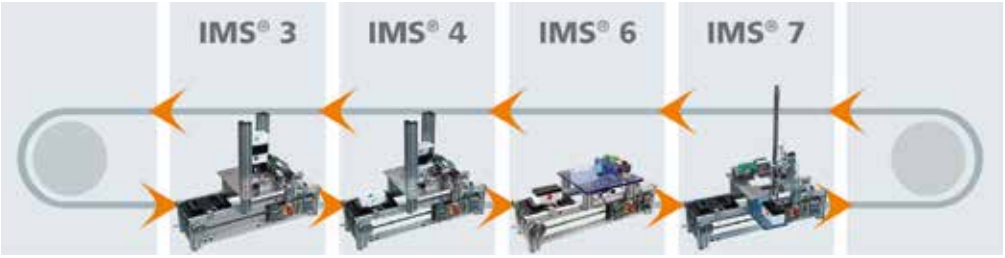
IMS® 24 - Production line with 4 sub-systems

IMS® 3 - Sorting, IMS® 4 - Assembly, IMS® 6 - Testing, IMS® 7 - Handling

As per IMS® 23, plus:

IMS® 4 - Assembly

A carrier loaded with a bottom piece arrives at the station and is positioned under the magazine. A top component is selected from the magazine and assembled on top of the bottom section.



IMS® 25 - Production line with 5 sub-systems

IMS® 3 - Sorting, IMS® 4 - Assembly, IMS® 5 - Processing, IMS® 6 - Testing, IMS® 8 - Storage

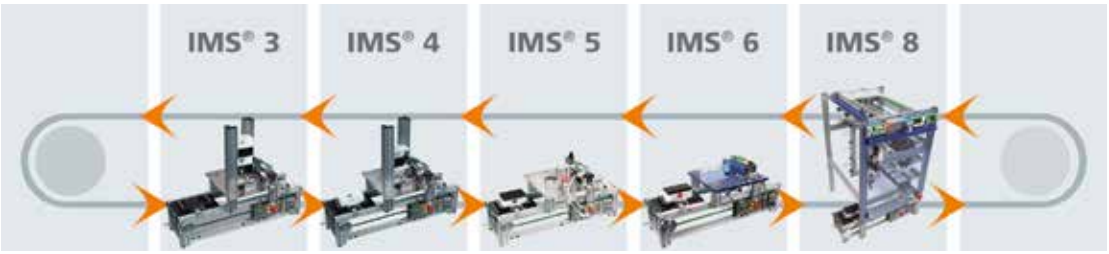
As per IMS® 24, with IMS® 7 omitted but including:

IMS® 5 - Processing

A fully assembled two-component workpiece loaded on a carrier is conveyed on a belt into the station. It is positioned in the processing module and clamped into place. A bolt is selected from the magazine and pressed into the hole in the workpiece.

IMS® 8 - Storage

The return system features a storage and retrieval system with twenty storage cells. Workpieces can be stored on the rack according to the production job and test results. Empty carriers are then returned to the start of the production line.



From IMS® Sub-Systems to IMS® Production Lines

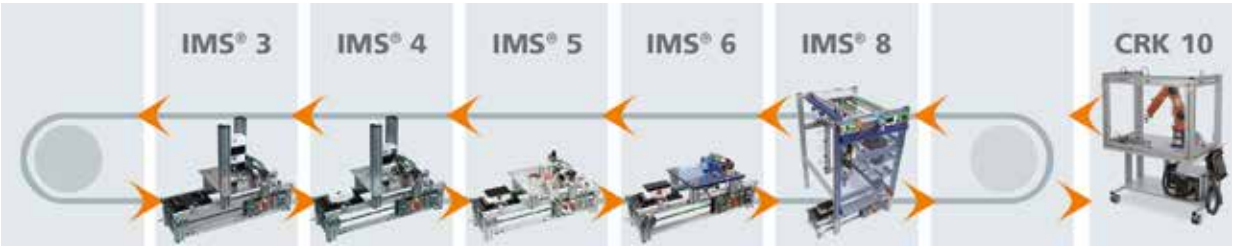
IMS® 26 - Production line with 6 sub-systems

