



BREAK THROUGH

the global premium metal working equipment and services provider



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AXILE ART™ - An Intelligent Monitoring System for smart manufacturing



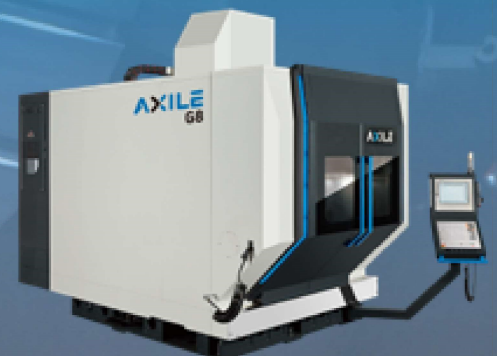
AXILE
agile smart machining

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 **TIMTOS**

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Buffalo Machinery Co, Ltd.

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AXILE

Article contribution is welcome!

BREAKTHROUGH welcome submission from all fields of machine tool industry related. BREAKTHROUGH is committed to prompt evaluation and publication of submitted articles. Company profiles, production experience, feedback of using AXILE and MICROCUT products are the most valuable article to share with "BREAKTHROUGH" readers. Please send the article and pictures (if any, images resolution in 300 dpi or above) to the local agent or email to info@mail.buffalo.com.tw

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From the Publisher

“ Challenge has never stopped.
It is the time to choose either wait to become weaker or fight to be stronger. ”



2020 is close to be over and it has been a challenging year for everyone. Buffalo Machinery is proud to have been able to keep things as close to business as usual as possible with all vendors and distributors support, AXILE is developing a new model of 5-axis and constructing a new factory for future production expanding. Buffalo Machinery continues to make its mark on 5-axis machine and its technology, with intelligent automation solution and i4.0 application developments reaching significant milestones. The AXILE smart automation system (iAutomation) has recognized by the Taiwan Excellence committee and received the 2021 Taiwan Excellence Awards. AXILE smart automation with integration of ART™ is ready for the markets which are looking for 24/7 unmanned production to raise productivity and reduce service cost and of course to increase the business profits and being more competitiveness in this ever-changing market. We are excited to announce that the AXILE iAutomation is going to deliver to the aerospace industry in US later 2021.

Coming with the new development plan of Buffalo Machinery, the popular G6 line needs a new home to accommodate the growing production. The new factory development is at its final stage and will start construction before end of this year. The new factory construction will be completed by end of 2021 and start to operation early 2022. It is not only for G6 production line but also the production for the self-developed motorized spindle and i4.0 technology development center.

At this very difficult time, we need to be well prepared and accumulate our strength and get ready to go when the right time comes. Buffalo Machinery is striving to create business growth and will never give up. We need all your support and be confident that together we can make it.

Dr. Paul Chang
Nov 2020

The President of Buffalo Machinery,
A Smart Machining Technology and Industry 4.0 device provider



Comprehensive 5X Smart Automation Wins Taiwan Excellence Gold Award 2021

Congratulations to AXILE wins Taiwan Excellence Gold Award 2021. With continuous technological development, AXILE once again has proven its competence in innovation technology.

