Flexible Manufacturing Systems (FMS)

Bridging the Gap Between Classroom and Industry

Flexible solutions for educating and training students in the principles and technologies of advanced manufacturing

Smart Factories and Industry 4.0 embody the transformation at the forefront of modernizing manufacturing processes to keep competitive in this fast-changing world. Employers need workers who are tech literate, process savvy, and natural problem solvers to take a role in the on-going design and improvement of manufacturing systems.

Intelitek's FMS (Flexible Manufacturing System) solutions are designed to provide relevant skills and introduce technical and engineering classrooms to the industrial automation and industry applications needed in modern plants.

Intelitek integrated curriculum encompass design, hands-on experience, project-based learning, and theory to deliver job ready graduates for industry.

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Why FMS?

- Increased Production Output – Automated processes allow products to be built quickly as materials are loaded, unloaded, and transferred from one machine to another by robots.
- Increased Efficiency – Flexible manufacturing keeps everything running smoothly and quickly in the production process.
- Improved Flexibility – Easily adapt and keep production flowing without delays and bottlenecks results in faster production times and increased customer satisfaction.
- Reduced Manufacturing Costs – Reduce the cost of operations with the ability to adapt to change and help prevent defective products as well as wasted time and resources.
- Labor Cost Reduction – Automated machines and robots with minimal human intervention save time and labor costs.

How an FMS training solution benefits students?

Flexible Manufacturing Systems help businesses to create better products, become more efficient, and increase revenue as time goes on. Teaching these skillsets to students early on will serve to prepare them for their transition into industry.

Complete Training Solution

Intelitek training systems provide students hands-on experience with industrial level equipment and applications within a school lab environment. The modularity and flexibility of the Intelitek FMS training solutions allow them to be configured and integrated into an educational program that best suits your school's particular needs and budget. FMS systems from Intelitek are supplied as turnkey solutions, ready for work as soon as your students are ready.

Supports Your Curriculum

Intelitek FMS systems integrate with stand-alone disciplines like Mechanical Engineering, Electrical Engineering, and Manufacturing. Moreover, it is the perfect solution for cross-disciplinary programs – such as mechatronics, informatics and industrial engineering – that require the integration of multiple technologies. Industrial level hardware combined with 3-D simulation software and interactive animated E-learning content is what makes Intelitek FMS solutions stand beyond and above other alternative solutions.

Industry Aligned Training

Intelitek delivers a complete training package optimized for education - an educational program that focuses on automated industrial management with an emphasis on research and programming tools. The stations in the Intelitek FMS cells are equipped with educational yet fully automated hardware components. Students use the simulation capabilities of OpenFMS, RoboCell and CNCMotion software to gain proficiency in the management and integration of automated manufacturing processes. The system is equipped fully and exclusively with industrial grade equipment and supports the design, manufacture and testing of products and components.

Building your FMS Solution

FMS Training Configurations

Compact Flexible Manufacturing Systems from Intelitek encompass hardware, software, simulation and curriculum that can be used to teach the fundamentals of manufacturing including robotics, machining, control, system programming, and materials handling. Coupled with a comprehensive set of curriculum, students will learn design, manufacturing, maintenance and much more about manufacturing.

FMS from Intelitek is a great solution for beginners and experts. The solutions are all modular allowing for students to start with individual trainers or the Starter FMS system while more advanced students can expand and extend the system and its' capabilities with the Advanced FMS system or a custom designed solution.

FMS configurations workcell or machine tending station) typically include a CNC machine, an industrial robot and a materials handling or mobility component with the robot. Bundled systems can begin with a very simple configuration of a milling machine and ER-4U robot and expand to much more complex multi-machine solutions that include linear slide bases, mills, lathes, or engravers as well as larger robots or even multiple robots.

Already have a BenchMill CNC or ER-4U Industrial Robot? Upgrading your system to the Starter FMS system is a simple solution to broaden your current offering with minimal investment while expanding the knowledge base of your students in other manufacturing areas.