IMS® 3 - Sorting, IMS® 4 - Assembly, IMS® 5 - Processing, IMS® 6 - Testing, IMS® 8 - CRK10 with disassembly project equipment

As per IMS® 25, plus:

CRK10 with disassembly project equipment set

The robot extracts the workpiece from the conveyor belt and places it in the disassembly station. There it disassembles the workpiece into its component parts. In conclusion it sorts the components into the storage sites provided for them.



IMS® 28 - Production line with 8 sub-systems

IMS® 3 - Sorting, IMS® 4 - Assembly, IMS® 5 - Processing, IMS® 6 - Testing, IMS® 8 - Storage, IMS® 9 - Routing, IMS® 10 - Buffering and CRK10 with disassembly project equipment

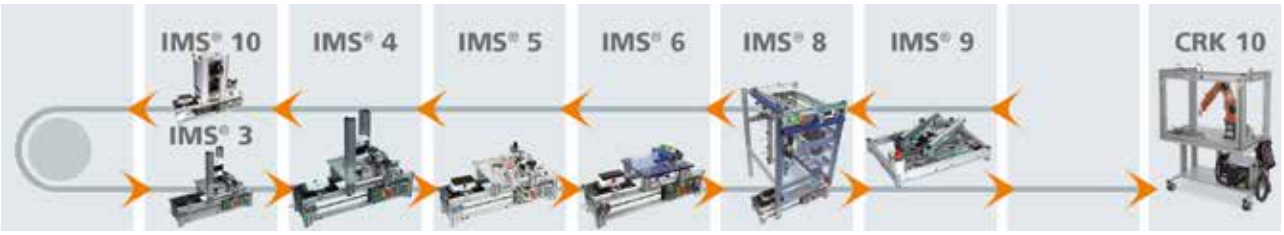
As per IMS® 26, plus:

IMS® 9 - Routing

The routing unit can move the workpiece carrier for a different sub-system or even change its direction.

