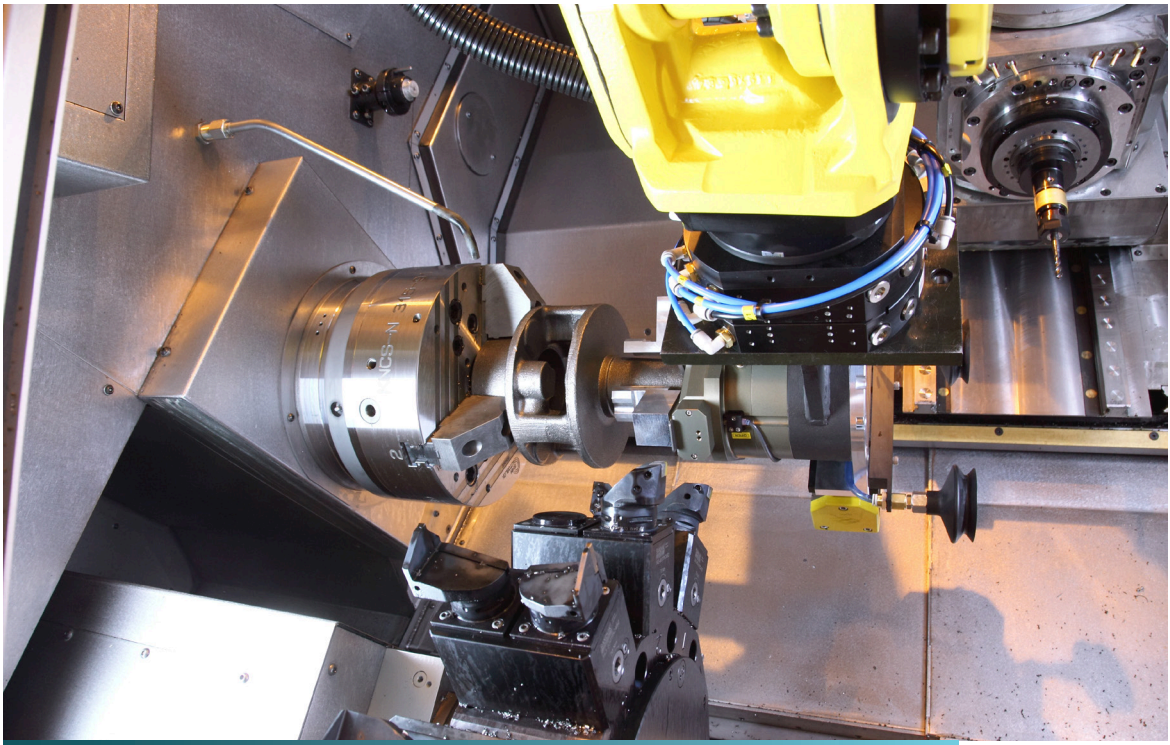
8760 Fastems



GUIDE

to Intelligent, Flexible Automation of Lathes and Turning / Milling Machines

Trends and Challenges for the Manufacturing Industry

CNC manufacturers in the machining industry are facing major challenges in the production of turned parts, as the trend continues to move toward smaller batch sizes with increasing part variance.

Manufacturing organizations are growing increasingly complex, as a multitude of different parts need to be continuously circulated. This complexity requires considerable additional effort in all stages of production: in planning, execution and monitoring.

Against this backdrop, a complex manufacturing organization requires sophisticated production management combined with a high degree of flexibility in order to be able to react adequately to unforeseen events or urgent orders while simultaneously minimizing deadline pressure.

A complex manufacturing organization requires sophisticated production management combined with high flexibility.

This guide describes why it pays to think about and invest in intelligent, flexible automation. It provides answers to the questions:

WHAT
does intelligent, flexible automation of CNC lathes and CNC turning/milling centers mean and how does it differ from other automation solutions?

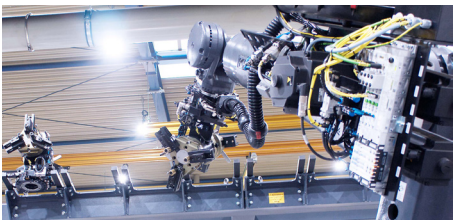
HOW
can intelligent, flexible automation be implemented and what are the key benefits?

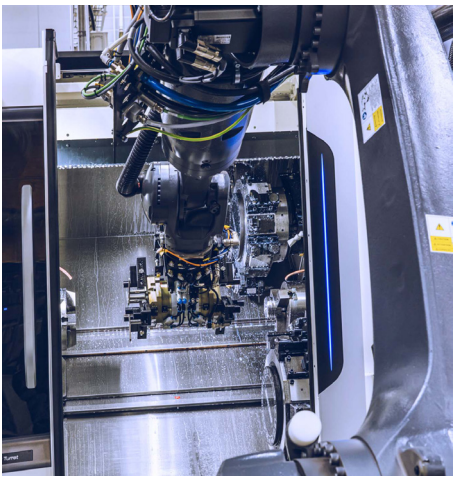
WHICH
concrete solutions of intelligent, flexible automation are there and what are the results in practice?

