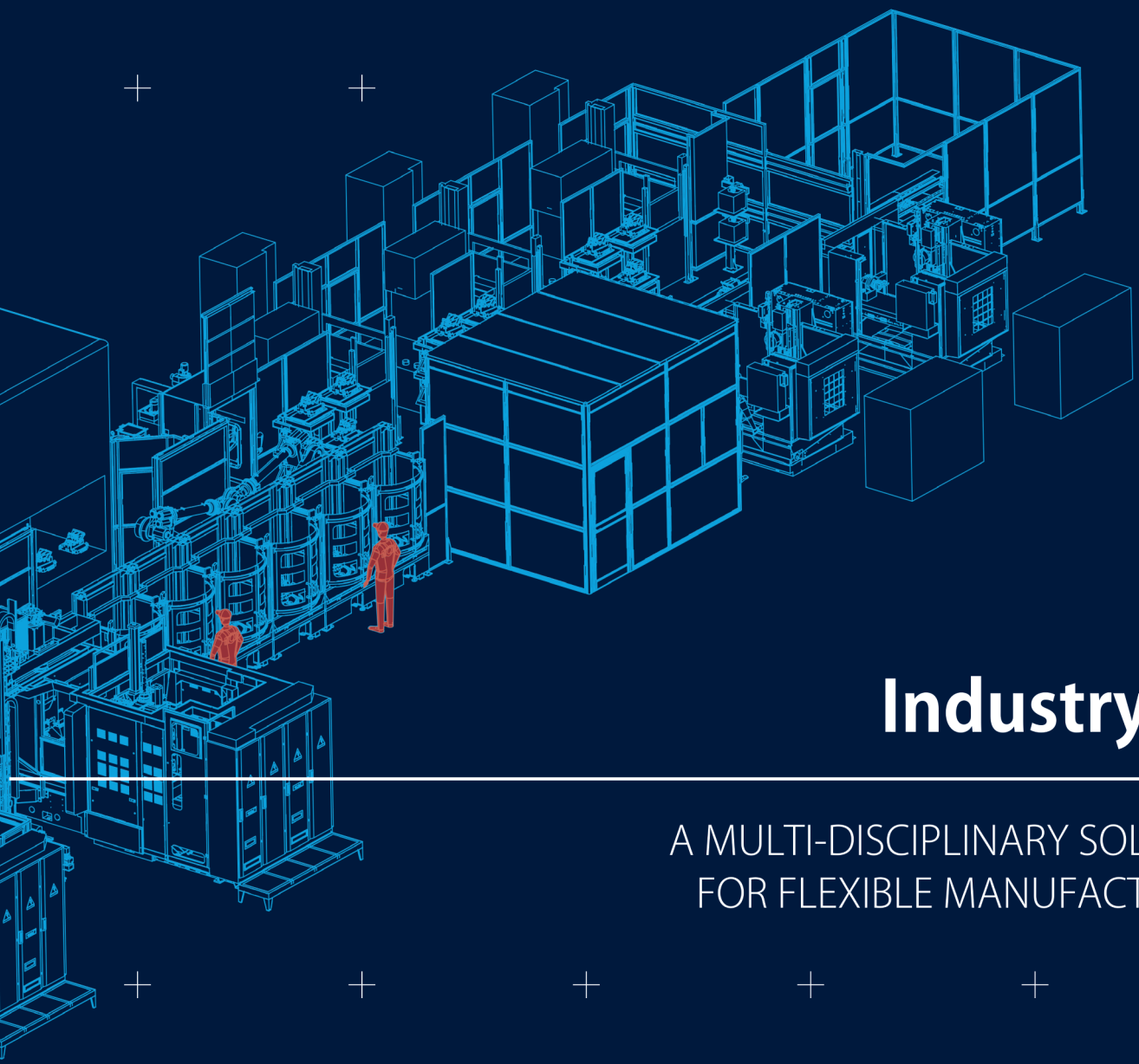
INTEGRATED MANUFACTURING SOLUTIONS



Industry 4.0

A MULTI-DISCIPLINARY SOLUTION FOR FLEXIBLE MANUFACTURING

THE MCM APPROACH

Following the Industry 4.0 rationale, MCM has developed tools coherent with the 4.0 philosophy:

by using the sensors already installed on MCM production systems, by integrating additional sensors and by adapting the overall control architecture, which was long ago equipped with nodes for processing the information generated and requested by the production systems, MCM has been able to come up with a wide array of tools for constantly monitoring the production systems status, in terms of:

