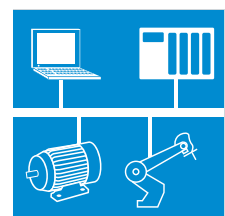


IMS

Industrial Mechatronics System

From individual mechatronics sub-systems all the way to flexible FMS production lines





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Qualifications through Quality

Mechatronics training with the “Industrial Mechatronics System” **IMS**

Identifying problems ...

A more complex world of training and education

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

Integrating thought and action

Today 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 didactic approaches

These factors emphasise the need for a Mechatronics Training System to be the heart of a broad-based automation programme, from the start to the successful retention, comprehension and application of essential qualifications.

The opportunity for students to learn using complex mechatronics training systems makes it easy for them to step up to industrial practice.



Finding solutions ...

Working with the "Industrial Mechatronics System" IMS

To find a solution for the complex world of training, to promote integrated thought and action and to meet the demands of new didactic approaches, we have developed the "Industrial Mechatronics System" IMS, a comprehensive production line:



- Integrates all subjects from the area of automation technology into one system
- Realistic model of automated industrial manufacturing processes
- Modular design for the greatest possible flexibility
 - Functional components for the demonstration of individual process steps (e.g. conveyor belts)
 - Sub-systems for the demonstration of individual entire processes (e.g. selection, assembly, etc.)
 - Production line – consisting of individually assembled, interconnected sub-systems – for the demonstration of a complex production process
- Each sub-system is equipped with hardware and software of the blended learning system UniTrain-I
 - Didactically designed, multimedia-based experimenting and training system
 - Realistic experiments accompanied by graphics, text, animations and tests
- Integrated solutions for process control concepts using
 - ProfiNet
 - ProfiBus
 - AS-i
 - PROFI-safe
 - ASIsafe