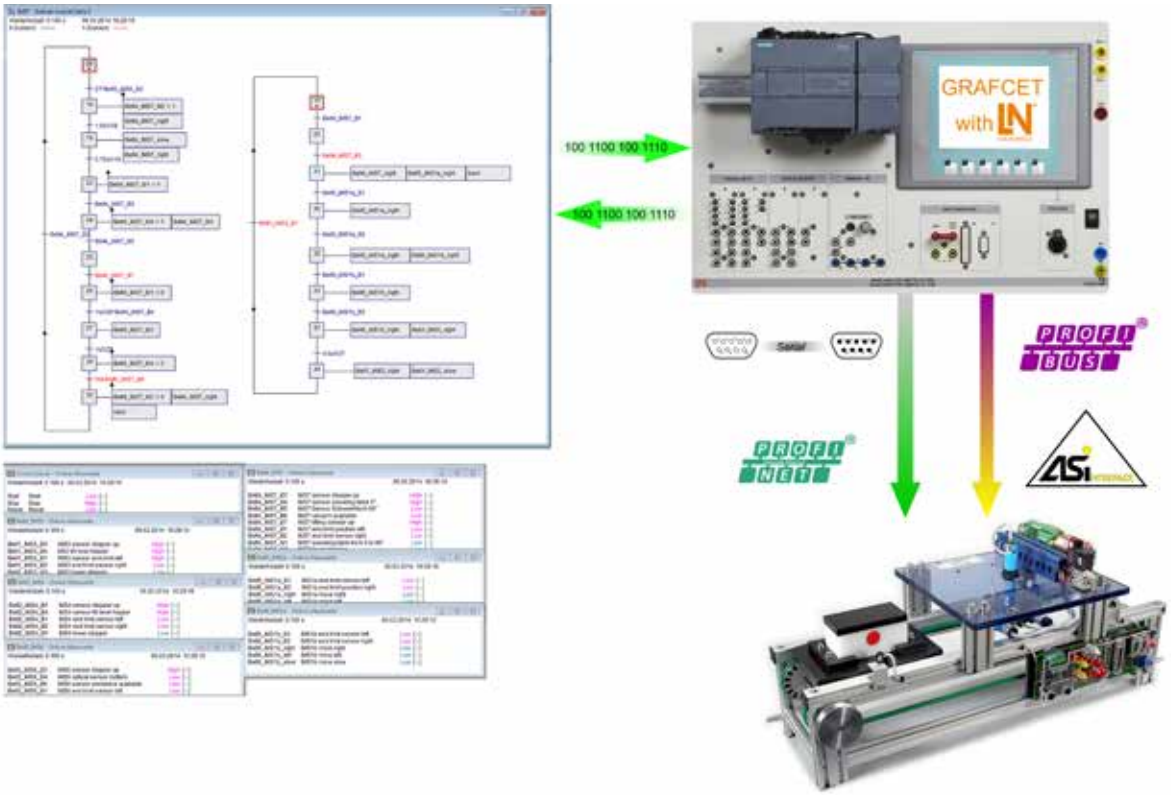
IMS® 10 - Buffering

Should more than one workpiece carrier be located on the conveyor belt, the buffering sub-system can control the material flow. The workpiece carrier is lifted using a lifting mechanism. The workpiece carrier can then be placed back onto the conveyor belt as needed.



Grafcet Lab for Controlling Hardware

Compile GRAFCET plans and implement them for controlling hardware. Use the editor to view the current steps in the processing and read the signal states directly using freely configurable signal tables. Using a Siemens S7-300/S7-1200/S7-1500 control system as its interface, GRAFCET Lab controls hardware connected to a PLC system. GRAFCET Lab has 40 digital inputs and 40 digital outputs. Another 8 analog inputs and 8 analog outputs can be used for control and evaluation on the basis of analog values.