- **reliability**
- **sustainability**
- **quality and accuracy**

with specific outputs for:

- **machine operators**
- **production planners**
- **maintenance engineers**
- **service providers**
- **machine manufacturers**

It is necessary to possess encompassing and multi-disciplinary skills to integrate precision mechanics, automation, control and supervision, technological and management know-how to create flexible and autonomous production systems.

MCM has been able to merge diverse contributions and seize the opportunities behind the framework of connecting machines: the great experience and full perspective on the issues have allowed MCM to manage the huge quantity of collected data and to achieve real improvements on the productive efficiency front.

BOUNDARY CONDITIONS

Industry 4.0 is not just affordable technology but an actual cultural transition.

Its added value consists in adopting the right approach for **transforming perceptions of opportunities into real actions and initiatives aimed at increasing competitiveness:**

- reduced machine downtime
- unmanned work shifts
- energy saving
- avoid human operators taking part to low added value operations

The digitalisation provides the necessary means for exploiting the advantages of an organisational improvement and the timing could not be better:
market changes have brought great uncertainty to the resource utilisation planning, because:

- production batches are ever smaller
- the product life cycle is much shorter than the production equipment life cycle
- companies' productivity is increasingly based on efficiency

It is no longer possible to compensate for losses by relocating to cheap labour countries, which are becoming less and less available: it is necessary to produce as close to the market as possible, but under different conditions.

The opportunity to use enabling technologies and the widespread IT culture are supporting the 4.0 Manufacturing, but since its application requires years of development and it is a matter of interest to all markets, we need look beyond the short term opportunities offered by the government fiscal concessions, considering it an incentive for rethinking production methods in the long term.