FMS Starter System

The base configuration bundle is a sophisticated starting point for any technical classroom and includes:

- ER-4U Robotic Arm and Accessories
- BenchMill 6100 CNC Milling Machine with Workbench
- Four Tool Automatic Tool Changer Package
- Gravity Parts Feeder
- LearnMate LMS (100 students/1yr license)
- Curriculum:
  - Robotics Fundamentals
  - CNC Milling Fundamentals
  - CNC Turning Fundamentals

FMS Advanced System

An expanded solution that includes a mobility system (Linear Slide Base) as well as two machines (CNC Mill and CNC Lathe). In addition, advanced curriculum as well as work projects are included that can be completed using the configuration.

All the components of the FMS Base System plus:

- CNC BenchTurn 7100 with Workbench
- 1.8m Linear Slide Base with Stand
- Pneumatic Feeder
- Engraving Package
- Additional Curriculum:
  - Advanced Robotics with ER4U
  - Intro to Advanced Manufacturing
  - CNC Turning Fundamentals

FMS Elements

Machine tending stations or workcells usually involve robots that tend CNC machines and performs other part manipulation and/or assembly tasks. When used in an FMS system, the robot loads and unloads parts to and from the machine. The robot is often mounted on a linear slidebase for mobility and to create a larger work area.

Manufacturing Machines

BenchMill 6100 CNC Milling Center

The BenchMill 6100 is a versatile PC-based benchtop CNC machining center that enables you to deliver robust instruction in computer numerical control and advanced manufacturing training for your students.

This classroom optimized machine includes safety features while delivering industry compatible operation and programming. The BenchMill 6100 comes equipped with Ethernet-based motion control, 3-axis stepper motors, ball screws, a variable speed spindle motor, and ISO20 taper tooling.

This CNC system requires no assembly, arriving at your facility ready to run on an Ethernet port on a standard PC, and fits comfortably into any classroom, without sacrificing features.

BenchTurn 7100 CNC Turning Center

The BenchTurn 7100 is a benchtop CNC turning machine for learning environments.

This classroom optimized machine includes safety features while delivering industry compatible operation and programming. The BenchTurn 7100 comes equipped with 2-axis stepper motors, ball screws, a variable speed brushless spindle motor, limit/home switches, and an MT3 taper spindle with MT2 taper tailstock.

This system requires no assembly, arriving at your facility ready to run on an Ethernet port on a standard PC, and fits comfortably into any classroom without sacrificing features.

As seen in larger industrial machines, the BenchMill 6100 and the BenchTurn 7100 use EIA, ISO, and FANUC compatible G&M code programs to cut parts in a variety of materials.

Materials Handling Robots

ER-4U

The ScorBot ER-4U robot is a versatile and reliable 5-axis robotic arm system for educational use.

The ScorBot ER-4U root arm can be mounted on a tabletop, pedestal, or linear slidebase. The robot's speed and repeatability make it highly suited for both stand alone operations and integrated use in automated workcell and FMS applications such as CNC machine tending, assembly, quality control and robotic welding.

MHJF

The ultra-light, compact MotoMan MHJF is a 6-axis, high-speed and accurate robotic arm for educational and industrial use.

This highly portable and easy to install robot enables simplified system integration and requires minimal installation space. The MHJF supports both stand alone applications as well as sophisticated automated workcells.

The robot offers superior performance in small part applications such as assembly, dispensing, packaging, material handling, and machine tending.

Linear Slidebase for Robots

The linear slidebase serves to mobilize the robot and increase its work envelope.

Ranging in length from 1.0m, 1.8m or custom lengths, the slide base is designed with mounts for different robots and can be integrated on a floor standing pedestal or mounted on a tabletop.

Manufacturing Training Curriculum

Intelitek training courses include introductory courseware for manufacturing (FMS) and provide students with an overall understanding of how CNC machining and robots work in an industrial environment. Students are also exposed to Intelitek simulation solutions, RoboCell and CNCMotion, 3D simulation software where they complete various projects virtually before using the hardware.