The Production Line “Industrial Mechatronic System” IMS

Hands-on training guaranteed





Conveyor



Testing



Buffering



Sorting



Handling



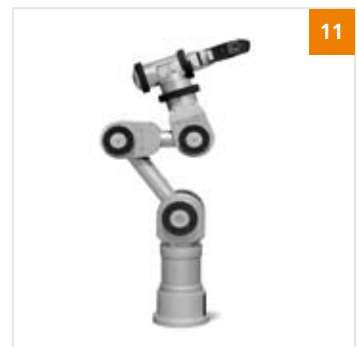
Disassembly



Assembly



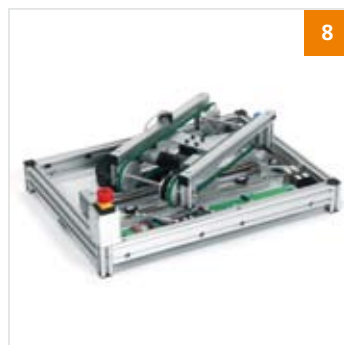
Storage



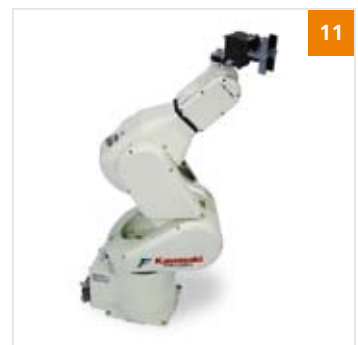
Robotics



Processing



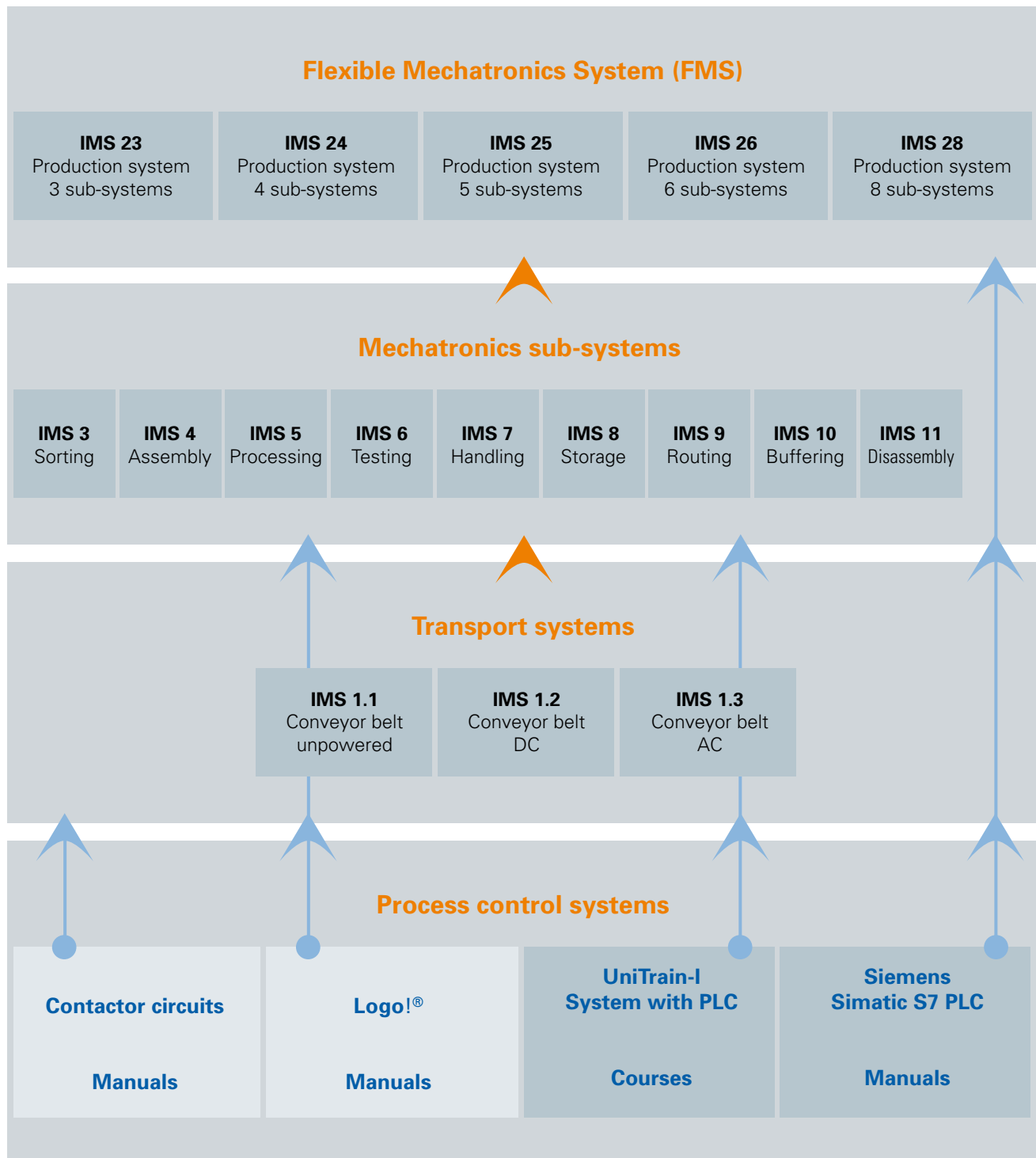
Routing



Robotics

From Process Control Systems to FMS Production Lines

The entire system at a glance



Didactic Approach to 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. To achieve rapid set-up and installation is – for that reason – an important objective in training.

By employing self-paced study using the UniTrain-I system and the Siemens Simatic S7 PLC, your students are optimally prepared for the task at hand. UniTrain-I offers a simple, didactically structured introduction into 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 PLC.

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

The individual sub-systems are controlled using UniTrain-I. This includes a fully integrated, fully-fledged PLC with a ProfiBus master. Your student will run his first PLC programme 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 PLC**
(Process control with industrial standard equipment)

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

Benefits to you

- **UniTrain-I**

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

- **Siemens Simatic S7 PLC**

- Process control of the entire production line with industrial standard equipment
- Communication via ProfiBus, ProfiNet, PROFI-safe and AS-i
- Practical PLC
- Use of STEP7 as well as decentralised peripherals



Rapid Set-up and Installation Guaranteed

UniTrain-I self-study system

- Small groups of students each set up and learn to operate a sub-system with the UniTrain-I control system
- Thanks to extremely fast set-up times, the students can be implementing their **first PLC programme 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 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**