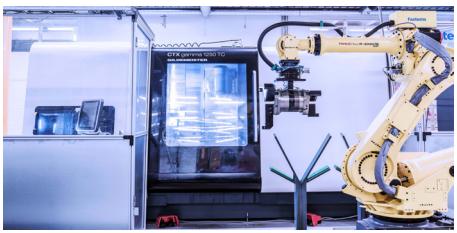
A checklist at the end of this guide provides valuable assistance for the implementation of intelligent, flexible automation of CNC lathes and CNC turning/milling centers.

BENEFITS OF INTELLIGENT AUTOMATION OF LATHES AND TURNING/MILLING CENTRES:

The more dynamic the demand, the more complex the processes. And the greater the effort required in production planning and resource management.







TYPICAL CHALLENGES

- Is your production flexible enough to efficiently produce orders in ever smaller quantities with higher part variance?
- How great is the programming effort for creating new parts in the system and is it also possible during ongoing production?
- Are you committing significant capital to inventory and/or semi-finished parts?
- Are the exacting standards for your production quality reproducible? Even with high-quality and demanding / advanced raw materials?
- Do you have integrated quality assurance in your manufacturing processes?
- Can you ensure end-to-end traceability of your produced parts?
- Is your manufacturing organization becoming increasingly complex and are your processes designed for this?
- Is the effort required for planning, execution and monitoring of your production extremely high?

What is Intelligent, Flexible Automation and what are the Benefits?

In contrast to conventional automation solutions, intelligent, flexible automation enables "high mix & low volume" production with end-to-end automated production planning. The automated detailed planning of production orders up to 96 hours in advance includes the entire resource management (NC programs, tools, raw material, etc.). What's more, additional processes can be integrated into the automation to achieve high added value for the production.

The following three questions point to the benefits of intelligent automation of lathes for your production:

- **Do you want to manufacture different parts in a highly automated way while still remaining flexible with part routing and work scheduling?**
- **Do you want to process different types of parts simultaneously in a highly dynamic production process?**
- **Do you want to implement long unstaffed production times and need a flexible solution that also handles fully automated production planning, including resource management over several hours or even days?**

Introduction / setup of new workpieces

Part routing flexibility (relevant for automation of more than one lathe)

Number of part types that are in the production process at the same time

Setup changes

Integration of additional processes

Unmanned production time

Order of processing the individual batches (work queue)

Fine-planning of the production (96 h in advance)

Resource management (NC programs, raw material, tools)

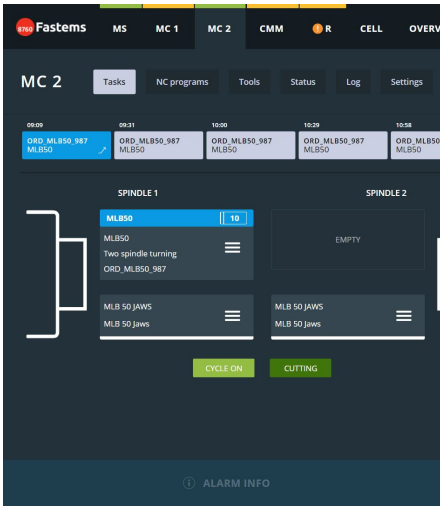
Traditional Automation For „low mix & high volume" production	**Plug-and-Play Entry-Level-Automation** For "mid mix & mid volume" production	**Semi-intelligent Automation** For "high mix & high volume" production	**Intelligent, flexible Automation** For "low mix & low volume" production
Has to be programmed	Easy to realize thanks to parametric programming	Easy to realize thanks to parametric programming	Easy to realize thanks to parametric programming
Limited	Not relevant	Limited	Flexible
One	One	Only few	If needed several
Is not an issue in long production runs	Manual setup changes between the batches	Automatic setup changes*	Automatic setup changes*
Yes	Limited	Yes	Yes
8 hours (depends from the solution and raw material buffer)	Max. 8 h	Extended lights-out capacity	Unmanned weekend
None	Single part type normally	Several part types in a pre-defined work queue	Several part types in a dynamic work queue
Not relevant	Manually	Manually	Automatically
Manually	Manually	Manually	Automatically

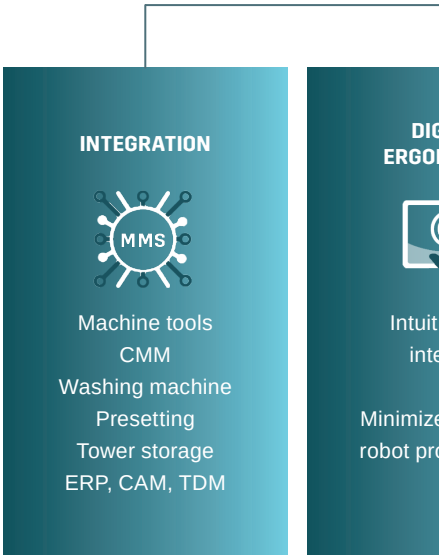
***AUTOMATED SETUP CHANGES TO EXPAND AND INCREASE SYSTEM FLEXIBILITY**

- Automatic gripper exchange
- Automatic gripper finger exchange
- Manually / automatically adjustable gripper finger
- Changing chuck jaws
- Changing chucks
- Changing mandrels

1 Building Blocks of Intelligent Turning Automation

Intelligent, flexible automation includes powerful functions for production planning and resource management that only intelligent software can make possible. The Manufacturing Management Software (MMS) from Fastems is such a solution.