■ CNC Milling

The CNC Milling Technology course introduces students to the fundamentals of CNC (Computer Numerical Control) milling. The curriculum uses CNCMotion, a 3D-solid modeling simulation software, which allows students to develop programming skills through a simulated machine process. Students learn the fundamentals of CNC milling hands-on by working with the Intelitek BenchMill 6100 or ProMill 8000 to accurately machine a series of complex parts.

■ Fundamentals of Robotics

The Fundamentals of Robotics courses provide students the skills needed to operate, maintain, program, and test robotic systems. The curriculum uses RoboCell, a 3D-solid modeling robotic simulation software, which allows students to develop programming skills through a variety of simulated robotic workcells. Students learn the practical side of robotics hands-on by working with the Intelitek ER-4U or MotoMan MHJF to practice robotic programming and operation.

■ Advanced Robotics

Building on the Fundamentals of Robotics curriculum, the Advanced Robotics course explores advanced robotic programming. Students will use RoboCell to teach positions, write programs, debug robotic applications, and test their execution offline using a virtual robot.

■ CNC Turning

The CNC Turning Technology course introduces students to the fundamentals of CNC (Computer Numerical Control) turning. Students learn the CNC process through a series of projects. Each project teaches job setup, drawing construction, tool path generation, tool path verification, and NC code generation. Project activities challenge students to develop and edit programs, and machine assorted parts using the BenchTurn 7100 or ProTurn 9000. The curriculum also uses CNCMotion, a 3D-solid modeling simulation software, which allows students to develop programming skills through a simulated machine process.

■ Introduction to Advanced Manufacturing

Introduction to Advanced Manufacturing familiarizes the student to the manufacturing industry and its associated career paths. Students learn about careers offered in manufacturing and about how to prepare for and then pursue those careers. Students study how manufacturing companies operate and the use of computers and automation in manufacturing is explored. Students work on hands-on projects designed to provide insight into the world of manufacturing.

■ Flexible Manufacturing Systems (FMS)

HOURS OF INSTRUCTION: 15

The Flexible Manufacturing System (FMS) course exposes students to the industrial workcell where automation and industrial applications are built by combining CNC technology with robotics and materials handling. Students develop and edit programs, record precise robotic positions, accurately mill parts, and synchronize mill and robot operation.

Students gain "virtual hands on" experience in CNC and robot programming, especially in I/O commands. Students design solutions for industrial FMS applications with emphasis on real industrial concerns, such as optimized CNC and robotic programming and accurate machine tending.
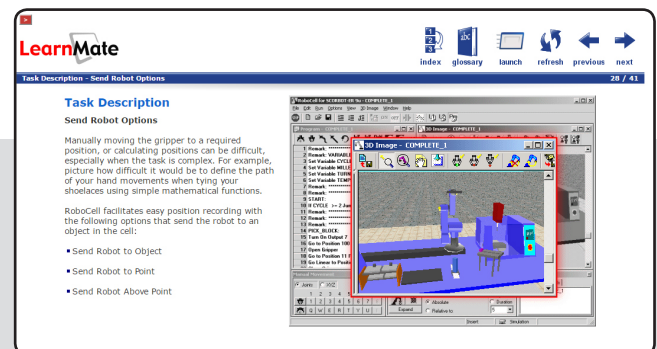
COURSE OUTLINE

- Introduction to FMS
- CNC Machining
- RoboCell Simulation and Control Software
- Designing an FMS Workcell
- Expanding the Workcell
- Writing a Program
- Programming Mill Operations
- Conditional Programming

- Storing Finished Parts
- Multiple Part Programming
- Lathe Operations
- Multiple Part Lathe Operations
- Program Integration
- Designing a Final Project
- Running the Final Project

FMS Management Software: OpenFMS

OpenFMS software provides a comprehensive solution for the study and practice of manufacturing methods and operations. OpenFMS is a platform to design, build and program workcells using Intelitek components. OpenFMS allows student to:

■ Experience the concepts, uses and interconnections of the various software modules that comprise a FMS system.

■ Gain practical experience in translating theoretical manufacturing methods and processes into actual applications.

■ Use and study components and subsystems individually as well as the entire integrated FMS system.

■ Provide flexible production using a built-in basic MRP system.