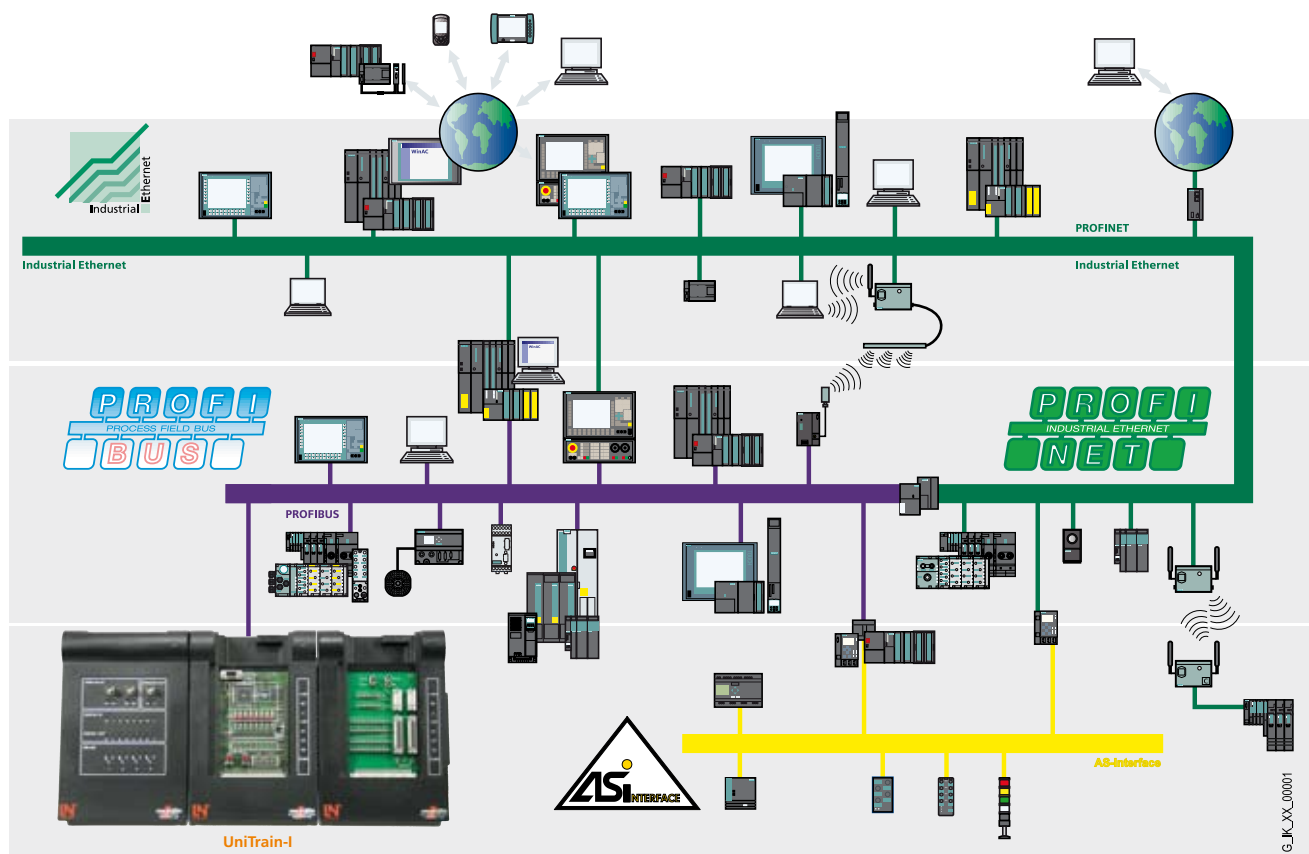


Integrated Solutions for Process Control Concepts

Using ProfiBus and ProfiNet

The trend currently dominating automation engineering involves modular system design with distributed intelligence.

ProfiNet, ProfiBus and AS-i offer every possibility of networking various intelligent components – from the lowest field level up to process control and instrumentation technology.



Benefits to you

- Configurations range from simple bus structures up to complex networks with rapid set-up and assembly
- Flexible modification and expansion of bus structures
- Use of authentic industrial components
- Communication

General:

- ProfiBus
- ProfiNet
- Industrial Ethernet

Safety-oriented:

- PROFI-safe
- ASi-safe

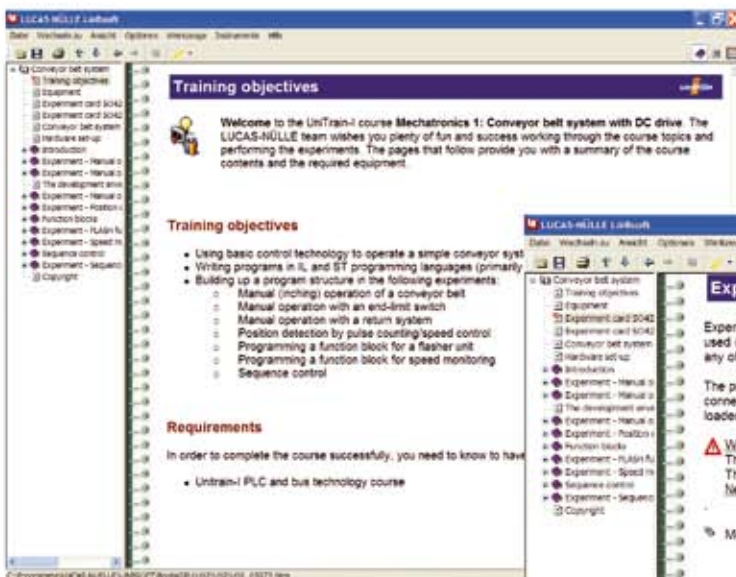
Easy Access to Each Sub-system

Learning through the multimedia-based UniTrain-I courses

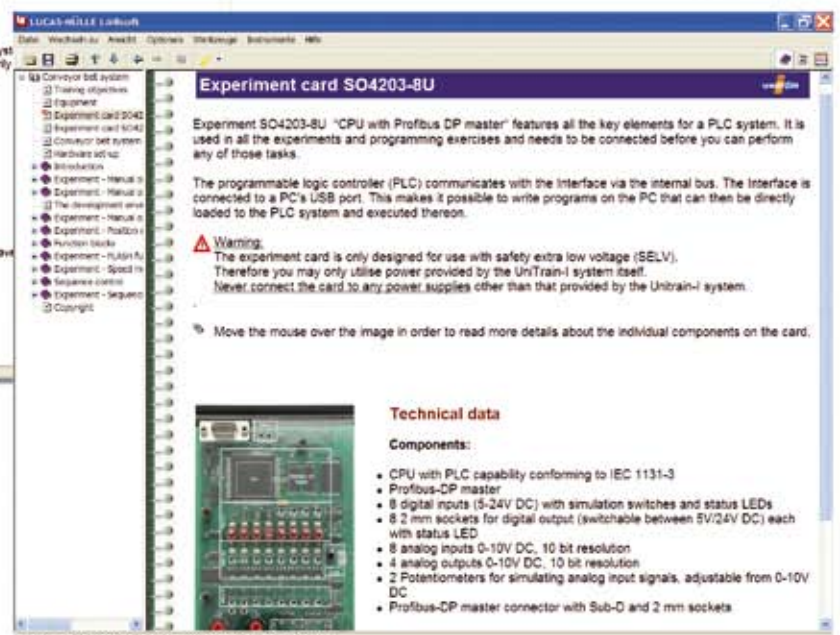
The UniTrain-I multimedia experiment and training system uses informative texts, graphics and animations in a clearly structured course software to guide students through the experiments. In addition to the training software, each course comes with an experiment card including a control unit on which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

Benefits to you

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



Systematic arrangement of training objectives



Experiment cards - contains all central elements of a PLC

IMS Conveyor Belt Systems

Perfectly connected

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



Benefits to you

- 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-I course
- Basic processes like “positioning” and “speed” can be demonstrated with just this simple system

IMS 1.1 - Conveyor belt, unpowered

(for extensions to IMS 1.2 and IMS 1.3)

IMS 1.2 - Conveyor belt, DC

(44 volt DC motor with variable speeds)

IMS 1.3 - Conveyor belt, AC

(Three-phase frequency-controlled motor with frequency converter permits continuously variable speed)

Training contents for conveyor belts

- 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



IMS Sub-systems

Open teaching structure

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



Benefits to you

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 3 - Sorting and IMS 4 - Assembly

Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Introduction to sub-systems for top section and bottom section assembly
- Definition of process sequences for sorting and assembly
- Programming of production sequences in manual and automatic modes

