



FAGOR AUTOMATION

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NEWS

4.0 Industry

New techniques for
higher productivity and
efficiency



FAGOR AUTOMATION

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Fagor Automation participates in the ReBorn project, funded by the European Union



Editorial

Our businesses are currently engaged in a new industrial revolution driven by digital transformation and the incorporation of new technologies in the manufacturing sector, such as big data, artificial intelligence, the Internet of things (IoT) and cloud computing.

This new industrial revolution, referred to as Industry 4.0, is best described by the amalgamation between the physical and digital worlds, resulting in the creation of smart factories. In these smart factories, all processes are interconnected and humans and robots or smart machines interact with one another. This digital transformation results in making production processes more efficient and flexible while optimizing resources.

At Fagor Automation, we understand that Industry 4.0 is an opportunity to continue to improve and grow, because the culture of innovation is printed in our DNA. For years now, we have been adapting our processes, products, business models and services to this new digital reality. As a result, all our products, especially our CNCs, are already prepared for Industry 4.0.

With solutions from Fagor Automation, our customers improve their productivity, save on energy costs and, resulting from predictive maintenance, production processes are more effective and efficient.

Our services are also ready for this industrial revolution. We offer individual solutions to organizations around the globe, customized for their operations, because our goal is to increase the performance of the machines, providing better value throughout their life cycle and generating more and better business opportunities.

One of the unique hallmark of Fagor Automation is our commercial network, made up of highly qualified personnel and is present in more than 50 countries on five continents and is rapidly adapting to the needs of our customers, developing customized solutions and offering immediate and effective responses.

JOSÉ PÉREZ BERDUD
GENERAL MANAGER





The Smart FACTORY

Industry 4.0 is a term invented in Europe, describing the new factories and production systems where products, processes and users are connected and interact with each other. All this has been possible thanks to the great advances made in information technology. In North America, the most commonly used term is IIOT (Industrial Internet of Things) which refers to the same concept.

The industry is incorporating connectivity, digitization, information systems and high-performance interactive software's into its manufacturing processes. Thus making it possible to achieve production processes that are more efficient while offering customers greater flexibility, innovative and customized solution to enhance productivity and quality.

Fagor Automation is developing new integrated automation solutions that are tailored to Industry 4.0 and a manufacturing sector that demands productivity increases, greater efficiency, production versatility, resource optimization, simplification of processes, better safety and reduced energy consumption.

At Fagor Automation, we are aware that the fourth industrial revolution is already taking place and, therefore, our CNCs are already prepared.

Mobile Internet and M2M (machine-to-Machine) communication are the basis of Industry 4.0. Both offer the possibility to exchange information between systems and products, capture and analyze data, integrate different systems including remote services.

In the productive systems of Industry 4.0, the data flow of low level systems (sensors on a machine or process) is centralized at the highest possible level (the cloud), is processed and then converted into production orders (commands), maintenance or even fault diagnosis and this newly processed data is returned to the drives to be executed.

The main players in these new factories are the Cyber Physical Systems (CPS), which compile data from the various connected sensors and manufactured products.



In a typical machine tool, one of the CPSs is the CNC. According to this diagram, the CNC is in charge of the following:

- Compiling data from the various sensors, either inside the CNC and drives or outside, such as accelerometers, power or energy meters, etc.
- Transforming all the data received to be processed later.
- Sending the data to the plant servers or to the cloud.
- Receiving instructions, programs and algorithms from the servers.

In a typical machine tool, the Cyber Physical System (CPS) is the CNC

All these tasks can now be performed by Fagor Automation's CNCs. Utilizing the enhanced power of CNCs, an OEM/user can develop new Industry 4.0 features to increase the added value of their machines.

Some of the most promising possibilities that can be implemented are as follows:

Maintenance

New technologies bring added value to both the machine manufacturer and the end user.

Instead of following a periodic maintenance schedule, Condition-Based Maintenance uses all the information of the sensors to suggest that a component needs to be checked or replaced. In addition, since the CNC is an active system,

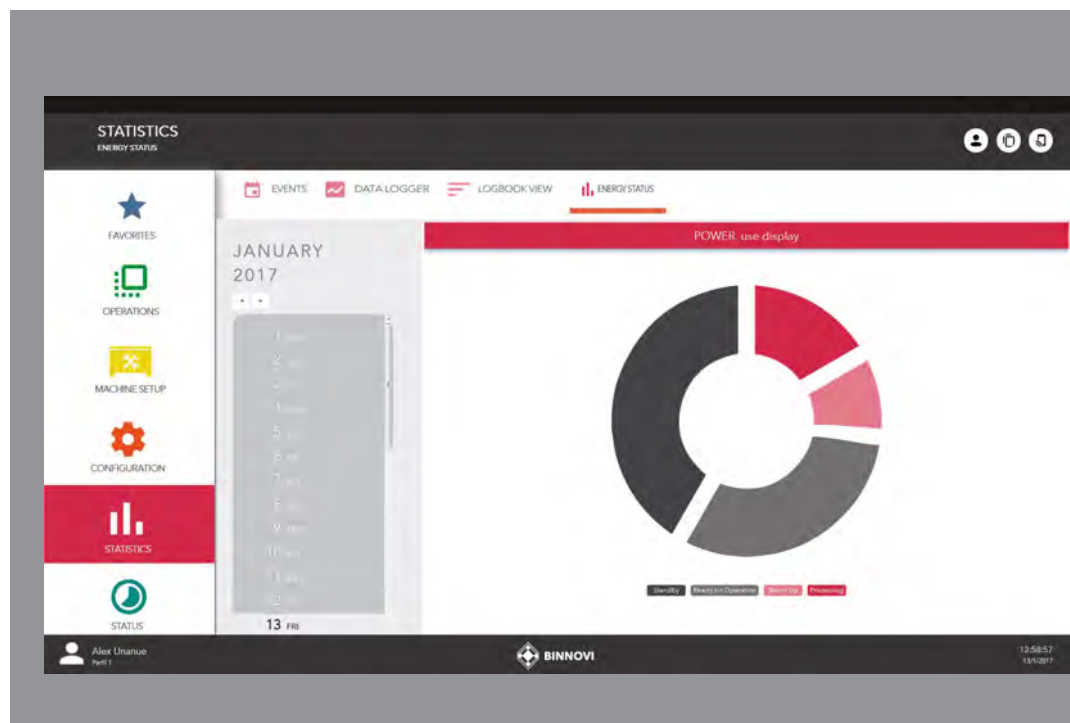
periodic tests can be programmed to run machine test programs and collect information on power, alignments, accuracy, acceleration, vibration, etc.