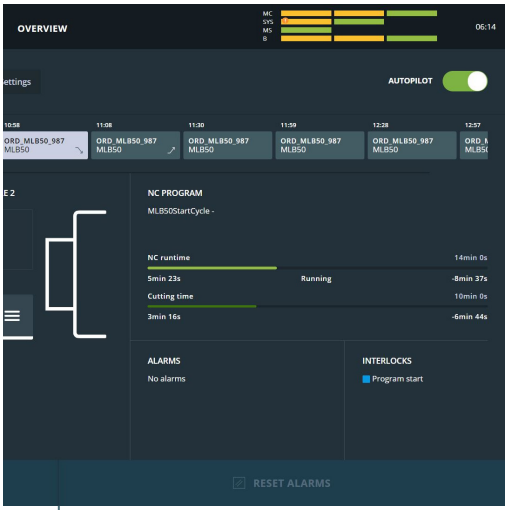


PREDICTIVE PRODUCTION PLANNING

To achieve this, all you have to do is store the necessary data (parts master data, production orders) in the MMS.

Then, based on the production orders, the MMS can automatically plan the entire production with changing workpieces in different lot sizes and taking into account all required resources (detailed planning).

The software also displays the current status of production in real time at any time (order progress, schedule, etc.), calculates the machine capacities for pending orders and visualizes any necessary machine changeovers for the operator in advance.



DIGITAL RGONOMICS

ntuitive user interface

imized need for ot programming

PREDICTIVE SCHEDULING

Fine scheduling
Workload estimates

Proactive ressource management

MMS ENHANCES AUTOMATED PARTS HANDLING WITH ADVANCED PRODUCTION PLANNING AND INTUITIVE OPERATION

- **Easy integration** of different turning or turning/milling centers and data systems
- **Easy implementation** of new workpieces with minimal programming effort for the robot
- **Predictive production planning** and resource management (raw material, tools, NC programs)

ADVANTAGES OF MMS FOR PARTS HANDLING

- Intelligent solution for planning, execution and monitoring of automated production
- Easy import of the necessary data via the optional ERP interface
- Automatic production planning for varying workpieces in different batch sizes
- Automatic calculation of machine capacities for pending orders
- Timely information for necessary machine changeovers

ADVANTAGES OF MMS FOR FLEXIBLE PRODUCTION

- **Decreasing production costs** per workpiece
- **Shorter throughput times** thanks to predictive planning
- **High transparency**: current production status is visualized in real time
- **Less deadline pressure** due to well thought-out production organization
- **High flexibility** – fast, targeted reactions even to unforeseen events or urgent orders

2 Intelligent Turning Automation – System Key Features

When a system for intelligent, flexible automation is first prepared for a new workpiece, almost no robot knowledge is required. This can be an immense relief, especially for parts families.

Instead of a time-consuming teach-in process for the robot, configuration is carried out via the MMS using parametric programming. Using the intuitive MMS user interface, the necessary values or parameters for part handling are stored in the controller. This enables quick and easy creation of new part master data and orders during ongoing production, i.e., simultaneously with machining.

Practical experience shows that parametric programming of a robot takes only a few minutes and does not require any in-depth knowledge.

CONSISTENTLY HIGH QUALITY

Consistently reproducible processes are the key to consistently high quality. The automated collection and storage of all data, including data on tools, NC programs and processes during automated part handling saves an enormous amount of time and ensures high production quality – right from the very first workpiece.

SELF-OPTIMIZING PROCESSES

Because the quality of the parts to be produced can be monitored during production, for example using an integrated measuring machine, even more complex workpieces can be machined unstaffed, for example on weekends, with Fastems systems.

If a just-produced part deviates from previously defined tolerances, the ongoing production can be optimized accordingly by transferring the measurement results to the machine (e.g., by temperature compensation or by readjusting or replacing the tools in the machine).

The very next part produced unstaffed is then back within the required tolerances.

FUTURE-PROOF INVESTMENT

Choosing a Fastems system for intelligent part handling in combination with intelligent control software is a future-proof investment in every respect.

Such solutions are **designed** for automated production of a wide range of different turned and milled parts **in batches of varying sizes** and therefore offer comprehensive solutions for flexible part production.

OPEN, SCALABLE CONTROL SOFTWARE

The MMS control software is a versatile platform that is constantly evolving. It can be used for parts handling, pallet handling, as well as digitizing non-automated manufacturing processes (WCO – Work Cell Operations).

The software is scalable at any time and therefore flexibly adapts to the respective requirements. Since the MMS is able to include non-automated processes, e.g., stand-alone machines and manufacturing cells, in the digital manufacturing organization, the entire production can be planned, executed and monitored via a single central control system. This increases value creation, facilitates the entire manufacturing organization through optimized and accelerated processes, and increases the transparency of production through an overview of the entire production with verifiable figures and concrete information.