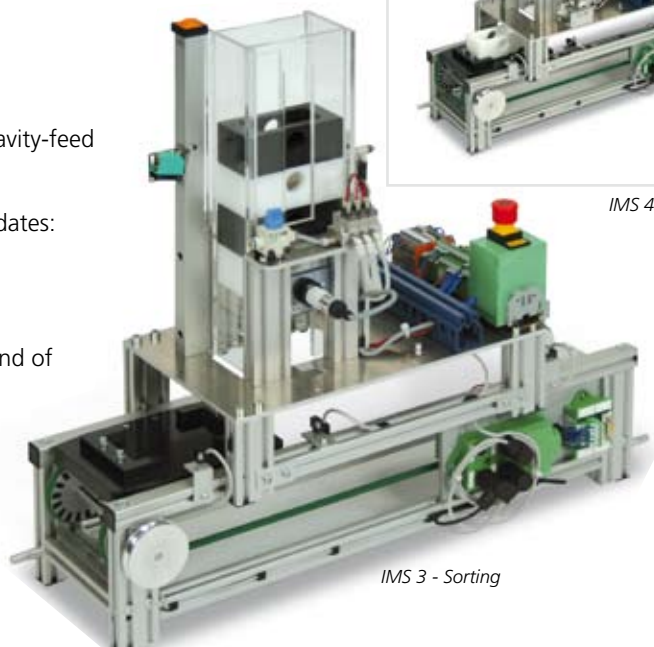
Example

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
- ▶ 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