This concept can be easily extended with the new communication possibilities that allow the safe transmission of test data to the cloud, enabling analysis by the machine manufacturer and planning of the maintenance stops, thus avoiding sudden production stoppages and the resulting loss in productivity of the machine.

In addition, the data of each specific machine can be added to the manufacturer's database. This allows the optimization of future predictive maintenance algorithms, achieved through collaboration. The intelligence from the data jointly provided by various machines helps improve each one of them - each customer receiving an improvement in the productivity of their machines while sharing their data.

Troubleshooting

In the event that machine experiences a fault, all data previously provided by the machine, along with the last events recorded before the fault, is useful in resolving the fault in an optimal and efficient way thus reducing both the diagnostic and the machine down time.



Thanks to the new technologies, Fagor Automation's CNC 8065 will be able to develop new Industry 4.0 features.

Additionally, the combined experience of similar machines or components is available on the web can guide and assist the operators in resolving the incident. This data may help in determining the type of diagnosis to run (which can be accessed even from a portable device), provide solution to the problem or a direct contact to technical support. A report on the current status of the machine and the tests performed can be simultaneously shared to expedite the solution.

Control and monitoring of energy consumption

Many of these functionalities may be developed with sensors already existing in a system equipped with a CNC and digital drives. In this case, information is provided on motor speed and power of the drives, making it possible to connect external devices to the CNC bus to measure the energy consumptions and provide information to the operator or plant management on real-time consumption data of the whole system.

Energy control from the CNC can be achieved by communicating with the PLC and optimizing the operation of various machine components based on the experience of other similar machines. The updated energy policies can be downloaded and integrated in to the PLC routines.

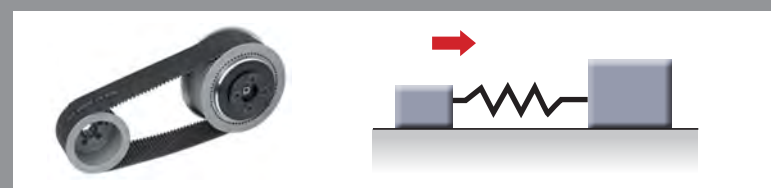
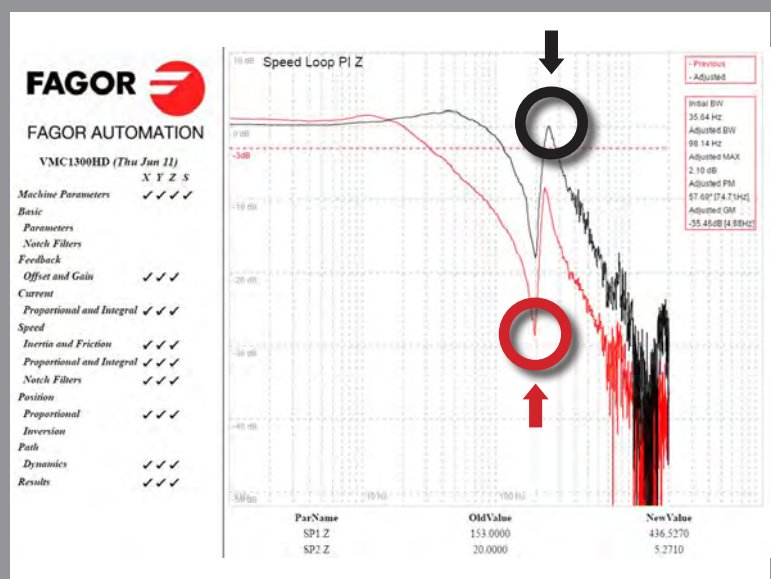
HMI

Advent of powerful smartphones and tablets allows access to information at all times. CNC 8065 with its widely open configuration can easily interact with such devices, hence information flow becomes seamless.



The future will unveil that a CNC will behave like HMI of various devices, that connects to remote servers to download data and algorithms or may even acts as data server for portable devices like

tablets and smartphones. Accessing the data tables, editing programs and having access to all information from the CNC or associated peripheral will be possible anywhere, anytime. ■



PIERRE DELARBRE - MANAGING DIRECTOR AND HEAD OF PLANNING OFFICES AT SOMAB

“Fagor and their CNCs help us **DELIVER** the expectations of our customers”

Somab designs and manufactures machine tools for chip removal. The company's reputation is based on two key ideas: technology and ergonomics.

For 14 years, Somab has equipped its machines with Fagor Automation products. Pierre Delarbre, Managing Director and Head of Planning at Somab, shares some details of the projects where both companies have worked together.

Which were the characteristics of the CNC 8065 that caught your attention the most?