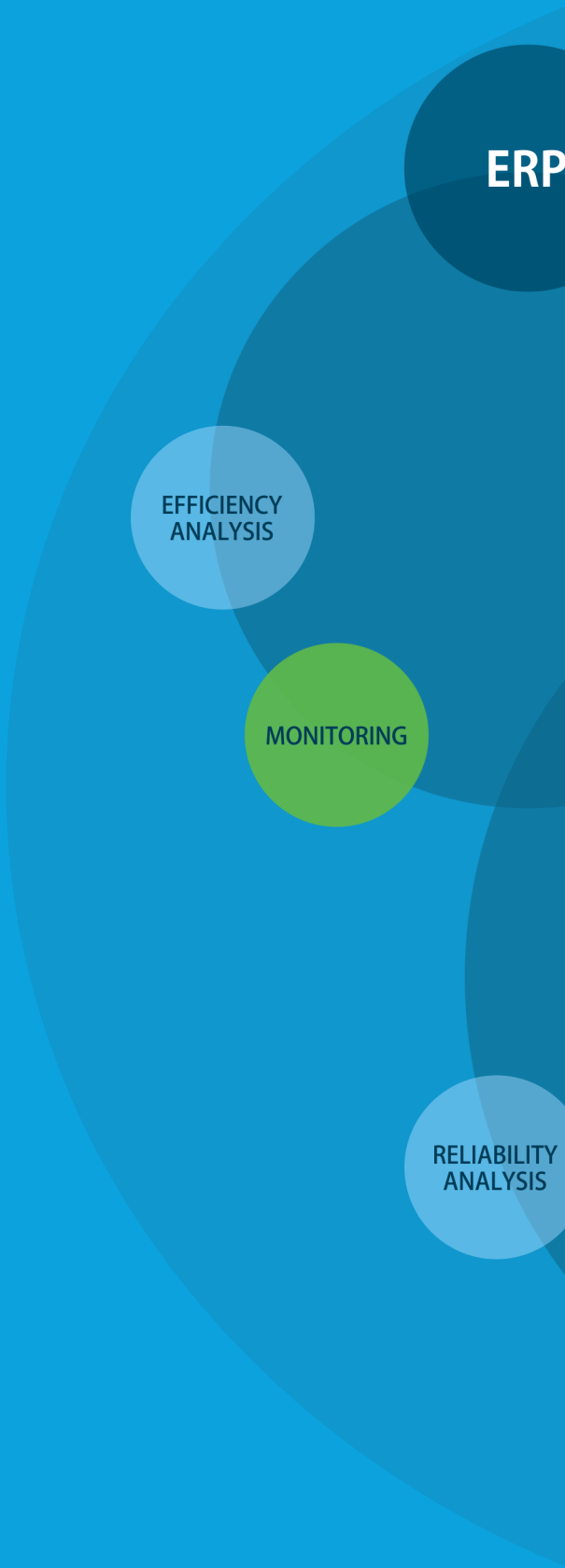
WHAT IS **INDUSTRY 4.0**

INDUSTRY 4.0 IS THE CONVERGENCE OF INFORMATION TECHNOLOGIES THROUGH CONTROL AND MANAGEMENT METHODS.

The application of information technologies allows to have connected machines but this is not enough to be 4.0 because we need to use open protocols and make information available on network platforms - at different levels up to the cloud - that exploit the web and its technologies in two ways: data telemetry towards large repositories on the web and an ecosystem of software applications exploiting this data for improved use.

MCM operates on both sides of the system, the side of generating information and the side of software applications:

- MCM machines inherently have the capability to be connected to a manufacturing platform through the jNODE, a communication bridge between the machines and the cloud, on which the jFMX supervision software is installed.
- jFMX generates, records and manages data coming from the production systems and provides a set of software applications for processing, aggregating and transforming the data into high added value information to the customer.