IMS 4 - Assembly



IMS 3 - Sorting

IMS Sub-systems

IMS 5 - Processing

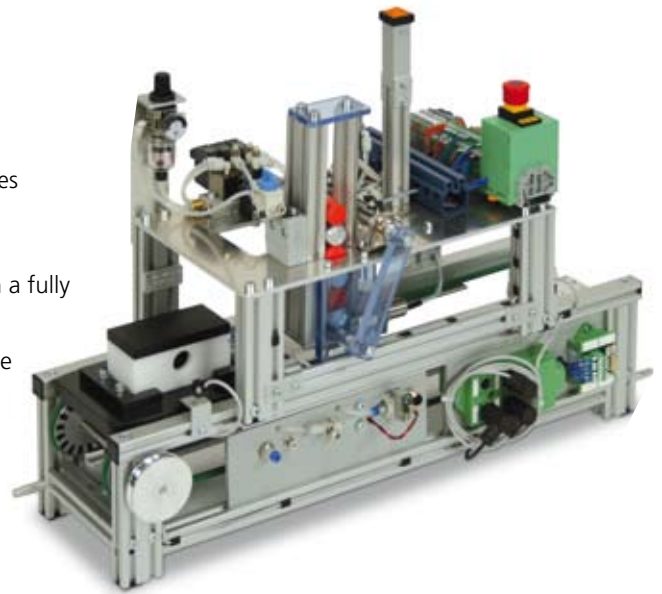
Training contents

- 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

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



IMS 6 - Testing

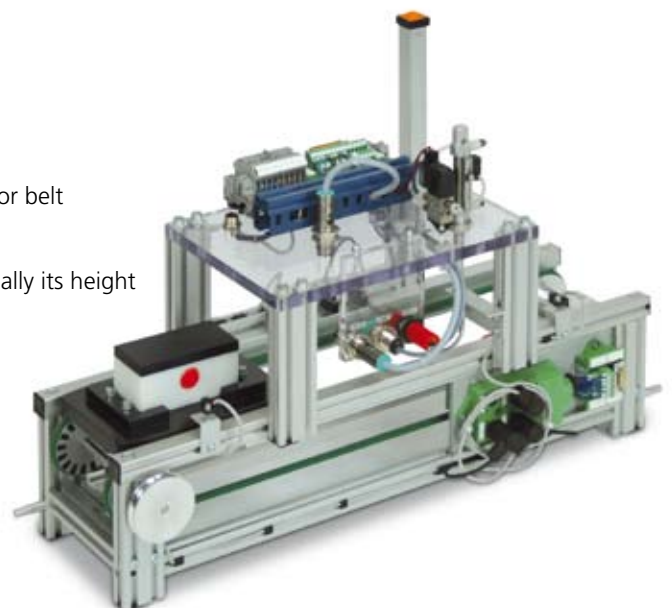
Training contents

- 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

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



IMS 7 - Handling

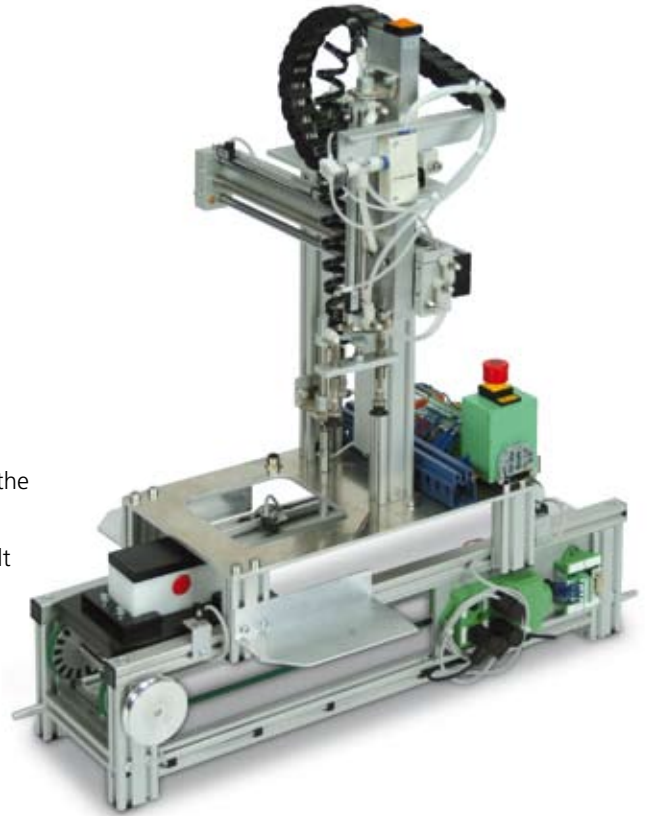
Training contents

- 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

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 one of two possible positions
- ▶ The empty carrier is conveyed to the end of the belt to be passed on to the next sub-system



IMS 8 - Storage

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

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



IMS Sub-systems

IMS 9 - Routing

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

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



IMS 10 - Buffering

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

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 while the belt continues moving with other pieces.
- ▶ The lifting unit can set the workpiece back on the conveyor when necessary



IMS 11 - Disassembly by robot

Training contents

- Assembly, set-up and testing of pneumatic cylinders and valves
- Introduction to the disassembly module
- Definition of process sequence
- Programming of production sequence in manual and automatic modes
- "Teaching" the robot in manual and automatic mode

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 robot lifts up the workpiece and transfers it to the dismantling station
- ▶ The workpiece is clamped in place
- ▶ The individual pieces of the workpiece are taken apart
- ▶ The robot sorts out the individual components into pre-defined storage places



IMS 11.1 with aluminium profile trolley and PC



IMS 11.2 and IMS 5 with aluminium profile trolley and PC

IMS Robot Technology

Made to meet your needs

Workforce training in automation requires a competence in robotics and its numerous applications in a production line.

For one group of students, rapid deployment in the minimum of space can be essential. For another, it may be more important to emulate industrial realities as closely as possible.

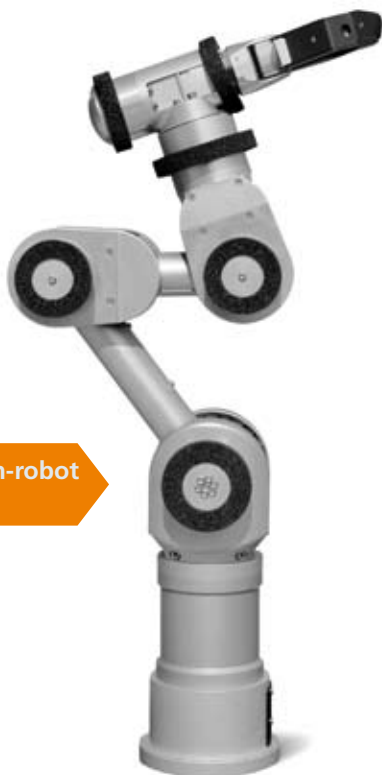
We have the right solution for either of these requirements

• Neuronics Katana6M

- Compact personal robot with 5 degrees of freedom and 6 drives
- Direct interaction possible between human and robot
- No special safety equipment is required (as per EU risk analysis)
- Rapid programming and redeployment
- Simple programming by means of manual "teaching"
- Intuitive operation
- Minimal footprint

• Kawasaki FS 003N

- Compact, high-speed handling robot as used in industry, with 6 degrees of freedom
- Professional training system to provide "real world" experience
- International standard for automobile work. Common industrial design
- Programming using Kawasaki's AS language or function block programming languages via "Teach Pendant"
- Programming and operation via laptop with supplied software
- PLC functionality



Direct human-robot interaction

Robot from IMS 11.1



Automobile industry standard

Robot from IMS 11.2

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.