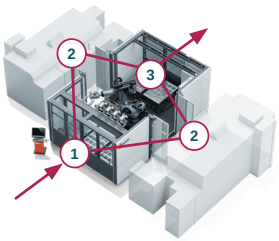
INTEGRATION OF ADDITIONAL PROCESSES

Additional processes (e.g., deburring, grinding, measuring, etc.) can be integrated into Fastems automation solutions as needed.

3 Entry-level solution for Intelligent, Flexible Automation of Lathes

STRATEGY 1:

MACHINING TAKES PLACE ON ONE OF THE TWO MACHINES.

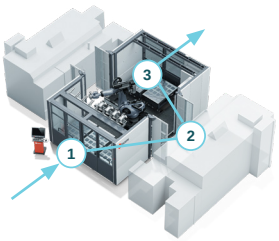


1. The workpieces are fed into the cell with a trolley.
2. The machining takes place on one of two machines.
3. The finished parts are discharged from the cell.

Both machines can be used for manufacturing the part. In case the machines are different, limitations to this strategy may apply due to technical reasons.

STRATEGY 2:

MACHINING TAKES PLACE IN A SPECIFICALLY ASSIGNED MACHINE.



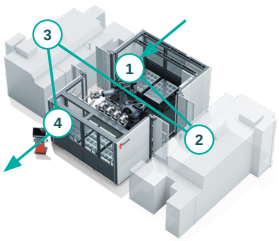
1. The workpieces are fed into the cell with a trolley.
2. The machining takes place in a specifically assigned machine.
3. The finished parts are discharged from the cell.

The two machines do not have to be of the same type since the machining of specific workpieces is always performed by a specifically assigned machine.

The RoboCell ONE is a standardized, highly flexible entry-level solution for automated workpiece handling with flexible part routing on up to two lathes.
It allows you to choose between different production strategies as desired, and the connected machines do not have to be of the same type (e.g., combination of new machine and existing machine). Special feature: The automated gripper changing system (optional) for flexible workpiece handling as well as easy implementation of new parts even during ongoing production.

SEQUENTIAL MACHINING ON BOTH MACHINES

STRATEGY 3:

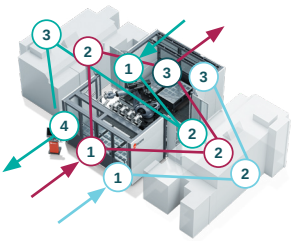


1. The workpieces are fed into the cell with a trolley.
2. Machining takes place first in machine 1 and then in machine
3. The finished parts are discharged from the cell.

The two machines do not have to be of the same type since the machining of workpieces is first carried out in machine 1 and then, additionally, in machine 2.

BOTH MACHINES ARE AVAILABLE FOR ALL ORDERS

STRATEGY 4:



1. The workpieces are fed into the cell with a trolley.
2. Machining takes place on one of the two machines.

   OR Machining takes place in a specifically assigned machine.

   OR Machining takes place first in machine 1 and then in machine 2.
3. The finished parts are discharged from the cell.

This production strategy achieves the highest flexibility since both machines can be used to process all orders.

THE RESULT: Optimal machine utilization even with frequently changing orders and a highly variable product mix.

4 The Next Level of Intelligent, Flexible Automation

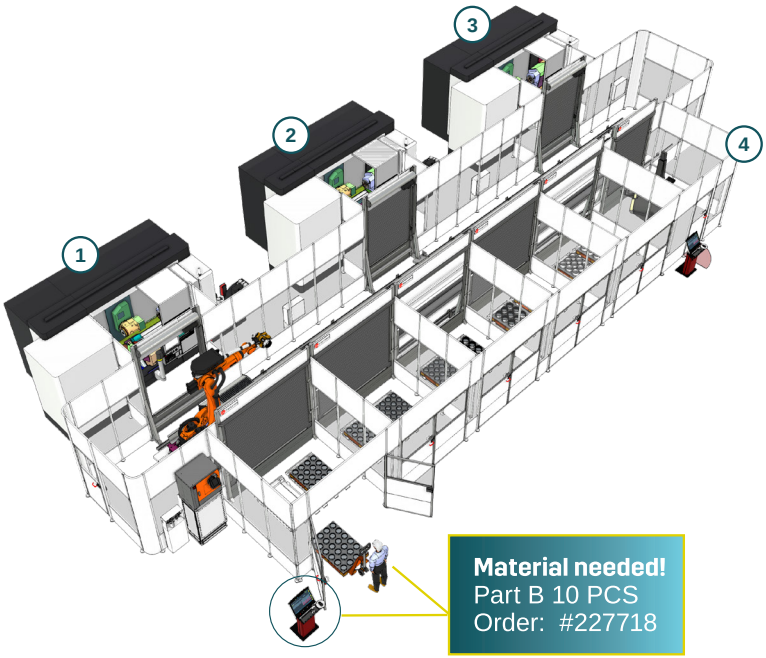
Agile Manufacturing Cell | AMC

ECONOMICAL PRODUCTION OF SMALL BATCHES

The Agile Manufacturing Cell (AMC) enables the integration of multiple machines and additional processes into the automation.