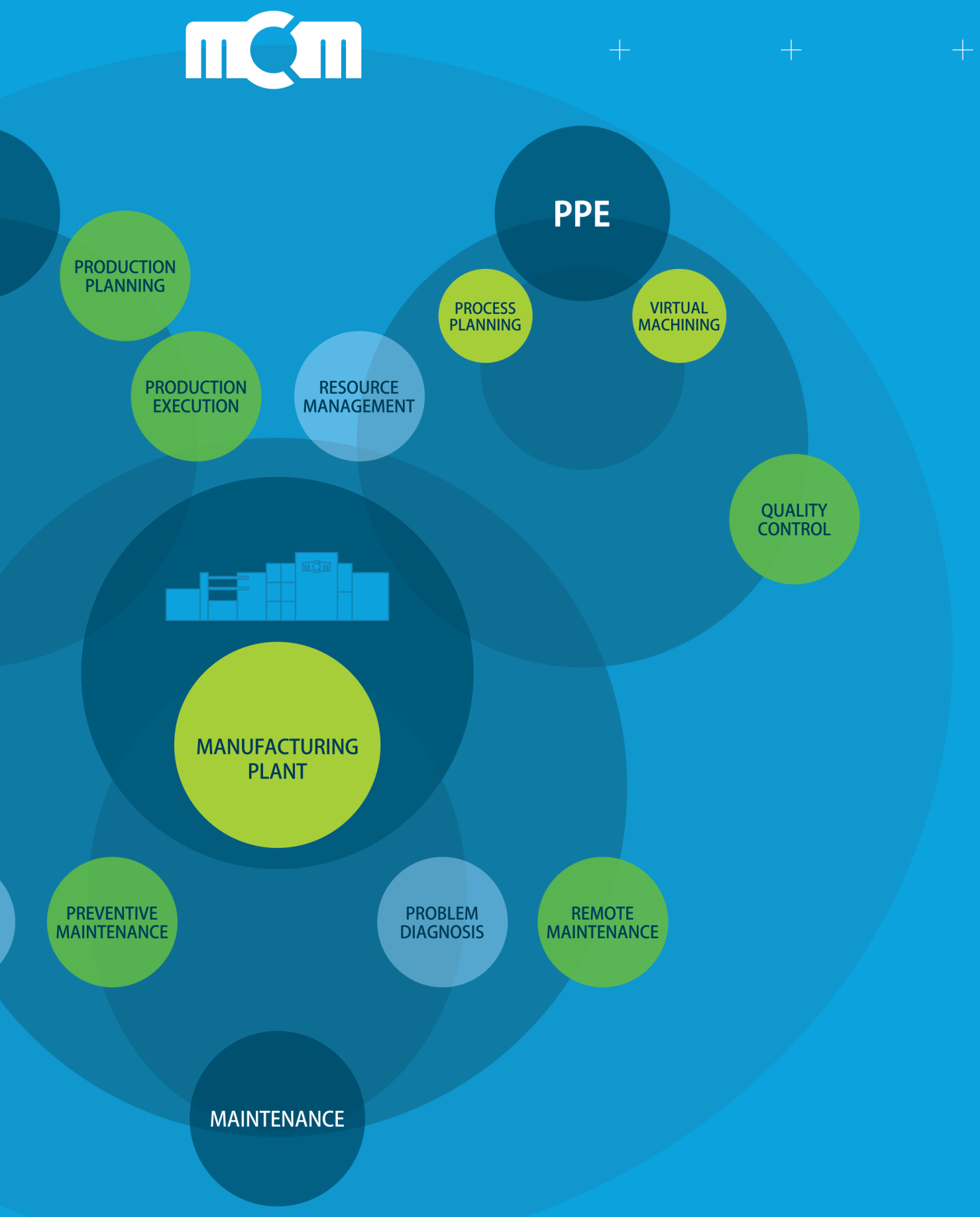


Operation systems of advanced companies

MCM Proposal

MCM Products

MCM Services


PPE
PRODUCTION PLANNING
PROCESS PLANNING
VIRTUAL MACHINING
PRODUCTION EXECUTION
RESOURCE MANAGEMENT
QUALITY CONTROL
MANUFACTURING PLANT
PREVENTIVE MAINTENANCE
PROBLEM DIAGNOSIS
REMOTE MAINTENANCE
MAINTENANCE

THE GATEWAY FOR INDUSTRY 4.0: **jNODE**

The **jNODE** is a gateway to the Internet of Things platforms through which MCM enables the publication of information contents retrieved from the machines towards IoT platforms through standard protocols.
The data flow coming from sensorized devices must be organized to become significant and processable information to provide services.

Thanks to its **IT division MCE,** MCM started 30 years ago working in this direction, **by designing software for machines and by creating a hierarchy of abstraction layers that:**

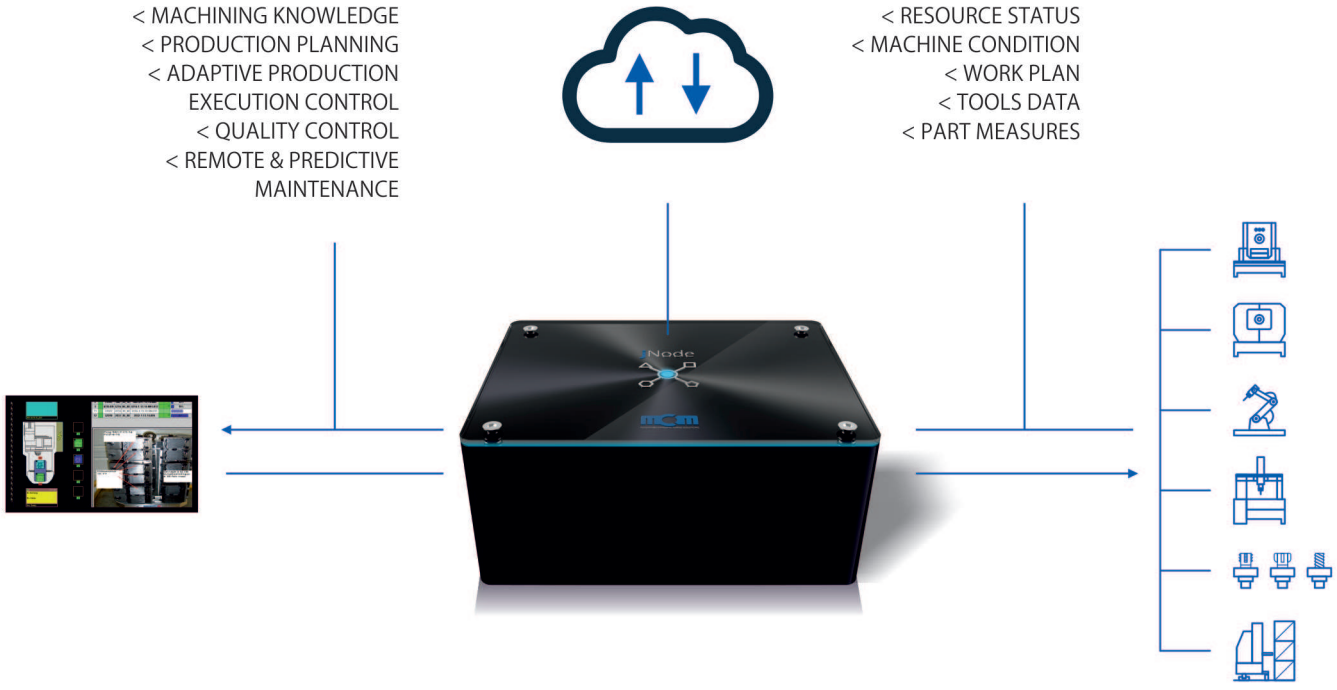
- **starting from sensors and actuators**
- **structures them into devices** (ATCs, electrospindles, APCs, shuttles, operator stations)
- **that come together into units** (machine tools, loading/unloading stations, transport systems)
- **which are further organised into work-areas** (FMC, FMS)
- **controlled by a jNODE**