■ Investigate and learn enhanced optimization functions and performance analysis to support studies in industrial management, operations research, management sciences and related fields.
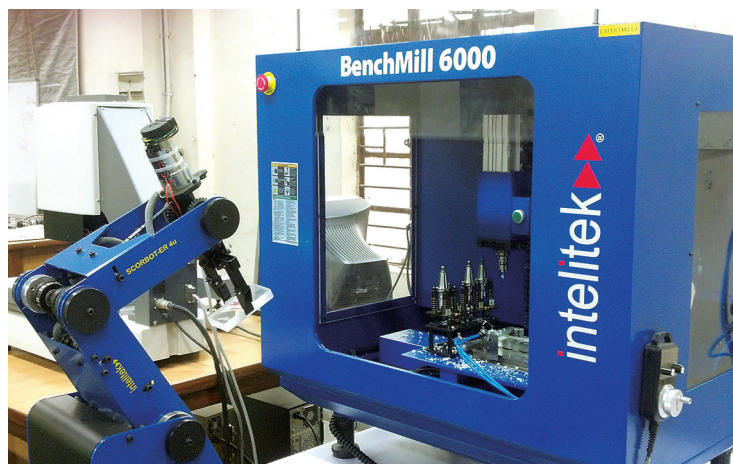
FMS Product Packages

Part Number	Description	Starter FMS Bundle	Advanced FMS Bundle
00-0413-0000	SCORBOT-ER 4u	✓	✓
00-0609-0000	Gripper attachment for round and square parts	✓	✓
00-1710-0000	Teach Pendant	✓	✓
10-1007-4000	Gravity Parts Feeder	✓	✓
00-1110-0000	Palletizing Rack	✓	✓
10-2120-0000	CNC Interface with BenchMILL 6100	✓	✓
00-5505-0110	CNC BenchMILL 6100, 110 VAC	✓	✓
10-1110-7000	Dual Axis Vise (for FMS)	✓	✓
10-1115-2000	Table mounted ATC package	✓	✓
10-1113-1000	4-Station ATC, Table-mount	✓	✓
10-1111-7000	4 Tool ISO20 Tool Holder Package	✓	✓
10-5815-0000	ER16 Collet Set	✓	✓
10-1113-5000	Imperial Advanced End Mill Package 5120	✓	✓
10-1111-1000	Handwheel - Manual Control	✓	✓
113034	Raw Material - Perspex Block (50 pcs)	✓	✓
00-1261-0000	Workbench 1800x900mm (Heavy duty for CNC)	✓	✓
00-1265-0000	PC Extension Shelf 600x900mm	✓	✓
00-1021-0000	LSB 1.8m, Belt, TT		✓
10-1003-8000	Stand for table's LSB		✓
10-2521-7000	Pneumatic Feeder for Rectangular products		✓
10-1113-7000	Imperial Engraving Package 5710		✓
10-2120-1000	CNC Interface with BenchTurn 7000		✓
00-5504-0110	CNC BenchTurn 7000 110V		✓
10-1110-5000	Pneumatic Shield (BenchTurn 7000 for FMS))		✓
10-1110-9000	Pneumatic Chuck (BenchTurn 7000 for FMS)		✓
10-1110-1000	10 x 10mm cutter tool holder		✓
10-1105-7000	Drill Chuck for Tailstock		✓

Part Number	Curriculum	Starter FMS Bundle	Advanced FMS Bundle
77-1201-0000	LM7 1st year hosting, setup & support	✓	✓
77-3140-0002	LM7 Content, Vir, CNCMilling w/BenchMill 6100(M)	✓	✓
77-3046-0000	LM7 Content, Vir, Fundamentals w/ER4U	✓	✓
77-3022-0000	LM7 Content, Vir, FMS Curriculum	✓	✓
77-3141-0002	LM7 Content, Vir, CNCTurning w/BenchTurn 7100(M)		✓
77-3048-0000	LM7 Content, Vir, Advanced w/ER4U		✓
77-3096-0000	LM7 Content, Vir, Intro to Advanced Mfg		✓

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