They were mainly the conversational language, as it can be combined with ISO, 3D simulation, and the possibility of custom cycles.

How do you assess the development of larger HMIs and the integration of the CNC in the environment following the Industry 4.0 philosophy?

The CNC is more open operating under Windows 7 and allows us to manage our Interface more easily. The new remote CNC model, coupled with a Full HD 21.5" touchscreen, has made it possible to offer our own HMIs. This new machine programming experience, which combines the simplicity of a conventional machine with the performance of a state-of-the-art CNC machine, perfectly reflects Somab's DNA.

What do you think of the solutions offered for HMI development? Do they meet the needs of the market in which Somab operates?

Previously, we had worked on our own and we had reached a definition similar to the proposal of Fagor Automation. It is very rewarding to know that Fagor can finally help us with matters that are so important to us. These components are perfectly integrated into our vision and

perfectly aligned with the next markets with Somab HMI.

What is your opinion regarding the operation of CNC?

The cycles are very intuitive and supports our developments and our philosophy.

Its easier navigation allows us to focus on markets such as education and training. We often learn and evolve based on the feedback we obtain from our trainers, as well as the experience of the teaching and professionally trained faculty.

What is your opinion about the support and flexibility provided by the Fagor Automation staff?

Fagor's teams play a key role in our collaboration. The material is essential, but the Service is very important. Thanks to the proximity of the people from Fagor Automation France, we can rely on these two aspects, as well as many others. Fagor Automation allows us to access their R&D department at their headquarters in Mondragón, Spain. This regular and close collaboration around our respective development paths represents real wealth for our companies.

How would you define the raison d'être and the mission of Somab?

The spirit of Somab, its DNA, has always been direct machine programming. Since

1985, Somab has developed various solutions on conversational CNC. Knowing how to combine intuition, manual control and performance of the most modern tools and, above all, those of Industry 4.0, has always been the workhorse of Somab.

Somab is a company with a strong track record. What demands do you think the market will have for the medium and long term?

In the medium and long term, the machine will primarily be controlled by the operators and helped by its intelligence and other technological advances they will be able to communicate various information's. These machines will be self-adaptive to ensure that processes and machines are safer, primarily due to anti-collision devices. In terms of machine operations, we must not forget the robotic interface for the machines of the future.

What were the main reasons to choose Fagor CNC systems to equip the machines you manufacture?

We began our collaboration with Fagor 14 years ago and, since then, we believed this collaboration would be able to help us with defining the technologies of the future. So far, this choice has been very productive.



PIERRE DELARBRE

The CNC lathes manufactured by Somab are intended for customers from different sectors, with very diverse needs and requirements.

Could you describe these sectors and their needs and how the Fagor Automation CNCs perform in them?

Somab machines are present in all sectors of the industry, from aeronautics to automobiles, as well as rail and armament. Somab, however, is deeply involved in a analysis of the behavior associated with prototyping of parts with a high added value. Fagor and its CNC allow us to perfectly meet all expectations of our customers.

Which characteristics would you highlight as best among Fagor Automation's CNCs?

The most important features for Somab regarding the Fagor solutions are clearly the simplicity of its use and possibility of customizing their products according to our users' preferences.

Which functions do you find crucial at machine level? Do you consider that Fagor's conversational CNC language responds adequately to the market demand?

With the aim not only of achieving, but also exceeding the market demand in terms of CNC products, Fagor's ability to help us in the development of our needs is fundamental for us.

Do you believe that the Fagor Automation solutions meet the new philosophy of Industry 4.0?

The first developments of Fagor regarding MT Connect, in particular, allow us to have a clear view of Industry 4.0.

How do you value the possibility of Fagor Automation collaborating with you in your experience of expanding into new markets?

China, with the specific support of SPARK, is a strategic market for the future of Somab. The global dimension

of FAGOR is also a strong point, so we can be close to our customers on the other side of the world.

How does Fagor Automation respond to the demand for new features from the market?

Somab attends several trade shows throughout the year, including the FERIA Industrie, which is held alternately in Paris and in Lyon and showcases many innovations every year. The access that Fagor gives us to its R&D is an incentive for our own development. This allows us to create products that respond to the real problems of our customers.

What is your opinion on the service offered by Fagor Automation?

Its ability to react – its ability to listen to both us and our final customers – are another element that makes our collaboration so strong and profitable. ■



Diversified Machine Systems and Fagor partner to provide IOT/Industry 4.0 solutions

Diversified Machine Systems (DMS), a privately-held corporation with headquarters located in Colorado Springs, Colorado, is an industry-leading designer and American manufacturer of 3 axis and 5 axis CNC routers and machining centers. Supplying machines to a wide variety of manufacturing sectors including aerospace, automotive, marine, recreational vehicles, 3D sculpture, concept models, pattern making, formed plastics and woodworking among others, they have thrived as a Company that is always on the Leading edge of Technology.

All engineering, structural fabrication and machine assembly takes place in their Colorado Springs facility and includes complete in-house mechanical and electrical engineering, welding and steel

fabrication, a fully-equipped machine shop, a large scale CNC machining center, mechanical and electrical assembly operations, control system integration and the final quality control test processes.

The DMS Quality Assurance Program pays close attention to every detail in order to guarantee that each machine is of the highest quality and standard of reliability for any CNC router available



on the market. In addition to manufacturing 3 Axis CNC routers and 5 Axis CNC machining centers, the company provides full technical product support and a complete spare parts inventory. With our expertise and unwavering commitment to quality, DMS is able to meet the strictest tolerance standards required by our clients using advance materials in industries such as aerospace, automotive and medical. As our customers continue to develop new uses for our advanced CNC machining centers, we adapt to meet their needs.