within shop floors to be integrated with Level 2 services.

This model builds the structure for the information flow:
- everything starts from the sensors that determine whether the machine is on standby, has stopped for an alarm or is working
- the gateway provides high-level aggregated information, which is the real added value offered by MCM
- through the gateway towards the IoT an entire production plant can become a single device made up of many elements, whose data can be published to an Industry 4.0 platform.

Since 2000, MCM has been collecting diverse information from the installed MCM machines, for example each tool change is registered and the gateway sends this information towards Level 2 applications that record it in the event log and publish it to higher levels up to the cloud platform.

In one of MCM's first case histories on this kind of application, the customer asked to calculate the tools usage for each workpiece. Since the related data was already available to MCM, MCM retrieved and processed the data with an appropriate cost model and associated to each workpiece the cost in terms of "consumables".
This application is a valuable type of service that can be created from the manufacturing cloud, thanks to Industry 4.0 technologies.



THE SOFTWARE FOR INDUSTRY 4.0: **jFMX**

The real added value of MCM machines is represented by **jFMX, the supervision software** running on jNODE, installed on MCM production systems since 1985.

The jFMX supervision software allows to fully manage a flexible production system, by:

- **carrying out the production**
- **coordinating the automation**
- **managing the pallets**
- **managing workpiece loading/unloading operations**
- **managing the tools and monitoring their status**
- **managing the programs**
- **calculating machinability**
- **issueing efficiency reports**

MCM also provides **jFMX Level 2 application services,** divided into:

- machining
- monitoring
- planning
- production
- quality
- maintenance

which send, process and add the machine data to other information to calculate performance indexes, such as machines saturation index, operational performance and overall efficiency.

jFMX also displays the energy consumption:
by adding a few inexpensive sensors to the machines and then sending, processing and adding this data to other information, MCM can keep much of the production costs under control.

With regard to large amounts of "finer" data, such as axes position and power absorption during machining, the system must be equipped with a high frequency flight recorder to avoid clogging the network used for automation coordination, which pre-processes, filters and acts like a buffer memory for a new generation of self-learning algorithms.

These devices are spread throughout the control hierarchy and are able to provide new and more advanced functions such as:

- predictive and opportunistic maintenance management
- automatic adjustment of expected consumptions
- automatic adjustment of cutting tools residual life.

With the same web technologies used to develop services for its customers, MCM also offers higher level possibilities:

exploiting internet to access safely a dedicated cloud platform of services to tap into the web at any time:

- **today, to see which are the jNODEs connected around the world and update, correct and exploit them to carry out diagnoses down to the lowest layers of the control hierarchy**
- **tomorrow, to support advanced maintenance services based on performance indexes defined with the customer or to improve the management of the production systems life cycle**

with a direct feedback to the workstation of the machine designer.