It is a customer-specific solution for order-driven, flexible series production of several different parts up or even multiple product families, with completely flexible part routing within the system solution.

The following example shows an AMC that is used highly flexibly to produce different types of parts in different batch sizes.
Parts are produced according to a process plan that is optimally adapted to the situation at hand (e.g., availability of machines, NC programs, raw materials, tool life, etc.).
This means that the parts can flexibly take different routes for machining as well as for additionally required process steps (e.g., finishing, measuring, washing, etc.) in order to complete all orders on time.



MANUFACTURING ORDERS

1	PART A	100 PCS	MC1 | MC2 | MC3
ORDER:	#226512	Started	
DUE:	In 2 days		
2	PART B	10 PCS	MC1
ORDER:	#228197	Pending	
DUE:	TODAY - RUSH		
3	PART C	100 PCS	MC2 | MC3 | CMM
ORDER:	#226577	Started	
DUE:	In 10 days		
4	PART D	200 PCS	MC2
ORDER:	#226598	Pending	
DUE:	In 5 days		
5	PART A	500 PCS	MC1 | MC2 | MC3
ORDER:	#226625	Pending	
DUE:	In 15 days		

MACHINING ORDER ON THE RESPECTIVE MACHINES AND SYSTEMS:

1 Lathe 1 (MC1)

1	PART A	5 PCS	
ORDER:		#226512	
MAIN SPINDLE:		Setup A	
SUB SPINDLE:		Setup A	
2	PART B	10 PCS	-RUSH-
ORDER:		#227718	
MAIN SPINDLE:		Setup B	
SUB SPINDLE:		Setup B	
3	PART A	45 PCS	
ORDER:		#226512	
MAIN SPINDLE:		Setup A	
SUB SPINDLE:		Setup A	

2 Lathe 2 (MC2)

1	PART A	50 PCS
ORDER:		#226512
MAIN SPINDLE:		Setup A
SUB SPINDLE:		Setup A
2	PART C	50 PCS
ORDER:		#226577
MAIN SPINDLE:		Setup C
SUB SPINDLE:		Setup C
3	PART D	200 PCS
ORDER:		#226598
MAIN SPINDLE:		Setup D
SUB SPINDLE:		NONE

3 Lathe 3 (MC3)

1	PART C	50 PCS
ORDER:		#226577
MAIN SPINDLE:		Setup C
SUB SPINDLE:		Setup C
2	PART A	500 PCS
ORDER:		#226625
MAIN SPINDLE:		Setup A
SUB SPINDLE:		Setup A

4 CMM

1	PART C	100 PCS
ORDER:		#226512
CMM:		Setup C

BENEFITS OF AGILE MANUFACTURING CELLS AMC

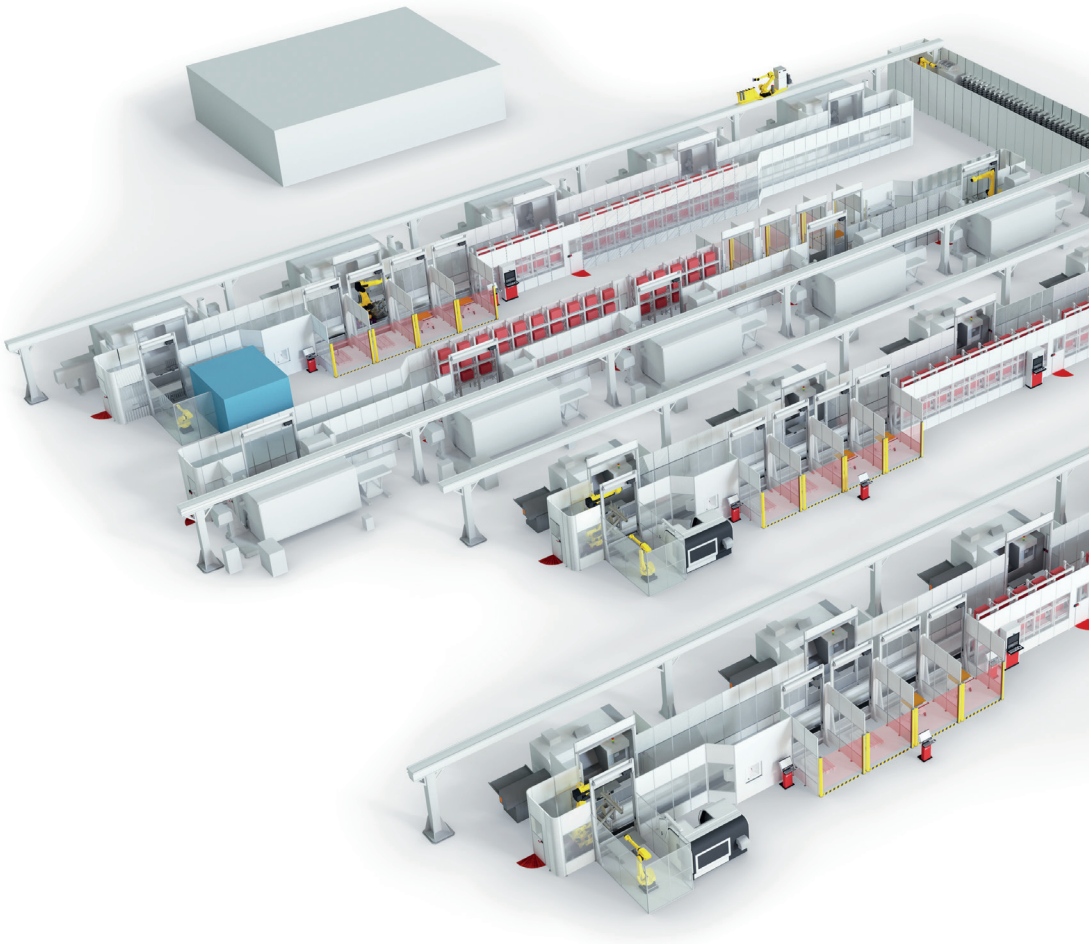
- Agile automation of one machine tool or several machine tools with only a single robot
- Long unstaffed times through higher raw material capacities and automatic batch changeover
- Minimization of non-productive time through proactive indication of required operator activities and resource needs, e.g., NC programs, raw material, tooling
- Higher added value through integration of additional processes and various machining tasks
- High flexibility through freely configurable workpiece flow and freely configurable part routing
- Easy set-up due to parametric robot programming