We sat down with Ed Hilligrass, Vice President of DMS to talk about implementation of IOT solutions.

Ed, are your customers asking for IOT/ Industry 4.0 solutions ?

Yes IOT/I4.0 is asked for often when implementing manufacturing and OEE solutions. (Overall Equipment Effectiveness) Clients are asking DMS as a CNC OEM in order to leverage our knowledge of the machine tool as it relates to aligning and improving their manufacturing operations through automation and integrated solutions.

Which Fagor CNC is your primary choice for your machines going into this market ?

The most common tends to be the Fagor 8065 with the Touch Screen capabilities

Is there features or flexibility from the 8065 CNC that helps you achieve your goals in this sector.

Ed: Absolutely. Unlike other control systems our clients have experienced in the past, DMS provides a full featured Fagor control package that includes the console, motors, drives, and feedback systems that are scalable to many different processing styles and material types utilizing the custom screen/editor and 3rd party software ability of the 8065 CNC.

How are you exchanging information within a Smart System?

Over the past 10 years, DMS has invested in the integration of technologies that preceded other communications standards. The investment has allowed DMS to work directly with the Fagor control system at the TCP/IP levels allowing for ease of communication and integration with existing and new MES product implementations by utilizing a standard and secure high speed base level protocol.

Have you utilized any 3rd party software for assistance?

DMS technologies such as Dashboards, Machine Data Collection, Barcode and RFID scanning, Schedulers, and others provide a fully integrated software solution and global support through our partnership with CIMCO. The seamless integration the DMS CIMCO solutions are at the heart of Operational Equipment Effectiveness (OEE).

With CIMCO, DMS is capable of providing a centralized Manufacturing Data Management (MDM) system to collect and maintain nearly any facet of the CNC operational information our client's desire including IOT/I4.0 solutions. And where the machine operator interactions need to be collected, clients can build customizable operator screens to record operator actions that cannot be automated. When utilizing the Fagor 8065

Touch Screen and programmable short cuts, any of the MDM or operator screens can be accessed directly from the Fagor console saving clients the cost of a shop floor PC at each CNC.

Can you provide an example of a particular process?

Yes, one of our projects is the integration of Autodesk Power Inspect into the DMS Machine. In conjunction with the Fagor 8065 Probing ability we not only Probe the part for basic inspection purposes, but we then also have the ability to compare the data to the CAD model. The results are then generated into detailed reports that can instantly be shared with all personnel ranging from the Quality department right up to Senior Management. We believe this capability is a real Game Changer in the industry.

DMS offers the full CNC-Servo-Scale Fagor Solution, is there a benefit to this?

While providing a complete Fagor Control Systems allows DMS to provide a full 2 year warranty on the entire control system, DMS support can quickly diagnose electronic system issues when they arise without have to troubleshoot compatibility issues down to the component level across multiple vendors.

Is there a specific DMS customer market that requires IOT solutions more than others?

We find the need for these types of horizontal products across all industry verticals where companies are implementing OEE automation solutions.

Do you see any new trends in the market you would like to discuss?

While it's not a new trend, we do see the ongoing expansion of manufacturing in the US with a focus on automation and operational transparency with regards to manufacturing data, business planning and maintaining a competitive edge. ■

In 2015 Ed Hilligrass and DMS received the 45th Annual Governors Award for Excellence in Exporting by the Colorado Office of Economic Development & International Trade. DMS was also awarded a 2014 Colorado Companies to Watch Winner, named a 2015 Made in Colorado Award Winner, and ranked #101 in the 2014 Top 250 Private Companies in Colorado, and chosen as a 2015 ACG Denver Growth Awards Nominee. DMS was also honored with the 2013 Regional Business Alliance Excellence Award given by the Colorado Springs Regional Business Alliance.

For more information, please visit the DMS Website: www.dmscncrouters.com

MASTER ELECTRONIC ANALYST OF THE
MACHINERY RETROFITTING DEPARTMENT AT DANA
INCORPORATED BRASIL

GIOVANNI BERETTA



«The equipment configured with Fagor CNC much greater **EFFICIENCY**»



Dana Incorporated is a leading global provider of transmission, sealing and thermal management technologies that improve the efficiency and performance of vehicles with conventional or alternative power systems. Founded in 1904 and headquartered in Maumee, Ohio, United States, the company employs 23,000 people in 26 countries across five continents.

Giovanni Beretta, Master Electronic Analyst of the Machinery Retrofitting Department at **Dana Incorporated Brasil**, with over 30 years of experience in the company, explains how the collaboration between Dana and Fagor has been developed with the incorporation of Fagor CNCs in their robots.

Describe the process of integrating the robot with the Fagor CNC ?

The integration process of the Fagor CNC has been really comfortable and simple. Through I/Os, we have generated command and control signals in the communication between the robot and the CNC to perform the tasks of loading, rotating and unloading the workpieces.

To what extent has the machine operation and efficiency improved due to integration of the robot with the Fagor CNC?

We have achieved a significant increase in productivity thanks to reduced time losses in loading and unloading of workpieces. In addition, the health and safety of operators has improved, as the workplace is now more ergonomic. Similarly, we prevent our operators from performing repetitive tasks that require a lot of physical effort.

How do you assess the possibilities of customizing the HMI to monitor the state of the robot?

The possibility of customizing the HMI greatly facilitates the communication task between the operator and the Robot,

as the access system to the features is much more friendly.

What is your opinion on the support provided by the Fagor Automation staff?

The best possible. The attention paid and level of knowledge presented by the engineers of Fagor Automation made the execution process very simple, without bottlenecks, and fully successful.