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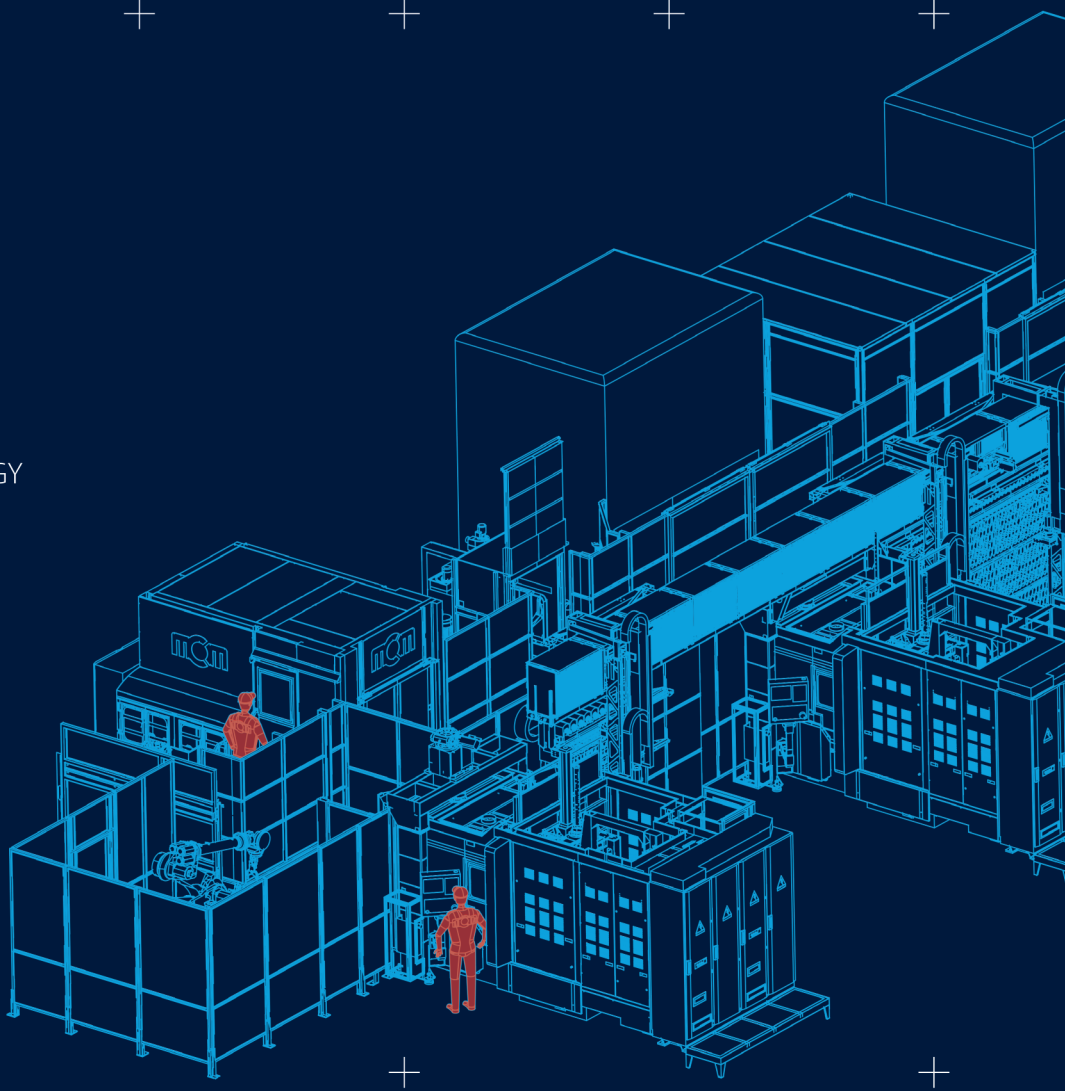
_ MACHINING CENTERS
_ FLEXIBLE AUTOMATION
_ SYSTEM INTEGRATION
_ SUPERVISING SOFTWARE
_ MANUFACTURING TECHNOLOGY
_ SERVICE



MCM Spa - Machining Centers Manufacturing
Via Celaschi,19 / 29020 Vigolzone / Piacenza / ITALY
+39 0523 879811
mcm@mcmspa.it

SALES DEPT
+39 0523 879901
divcomm@mcmspa.it

www.mcmspa.it