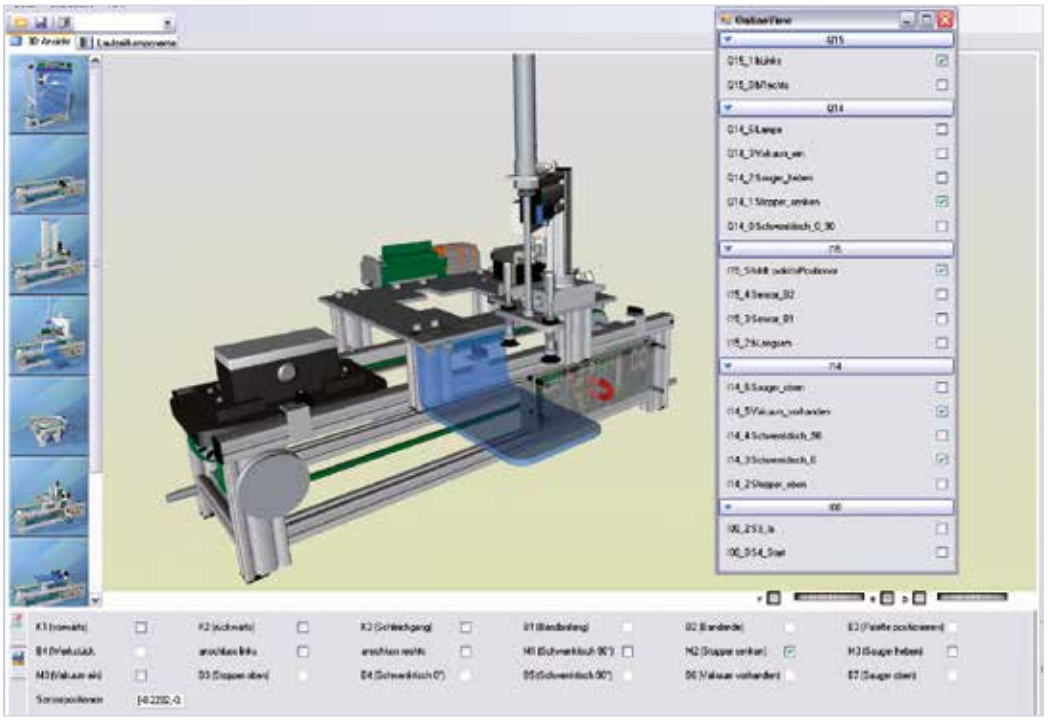
Your benefits

- 5 ms clock cycle
- 40 Digital inputs
- 40 Digital outputs
- 8 Analog inputs
- 8 Analog outputs
- Easy to link with Siemens PLC system
- Pre-configured projects lead to rapid success
- More than 50 templates and sample solutions for all IMS stations and plant configurations

IMS® Virtual

The "Digital Factory": Realistic, Dynamic 3D Display

IMS® Virtual is a PC-based, graphical 3D simulation program, which provides a virtual learning environment for the IMS® mechatronics training system. The virtual sub-systems and production lines are depicted in real-time as a dynamically animated virtual 3D scene featuring all the components. The 3D scene can be programmed using STEP 7 just like a real production control system and is controlled by the "PLCSIM" software.



Teacher/student version of IMS® Virtual

Real hardware: IMS® 7 – Handling

Training contents

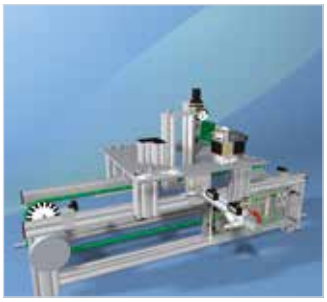
- Simulation and visualisation of technical processes
- PLC programming in accordance with IEC 1131-1 (IL, LD, FBD)
- Control and monitoring of technical processes
- Parameter setting, programming and commissioning of technically differing systems
- Systematic troubleshooting of production lines
- Central operation and monitoring of plant and processes
- Functions and system structure for a production line
- How an industrial robot operates within a production facility

Example Models of IMS® Sub-Systems and Production Lines

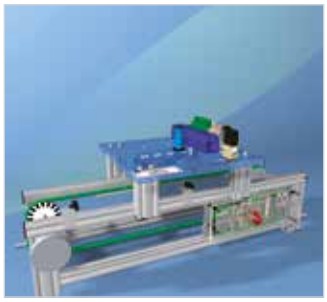
In the trainer/instructor version, with a few mouse clicks you can create almost any configuration of IMS® production line out of a library of virtual IMS® models.

IMS® 1 - Conveyor belt

IMS® 3 - Sorting and IMS® 4 - Assembly



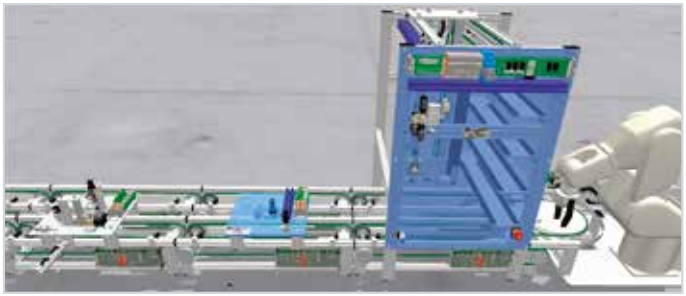
IMS® 5 - Processing



IMS® 6 - Testing

IMS® 7 - Handling

IMS® 8 - Storage



Production line IMS® 26 with industrial robot

Your benefits

- Design and behaviour of processes are accurate in detail and clearly modelled in 3D
- A library is provided with working mechatronics sub-systems and production plants
- Real-time simulation
- Collision detection
- Fault simulation: configuration of errors in the adjustment of sensors or in electrical or physical properties of components
- Classroom licence including student and trainer/instructor versions
- Development of self-written process models with the expert version