4 The Next Level of Intelligent, Flexible Automation

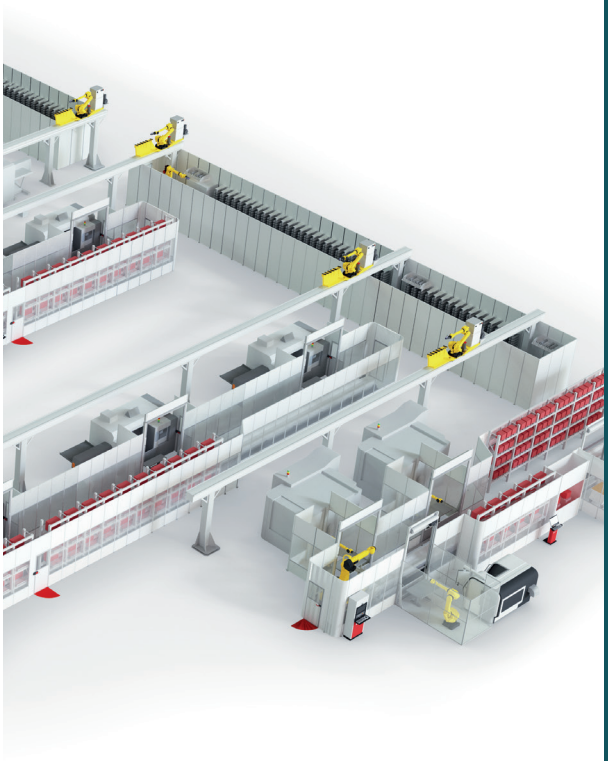
Agile Manufacturing System | AMS

INTEGRATION OF COMPREHENSIVE AND SOPHISTICATED MANUFACTURING PROCESSES

The Agile Manufacturing System (AMS) differs from an AMC by integrating pallet handling and non-automated machines and processes into the automation, which is centrally controlled by the Manufacturing Management Software (MMS).



The system is thus a combination of various Fastems automation solutions and, in its most advanced configuration, serves as a factory-wide solution, enabling the automation of complete manufacturing chains.



BENEFITS OF AGILE MANUFACTURING SYSTEM AMS

- Comprehensive solution for demanding manufacturing processes on the shop floor level
- Higher added value through integration of numerous manufacturing and process steps in a single system
- Automated detailed planning for all manufacturing processes controlled by the MMS
- Shorter throughput times, as the control system (MMS) constantly advances semi-finished parts in the process chain
- Minimization of non-productive time through proactive indication of required operator activities and resource needs, e.g., NC programs, raw material, tooling
- High transparency of the current production status and the manufacturing situation as well as the workpieces in process thanks to MMS
- Targeted forecast of future workload based on current job status
- Easier connected to higher-level IT systems

5 Success Stories

Buck CNC Technik GmbH – Productivity in a Twin Pack

Buck CNC Technik GmbH, as a full-range supplier in the technology network of the Hydraulik Nord Group, manufactures, among other things, machine components for machine tools, electric motors and internal combustion engines, gearboxes, hydraulics and construction machinery.

Mainly cast iron and steel are processed, whereby quantities of around 100,000 per year are achieved due to the frequently recurring families of parts. The batch sizes range between 100 and 1,000 pieces per order, with piece weights of several workpiece weights from a few hundred grams to 200 kg.