Benefits to you

- 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 assemble a continuous self-repeating production process

IMS 23 - Production line with 3 sub-systems

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

IMS 3 - Sorting

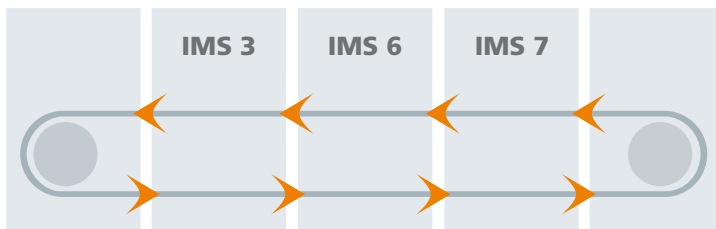
An empty carrier is conveyed into the station and positioned under a gravity-feed magazine where a bottom section for a workpiece is selected and loaded onto the carrier.

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



From IMS Sub-systems to IMS Production Lines

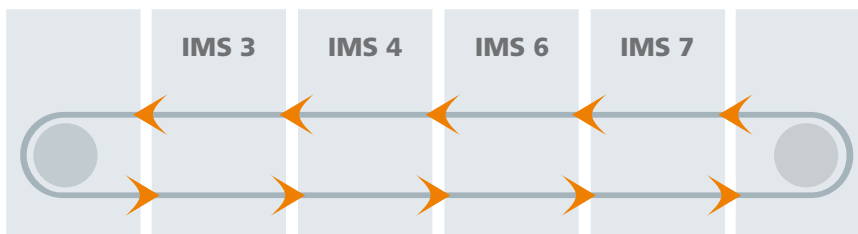
IMS 24 - Production line with 4 sub-systems

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

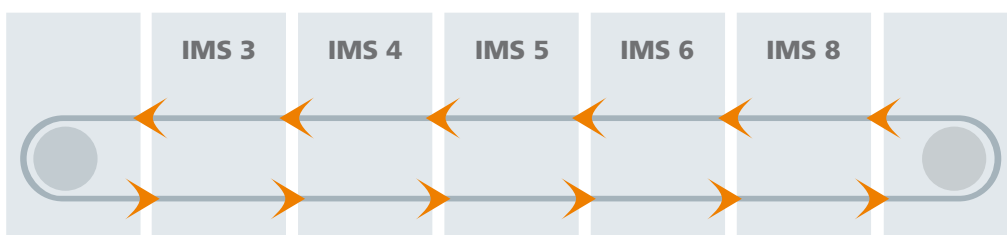
As per IMS 24 with IMS 7 omitted but including:

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.



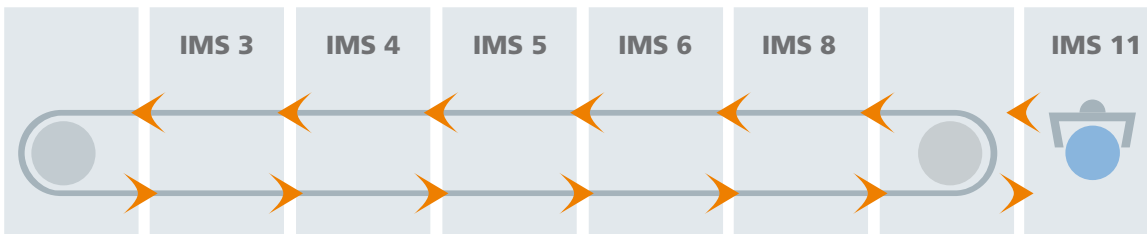
IMS 26 - Production line with 6 sub-systems

IMS 3 - Sorting, IMS 4 - Assembly, IMS 5 - Processing, IMS 6 - Testing, IMS 8 - Storage, IMS 11 - Disassembly

As per IMS 25, plus:

IMS 11 - Disassembly

A robot lifts the workpieces from the conveyor belt and places it in the disassembly station where it dismantles the piece into its individual components and sorts them into pre-defined storage locations.