What were the main reasons to choose Fagor Automation to equip the machines you manufacture?

Reliability, technology, rapid responsiveness to project needs and full support where necessary. All these reasons led us to choose the products of Fagor Automation.

What do you think are the features of the Fagor Automation CNCs that bring greater added value to your machines?

The quality of the products and the low failure rate allow the equipment configured with Fagor to achieve very high levels of efficiency.

What is your opinion on the service offered by Fagor Automation?

We at Dana have an extremely positive

opinion on the service provided by Fagor Automation. We have been working as a team with Fagor for more than 20 years and have achieved excellent results. We are confident that this partnership will last for years to come.

Dana Incorporated Brasil is a company with a consolidated track record. What demands do you think the market will have for the medium and long term and how can Fagor Automation help you meet them?

Dana always seeks to be prepared for the challenges posed by the global market. This year in Brazil, in a crisis scenario, Dana has acquired two new companies incorporating more than 3000 new employees, with the goal of reaching the leading position and consolidating ourselves as one of the largest suppliers of automotive components worldwide. To achieve these goals, it is necessary, if not essential, to ensure the continuous technological improvement of our manufacturing processes and facilities. It is thus essential to partner with companies with proven reliability and continuing technological innovations. Fagor Automation plays and will play a key role in our goal to become leaders in this industry. ■

INNOVATIONS in feedback systems



Serie PB

Fagor Automation's new self-guiding **LINEAR** encoder, with a fundamental shift in mechanical design

The self-guided linear encoder has a compact design with bearings and a guide integrated in a single aluminum profile and offers two options for coupling with the machine

Fagor Automation achieves more success in the improvement of its products with the new self-guided linear encoder, mainly intended for fabrication applications, such as press brakes or shears.

Fagor Automation has completely re-designed and re-developed the new self-guided linear encoder based on market trends and knowledge acquired with a prior model in the market for many years.

The new self-guided linear encoder represents a fundamental shift in mechanical design. It emphasizes the compact design with bearings and a guide integrated in a single aluminum profile. Furthermore, Fagor Automation offers two possibilities of coupling with the machine, either

by using a metal bar with articulated ball joints or directly by a flexible metal bar. Both design options allow for absorbing any misalignments between the machine and the linear encoder.

For the opto-electronic components, Fagor Automation integrated the previously developed technology, used in other models of its catalog, with proven reliability and acceptance in the market, offering up to 1 μm resolution and a selectable reference mark every 50 mm.

In fabrication applications, especially in medium-sized and large machines, for smooth movement two linear encoders are used, one on each side of the ram. It is preferable, in these cases, to maintain symmetry with respect to machine axis

movement and the cable direction and machine position.

The design of the new self-guided linear encoder has taken these aspects into consideration. Therefore, it offers two options so that the cable outlet is on the same side while maintaining the reference marks to locate the machine in the same position. Thus, the installation and configuration of the control system is greatly improved.

This smart design, which takes into account various mechanical aspects to facilitate the installation and meet the requirements for precision and repeatability control is competitively priced and provides the best value in the market today. ■

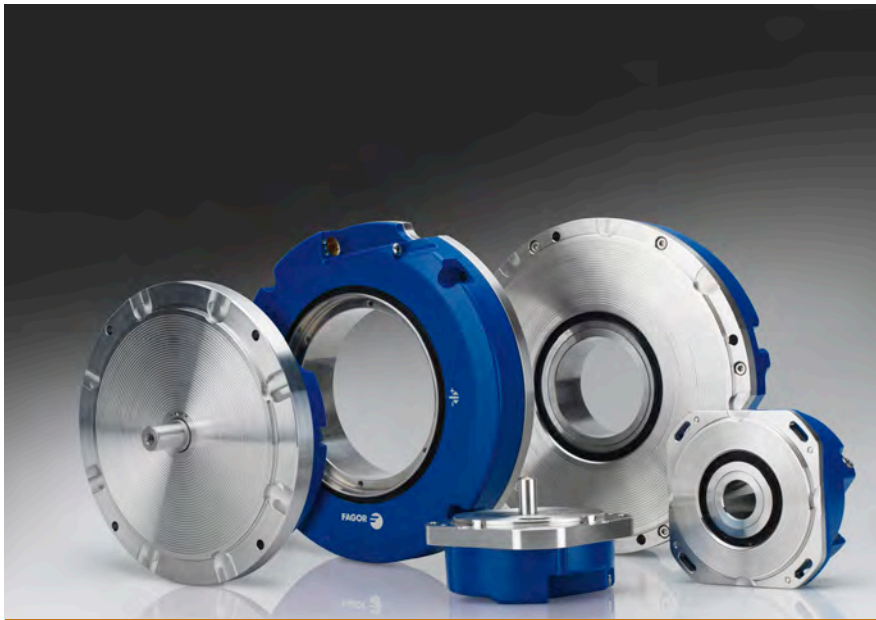
New high-end **ANGULAR** encoders for high-precision, high-resolution equipment

The new line is especially designed to work in hostile environments as it offers higher rigidity and protection

Fagor Automation is expanding its current offering of high-end angular encoders and has re-designed the entire existing family of hollow and protruding shaft models with external diameters ranging from 90 mm to 200 mm.

The high-end angular encoders have acquired market recognition for their rigidity and reliability and are very popular

among machine tool manufacturers and other equipment manufacturers where high precision and resolution requirements are stringent. In addition, its popularity in the market has been supported by the entire connectivity offer with drive and control systems – one of the most complete offerings in the market – both through analog and digital interfaces.