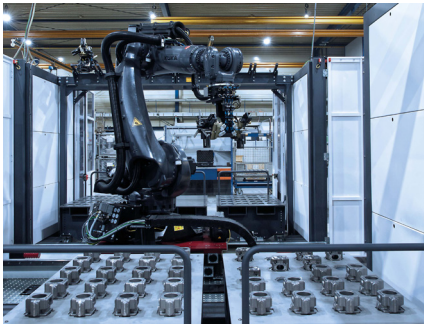
INTERACTION OF NEW INVESTMENT AND EXISTING MACHINE

In 2017, Buck decided to invest in a G220 turning-milling center from Index with counter spindle to completely manufacture specific cast housings that were previously produced on a milling machine in two setups. These are different products in a family of parts. A robotic solution was also sought for loading and unloading the machine. Since the machining times are between 12 and 16 minutes, depending on the part, it also made sense to integrate an existing machine (Mori Seiki NT4300 DCG), also with a counter-spindle, into the automation solution for the production of similar castings, in order to optimize the utilization of the robot. The RoboCell ONE from Fastems was finally found to be the ideal robotic cell for these requirements.

Automation of an existing machine and new investment in one solution.

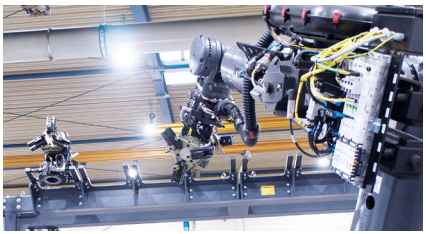
FIVE VARYING PRODUCTS AND 20 DIFFERENT COMPONENTS

According to the production manager, the robotic cell produces two families of parts, each with five varying products on the Mori Seiki NT4300 DCG and 20 different parts on the Index G220. Transport trolleys with grid plates are used to feed the blanks into the system, with two trolleys with 40 workpieces each available for each machine. An additional trolley is also reserved for the separate storage of test specimens.



AUTOMATIC CHANGE OF THE DOUBLE GRIPPER

To handle the unmachined and finished parts for both machines, the robot uses one double gripper each, which it picks up or sets down automatically as required via the integrated gripper changing station. If a workpiece change with different component dimensions takes place within a part family, an employee sets up the corresponding gripper manually via a quick adjustment. "A matter of a few minutes," as the production manager points out.



NON-PRODUCTIVE TIMES DECISIVELY REDUCED

The magazine of the existing machine has 102 tool places and thus has a sufficient number of tools for the manufacture of the products. The range of products manufactured on the Index is, however, far more diversified. Therefore, the complete machining of all workpieces machining of all workpieces with a total of 118 tool stations, despite the double turning tools. "Consequently we sometimes have to change the tools when we also have to change the tools. We nevertheless decisively shorten the non-productive times by producing similar parts in parts in succession," says the production manager.

DEFINE ROBOT TRAVELS WITHOUT PROGRAMMING KNOWLEDGE

The central component of RoboCell ONE is Fastems' MMS. Initially, the orders for production planning were still created manually in the MMS, which also handles the master data management of the components. In the meantime, however, the orders are transferred directly from the ERP system to the MMS. Thus, all production orders can be planned, controlled and monitored via the software.

"For the robot configuration we do not need any additional programming knowledge."

Regarding the simple robot configuration via the via the MMS, the production manager said "In a training session, we learned how to configure on the basis of two concrete sample parts how it works. Afterwards we were able to determine the robot kinematics for the other products ourselves. It really works very quickly and without any additional programming knowledge."

MINIMAL MANPOWER PLUS UNMANNED SHIFT

From the production manager's point of view, the investment in the RoboCell ONE has paid off in many respects: "We are now able to produce a total of 25 different components from two different part families flexibly and economically in a single robot cell. Around 15 different components are also produced in an unmanned shift."

5 Success Stories

Konepaja Sihvo Oy – Complete Solution at the Highest Level

Konepaja Sihvo Oy, based in Hyvinkää, about 50 kilometres north of Helsinki, produces prefabricated parts for applications in which high safety requirements are placed on the individual components - the quality demands of the clients are correspondingly high.

The dimensions of the manufactured parts with diameters ranging from from around 100mm to 1250mm, so to speak in the midsize range. Machined metals are machined, among them mainly cast iron, with the proportion of turned parts being relatively higher.

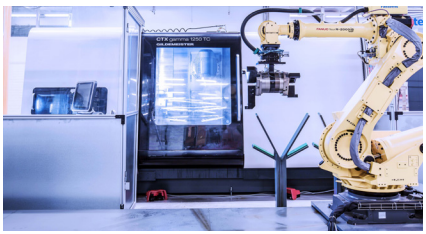
CONTINUOUS QUALITY INSPECTION IN AUTOMATED PRODUCTION

A few years ago, Sihvo received a large order for the production of specific parts made of cast iron with a diameter of around 700 mm. Due to the expected batch sizes of around 10,000 pieces per year, the company was decided to invest in a robotic cell for the machining of parts.

One of the special requirements on the part of the client was that the 100 per cent of the finished parts. For this a complete solution was required, which not only take care of the automatic loading and unloading of the machines, but also a continuous quality inspection as an integral part of the overall automation. The choice of partner for the realization of this solution was Fastems.

AIR-CONDITIONED MEASURING MACHINE INTEGRATED INTO ROBOT CELL

The robot cell consists of two five-axis turning/milling centres that are loaded and unloaded by a shuttle robot with a payload of 165 kg. The central component of the automation solution is a measuring machine in an air-conditioned room.