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, IMS 11 - Disassembly

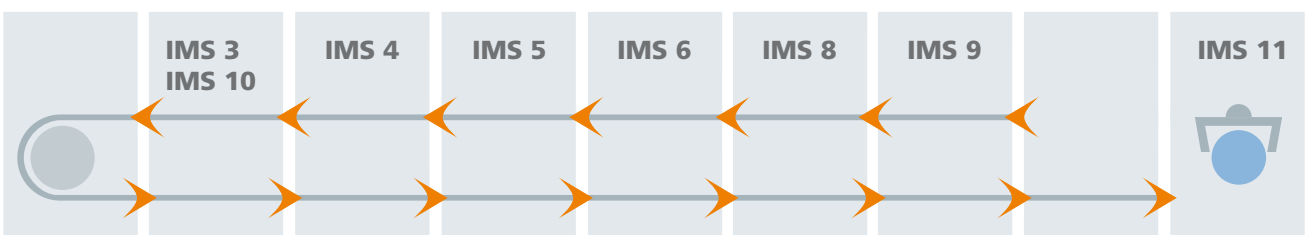
As per IMS 26, plus:

IMS 9 - Routing

The routing module can direct carriers to a different sub-system or otherwise change their direction of travel.

IMS 10 - Buffering

If more than one carrier is on the belt, this sub-system can buffer the flow of materials by employing a lifting unit to raise the carrier off the belt entirely. It can then be replaced on the belt when necessary.



IMS Aluminium Profile Trolleys

Perfect platform

To utilise the “Industrial Mechatronics System” IMS to the best advantage, a range of trolleys built from aluminium profile frames is available that has been specially developed for use with the system.

Benefits to you

- Trolleys custom-made to match the length of the conveyor belts
- Stability thanks to connecting mechanisms for combining elements into complete production lines
- Ease of working since panels simply slot into the experiment frames
- Common trolleys can easily be expanded to make up a multi-functional experiment trolley



Standard version
ST 7200-3M

IMS aluminium profile trolleys

- Specially designed to accommodate IMS sub-systems
- Cascadable for production lines or pallet return systems
- Including robust connecting mechanisms for expansion into complex production lines
- Training frames can be added to accommodate experiment panels
- Working surfaces can be expanded to the left or right via extension boards
- A lower shelf can be installed to accommodate PCs, hydraulic units and compressors
- Optional extensions to hold keyboards and monitors



Fully expanded version

IMS – for Use with all Process Control Systems

Process control using contactor circuits or LOGO!®

Control of the IMS system can also be performed by conventional industrial electronics techniques.

IMS conveyors are ideally suited for small projects with contactor circuits.

LOGO!® Micro Automation Software by Siemens can be integrated seamlessly and expands the range of possible control mechanisms.

Our consultants will be delighted to provide you with additional information.

Benefits to you

- **Contactor circuits**
 - Conventional, connection-based process control programming
 - Introduction via simple exercises
 - Extensible for comprehensive process control projects
 - Preparation and implementation of process control projects using programmable logic control systems
- **LOGO!®**
 - First steps in programmable process control systems
 - Combination and expansion of existing process control tasks
 - Utilisation of LOGO!® Soft Comfort
 - Including multimedia self-study training course



Essential Product Advantages

... ensure long-term customer satisfaction



Michael Lorf, lecturer at the Leopold-Hoesch vocational college, Dortmund, Germany:

I'm a great fan of the "Industrial Mechatronics System" IMS. It's a **flexible system** that can always be put together in a different way depending on your needs. No other manufacturers offer anything like it. Its **tremendous extensibility** makes it quite simple to adapt it from parallel wiring to a bus system. The integration of frequency converters and RFID labels is also very useful from a training point of view.

We are using the "Industrial Mechatronics System" IMS in a pallet return system and have added safety equipment to it as well. That too was implemented without any difficulties.

The documentation is great as well.

IMS corresponds to genuine industrial standards. It is therefore ideal for use in project work involving authentic conditions. Components can easily be added, removed or relocated. It is ideal for **working in a school environment**. The robust design matches up to the tough demands of everyday life in schools.

Now we have a really great system that impresses not only teachers and students but also a great many of our visitors.

The Whole is Greater than the Sum of its Parts

Individual consultation from Lucas-Nülle

Share your training objectives with us and receive a tailor-made proposal designed to help your programme succeed!

Then contact us at

Phone: +49 2273 567-0

Fax: +49 2273 567-39

Email: export@lucas-nuelle.com

Lucas-Nülle is known worldwide for tailor-made training systems for technical education in the following areas:



Installation Engineering



Electrical Power Engineering



Power Electronics, Electrical Machines, Drivers



Electrical and Electronic Circuits



Communications Technology



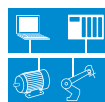
Process Control



Instrumentation



Micro Controllers



Automation Technology



Automotive Technology



Lab Systems

To ask for detailed information, contact us or your local dealer.

Further information is available online at:

www.lucas-nuelle.com

www.unitrain-i.com

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