Serie 2 Angular Encoders

A host of mechanical design improvements have been made including a completely new encoder body and a double flanged design with improved sealing capabilities. As a result of this design change they facilitate better drainage of liquids, provide larger mounting tolerances while maintaining accuracy and rigidity. The new line has full mechanical and electrical compatibility with the previous models and ensures direct drop

Fagor Automation has developed an angular encoder with a 200 mm external diameter and a 100 mm internal diameter that integrates the channel into the encoder body.

in replacement. The ergonomic design changes to the external encoder body and covers provide enhanced looks.

Two new models of angular encoders

Fagor Automation added to the existing line two new models with different mechanical dimensions: an angular encoder with a 200 mm external diameter and a 100 mm internal diameter; and an angular encoder with a 87 mm external diameter.

Angular encoder with a 200 mm external diameter and a 100 mm internal diameter

This new model while maintaining the current line of 200 mm external diameters includes all the improvements listed above. Fagor Automation has developed a model with a 100 mm internal diameter, which, given its uniqueness, required the implementation of specific technology to integrate the separate channels into the encoder body.

From the standpoint of connectivity, it will offer, as in all other models, a wide range of analog and digital interfaces for various drive and control systems. The main characteristics such as resolution of up to 29 bits and accuracy of 1 arc second, places this product in the forefront of many new sectors.

This encoder helps expand Fagor Automation's offering, provides more flexibility in machine or equipment design and also provides an alternative for applications in a range of services which are only provided by handful of manufacturers.

Angular encoder with an 87 mm external diameter

The new family of angular encoders with an 87 mm external diameter has been designed following the market trend

The angular encoder with an 87 mm external diameter is specifically designed for rotary tables and is aimed at flexography, hoisting and industrial automation applications

with integrated bearings and external coupling.

This angular encoder is specially designed for rotary tables and is aimed at flexography, hoisting and industrial automation applications in general, reaching up to 23 bits of resolution in absolute models and an accuracy up to 10 arc seconds.

The first available model will be with the coupling flange, absolute with a 20 mm internal diameter. In addition to the usual output signals, the line will be completed by offering another type



H2-D87

of external coupling, with different internal diameters available for the two types of couplings. The different options will provide a wider family both from the standpoint of mechanical and electrical design and better adaptability to the needs of different designs and applications. ■

ITRI and Fagor Automation to develop

SMART SOFTWARE

for applications that improve the performance and safety of the machining process



The Taiwan Industrial Technology Research Institute (ITRI) is a non-profit R&D organization dedicated to applied research and technical services. Founded in 1973, ITRI has been dedicated to improving the competitiveness and sustainability of the country's industries and has played a key role in Taiwan's economic growth and the transition from a labor-intensive industry to an added-value industry driven by innovation.



ITRI's five-axis machine with Fagor 8065 at the TMTS 2016

ITRI is developing, along with Fagor, a five-axis machine tool designed to manufacture small parts with freeform surfaces, among other projects. Derek Luo and Shuo-Peng Liang, Managers of the Intelligent Machine Project at the Intelligent Machine Technology Center of ITRI, explain the work being carried out by the entity and the projects being executed in collaboration with Fagor Automation.

What do you think is the current situation of the machine tool sector in Taiwan in relation to the Industry 4.0?

Taiwanese companies dedicated to the machinery have focused on the performance of the machines themselves, and there is a mature cluster for precision machinery in the central area of the country. Currently, these companies are facing the challenge of global compe-

tition and the demand for significant customization in the manufacturing industry. On the other hand, with the trend of Industry 4.0, the term "intelligent machinery" not only means a machine that improves safety and performance through the use of software technology, but also sets the most important foundations for the next generation, with workshops in which humans and machines collaborate to achieve high efficiency in production, based on sophisticated communication protocols.

Many machinery companies have begun development activities related to Industry 4.0, such as diagnostics and forecasting based on sensor data, IoT and big data. Nevertheless, the development of these aspects often requires multidisciplinary groups that are not easy to

assemble for small and medium-sized enterprises in Taiwan. Thus, a research institute such as ITRI plays a key role in the organization of integrated multidisciplinary projects, as well as the corresponding research teams.

Intelligent machinery has also been selected as a key sector in industrial policy, and budgets have been allocated to research and development projects related to Industry 4.0. Thanks to all activities by the sector, research institutes and the government, the cluster of precision machinery is becoming the cluster of intelligent machinery and should maintain its competitiveness in the Industry 4.0 era.