For each workpiece, compliance with specified tolerances must be continuously checked at up to five different measuring points. For this purpose, the production quality is subjected to regular analysis. If the manufacturing process deviates from the expected results, the number of automated checks per workpiece is increased.

For documentation of the measurement results and seamless traceability, the manufactured parts are also marked in the robot cell.

Quality inspection and workpiece marking are integrated integrated into the automation.

AUTOMATIC ADJUSTMENT IN CASE OF DEVIATIONS

The most important factors for high production quality, according to the Sihvo quality manager are the test results of the measuring machine, and consequently the temperatures of the workpieces during machining.

The turning/milling centres were therefore specially equipped with temperature compensation. In addition to the temperature measurements, the results of the measuring machine are also transmitted to the respective machine controls, whereby this is a continuous, automated process during production. If, for example, the results of the measurements on the finished parts move up or down within the tolerances, the production process is automatically optimized.

According to the quality manager, the possibility that the measurement results on the workpieces could move outside of the tolerances is rather excluded, since the overall system permanently and, above all, completely autonomously counteracts this possibility during ongoing production.

The automation solution is being utilized at a rate of around 80-90 %.

SEAMLESS DOCUMENTATION AND TRACEABILITY

This can also be proven by a complete documentation of the production quality. For this purpose, all process and measurement results of the production are stored in a database together with the raw material data. As described above, each individual workpiece is marked in the course of production in the robot cell and thus receives all the relevant information required for seamless traceability of the production quality. are required.

PERMANENTLY HIGH CAPACITY UTILISATION

The Fastems robotic cell has been at Konepaja Sihvo for several years and the results are convincing: The automation solution produces around the clock in three shifts and, measured in terms of production hours in a year, the automation solution is up to 90 per cent of the production hours in a year.

Summary

Machining industries are facing new and growing challenges in terms of organizing production, for a simple reason:

More different parts have to be produced with decreasing quantities per order.

Against this backdrop, more efficient production strategies that can do much more than automated loading and unloading of lathes and turning/milling centers are required.

"HIGH MIX & LOW VOLUME" PRODUCTION

In contrast to conventional automation solutions, intelligent, flexible automation enables "high mix & low volume" production with end-to-end automated production planning. The automated detailed planning of production orders up to 96 hours in advance includes the entire resource management (NC programs, tools, raw material, etc.). What's more, additional processes can be integrated into the automation to achieve high added value for the production.

The results: long unstaffed production times, dynamic processing of batches with different types of parts through automatic set-up, highly automated production of different parts with flexible part routing and flexible work scheduling.

POWERFUL, INTUITIVE SOFTWARE

All this is made possible by Fastems' Manufacturing Management Software (MMS) for planning, executing, and monitoring automated production. Among other things, it automatically and proactively plans production, takes into account all necessary resources; displays the current status of production in real time; calculates machine capacities for pending orders; and provides timely information on machine set-ups. If orders have to be added at short notice and in a very flexible manner, the MMS automatically updates the production planning.

FROM ENTRY-LEVEL TO HIGH-END SOLUTIONS

As an entry-level solution for intelligent, flexible automation, the RoboCell ONE is recommended for the automation of up to two lathes. On the other end of the spectrum, the AMC (Agile Manufacturing Cell) for automation of multiple lathes including integration of additional processes and the AMS (Agile Manufacturing System), our most advanced and customizable option, take companies to the next level. Real-life examples demonstrate the enormous potential of intelligent, flexible automation and show that Fastems solutions can provide significant increases in efficiency.

Checklist – Requirements for Automation Planning

MANUFACTURING POTENTIAL

- ☐ Machining different parts at the same time
- ☐ Machining parts on different machines as needed
- ☐ Integrating additional value-added processes such as washing, marking and measuring
- ☐ Easy decoupling of a manufacturing resource from the automated cycle

PRODUCTION PLANNING

- ☐ Interfaces to ERP, machines (independent of manufacturer), CAM, PDM and tool data management software
- ☐ Predictive planning and adaptation to changes based on real-time data
- ☐ Transparency over the production process and accurate forecasting of job completion

MACHINING PROCESS

- ☐ Optimal machine utilization through automated production of specific parts
- ☐ Automated set-up of machine tools for different part types
- ☐ Tool and tool life management

MACHINE TOOLS

- ☐ Integration of additional processes (e.g., finishing, washing, measuring)
- ☐ Parallel operation of machine tools and execution of additional processes in one solution
- ☐ Investment in new machines vs. use of existing machines
- ☐ Machine tool controllers:
  - ◦ Type of machine tool controller
  - ◦ Robot interface with NC program selection and start
  - ◦ Automatic door for machine tool

USER-FRIENDLINESS OF ROBOT AUTOMATION

- ☐ Introduction of new parts into the process without in-depth robot know-how due to parametric programming
- ☐ Flexible part routing depending on the situation (e.g., availability of NC programs, raw material, tools, etc.)
- ☐ User interface in native language

FUTURE-PROOF INVESTMENT

- ☐ System scalability (easy implementation of new systems and processes)
- ☐ Easy integration of manual workstations and standalone machines into automated production planning including clear instructions to the operator

Read how manufacturers have solved their productivity challenges with automation:

fastems.com/cases