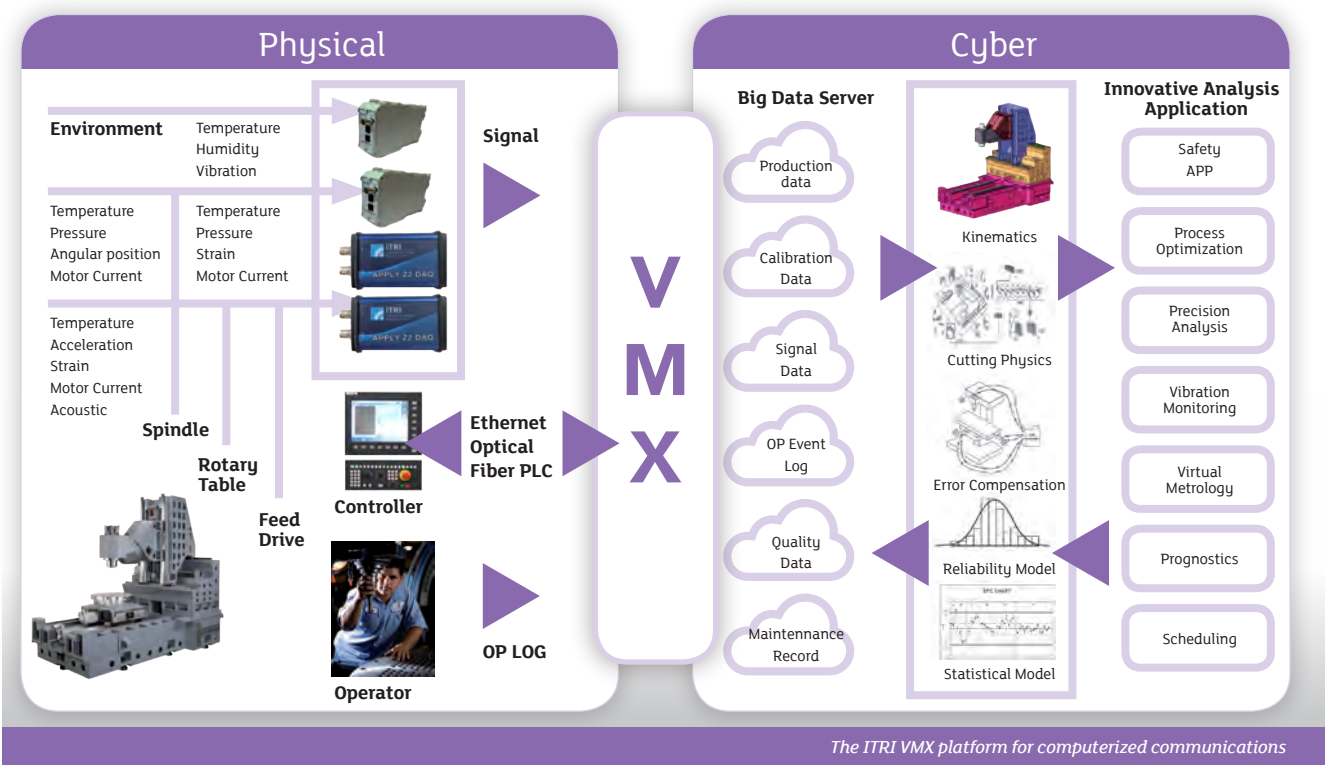
What solution does ITRI offer OEMs in Taiwan to ensure that they have intelligent machines?

ITRI began developing software for intelligent machine tools in 2009. Since then, the ITRI development team has provided software for security, performance enhancement, control and diagnostics.

In addition to products that are already being used by OEMs or machine users, it is dedicated to capturing and packaging of software modules and libraries so that developers in the industrial and university sectors can use a toolbox to develop custom applications.

In 2015, the toolbox was again upgraded into an easy-to-use development environment called VMX. VMX provides

Cyber Physical Manufacturing System © ITRI



a unified communication interface to a number of commercial drivers, as well as different data capturing devices. It also provides a connection to database systems so that captured data from the is and sensors can be stored in the local or network-based database.

ITRI has provided software for subjects/problems related to security, performance improvement, control and diagnostics

VMX defines a software development scenario similar to an APP in which developers are actually developing plug-ins or extension modules to the extensible VmxHost program.

VmxHost manages all communications from the database system, the sensors and the is, so that developers can focus on the specific problem of the application without needing to know the underlying details of the communication. The VMX development scenario will significantly reduce the cost of development and maintenance to allow OEMs to create intelligent software.

ITRI also conducts workshops and training courses for OEMs to train their engineers or help them solve specific problems during the development of the VMX APP.

ITRI is currently collaborating on a project with Fagor Automation. Can you explain what this project is about?

ITRI is currently developing a five-axis machine tool alongside Fagor. The machine was successfully introduced at the International Taiwan Machine Tool Show (TMTS) in 2016. This machine was designed to manufacture small parts with freeform surfaces, such as wearables, propellers and dental implants. The machine is equipped with the latest version of the Fagor HMI touchscreen device. Thanks to the 8065 API, the ITRI team has deployed a VMX adapter and successfully installed intelligent software to control head vibration and eliminate vibration marks.

ITRI and Fagor will continue to work on the current prototype and will develop more intelligent software for specific applications that should help machine operators improve performance and process safety.

What do you think of the Fagor Automation solution for Industry 4.0?

We were very impressed by the Fagor team during the development of the five-axis machine tool. The use of the API provided by the Fagor is very simple, so the ITRI team can integrate the Fagor VMX within 2 weeks. The MT-Connect interface adapts well to the Industry 4.0 trend and makes it an appropriate platform for building intelligent machine tools or turnkey solutions for the next generation of manufacturing systems in the Industry 4.0 era. ■





INTELLIGENT Maintenance

Predictive maintenance detects faults by identifying fault patterns

Industry 4.0, also known as the Fourth Industrial Revolution, incorporates three fundamental concepts: machines digitization, interconnection and processing of large amounts of data obtained from the monitoring of these machines. The application of these elements is what is referred to as the intelligent factory.

The technology allows the easy integration of all types of sensors: level, pressure, temperature, speed, torque, power, acceleration, vibration, energy consumption, loads, concentration, pH, conductivity, etc.

These sensors continuously provide valuable information about the behavior of mechanical, electronic, mobile or liquid components that are subject to possible wear, deterioration or maintenance throughout the service life of a machine.

The current trend of permanent sensor and monitoring and expansion of connectivity to all areas and industrial components, along with the development of specific software and applications for the processing of the information collected, opens up new possibilities for service and allows the development of concepts such as Smart Maintenance, which features predictive maintenance as its main innovation and component.

Predictive maintenance is of great importance in Industry 4.0, as it offers

anticipation, efficiency and effectiveness to the intelligent factory.

Unlike traditional maintenance, which is either corrective (repair) or preventive (replacement of a component in anticipation of failure), predictive maintenance is based on early failure detection by identifying failure patterns.

Predictive maintenance involves taking a series of measures based on the analy-

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sis of current and historical information to predict the behavior of equipment while applying, where necessary, maintenance before a defect can occur.

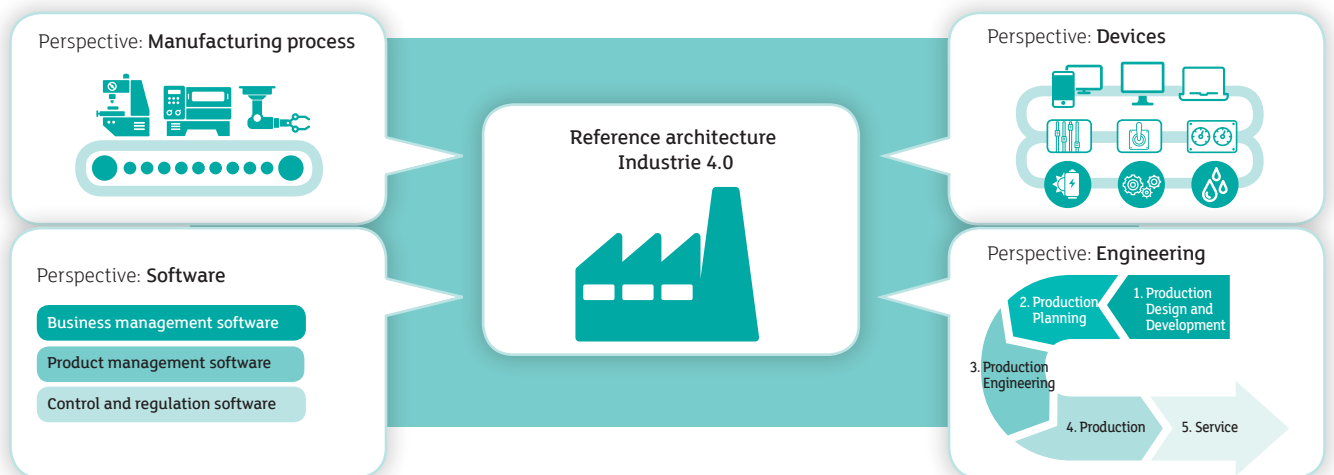
Although predictive maintenance represents initial investment costs for its development and application, its advantages are clear and many of them have an immediate effect. Since the state of the machine is permanently monitored and data are processed based on our historical knowledge and data, the clearest benefits are:

- Faults are eliminated by minimizing unplanned downtime.
- Downtime is reduced as they are programmed prior regarding both dates and materials involved.
- Productive intervals and the service life of the components are lengthened.
- The stocks of components for service are reduced, and their acquisition can be planned.
- Causes of hidden failures that may become chronic are detected.
- Serious breakdowns that may cause prolonged downtime are avoided.
- It allows the provision of reports and indicators that assess the functional aspects of the machines, even from a remote location.
- The reliability, productivity, quality and maintenance costs of the machines are improved.

Fagor Automation products are at the forefront of the possibilities of digitization, connectivity, specific software and performance requirements so that, together with the manufacturers, they can develop and apply the concepts of Industry 4.0 in their machines, obtaining all the advantages provided by the current technology. ■

Fagor Automation participates in the **ReBorn** project, funded by the European Union

The ReBorn consortium, composed of 17 partners, is working to demonstrate the strategies and technologies that support a new paradigm for the reuse/recycle of production equipment in factories.



Fagor Automation is part of the European project ReBorn, funded by the Horizon research and innovation program, of the European Union. This consortium, consists of 17 partners from across Europe, is working to demonstrate strategies and technologies within Industry 4.0 that support a new paradigm for the reuse/recycle of production equipment in factories.

ReBorn will take a significant step towards the reuse of 100% of the equipment. The participation of Fagor Automation consists of exemplifying as a final user the progress of the project and demonstrating, validating and comparing the different results.

Reuse will breathe new life into dismantled production systems and equipment, helping them to be "reborn" into new production lines. According to a survey conducted by the manufacturing industry, the degree of reuse of equipment is less than 25% in 9 out of 10 factories.

These new strategies will contribute to sustainable, resource-friendly and more environmentally friendly manufacturing. At the same time, they will bring economic and competitive advantages to the manufacturing sector by strengthening the competitiveness of European SMEs through state-of-the-art technology and new business models. As a demonstration-oriented project, ReBorn aims to deliver proven prototypes in the industrial environment.

Impact of ReBorn on the industry

Thanks to this project, Fagor Automation is planning to modify the distribution of its plants to achieve greater flexibility of production and reduced processing times. In addition, it will provide a new and more efficient organization.

Fagor Automation intends to begin using this technology for medium-term benefits. In one aspect it will reduce the time of configuration and initial period

by 30-40%. On the other hand, it will reduce downtime by means of predictive and proactive maintenance through the assessment of the state of the machinery by 15-20%

Regarding the industrial sector, the importance of vertical integration, from the devices to the higher-level software, is important as it facilitates the decision-making process of planners.

ReBorn is one of the projects included in Industry 4.0 of German research institutes and is considered by the VDMA (Verband Deutscher Maschinen- und Anlagenbau, the German Association of Manufacturers of Machinery and Industrial Plants) as a project that applies the reuse of modular plants and machines based on the knowledge. The VDMA accounts for more than 3100 companies, mainly medium-sized companies, in the capital goods sector, making it the largest industrial association in Europe. ■



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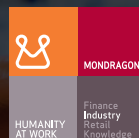


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