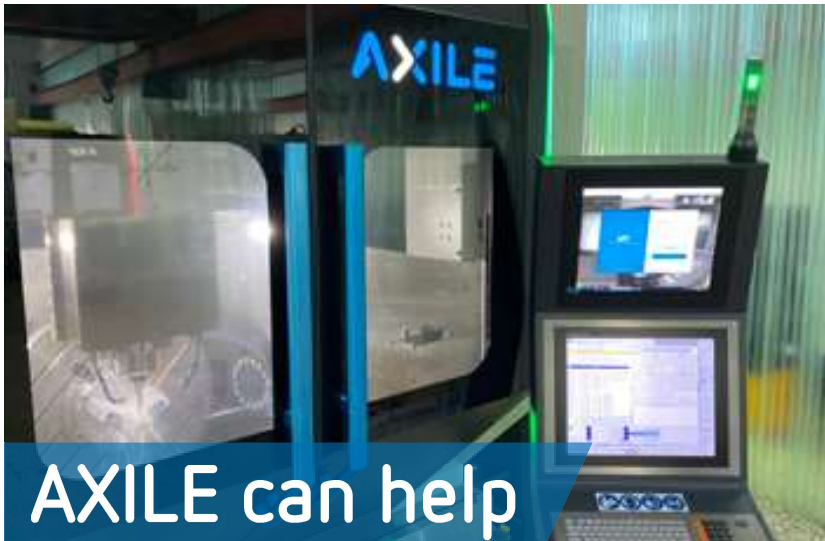
AXILE Comprehensive 5X Smart Automation receives award by meeting four criteria, R&D, Design, Quality and Marketing. AXILE Smart Automation is integrated with ART™ System to adapt to the Smart Factory production line which can enhance the productivity up to 30% - 200%. AXILE Smart Automation offers a total solution for smart manufacturing to meet the need of automated markets. It also helps organizations strengths business competitiveness and revenue. AXILE Smart Automation is the best applied to the aerospace, high-end die & mold, and medical industries.



The Taiwan Excellence Award is hosted by Ministry of Economic Affairs since 1993. There are 433 products won the Taiwan Excellence Award, and 30 products will compete for the Taiwan Excellence Gold and Silver Award this year.

AXILE is much honored to receive the 2021 Taiwan Excellence Gold Award. As an Industry 4.0 product and service provider, AXILE will keep the direction of innovation and technology.





AXILE can help

It is an honor to AXILE Machine to participate in making the anti-counterfeit mold of "Made in Taiwan" & "MD" (Medical Device, which means the medical materials) for the newly produced masks. AXILE G series has made the embossed mold within 24 hours including the drawing process which amazed the team members. The new anti-counterfeiting masks were officially launched on 24th September which can be purchased from the shops now.

In order to prevent counterfeit labeling and strengthen the identification of Taiwan domestic masks, the medical flat masks produced after 17th September must be marked with "Made in Taiwan" and "MD", announced by the TW Authorities in early September. When the new regulations were released, many production links have to be tuned, including the production of embossing wheels for stamping machines.

Many Taiwan manufacturers from Machine Tool Industry have been voluntary formed, we called "National Team" to produce the mask production machines to achieve 10-million mask per day in March to relieve the shortage of the masks due to the COVID-19 outbreak. When the TW Authorities declared that all the domestic masks have to add anti-counterfeiting stamps within 2 weeks' time, the "National Team" was dispatched again, and this time with different demanding skills. From parts measurement, embossing design, drawing process, NC program, to customized tool for anti-counterfeit machining technology, the manpower and material resources required within such short period of time were not an easy job.

AXILE Machine has proved its ability one more time with its high reliable 5-axis machining skills to complete the anti-counterfeiting mold within short time. AXILE Machine is proud to be able to contribute to the team and fulfilled the task precisely.



:::Made In Taiwan:::MD::

Dr Paul Chang, the leader of Buffalo Machinery, is recognized by the 74th Golden Merchant Awards as Outstanding Entrepreneur for his outstanding management and innovation capabilities. The award ceremony was held on October 30th to praise award winners and presented by Economic Affairs Minister Wang Mei-Hua.

Dr Paul Chang leads the Buffalo team to develop technology and improve product quality. With more than 40 years of hard work, Buffalo has become a global high-end metalworking machine manufacturer. Buffalo supplies a wide range of products and marketing to global markets in two brands. MICROCUT covers most of the product lines, including lathes, milling machines and boring machines. Facing the era of Industry 4.0, AXILE was launched in 2017 for the high-end market. It provides high-speed 3-axis and 5-axis machining centers. With agile machining capacity, AXILE is designed for the aerospace, automotive and medical industries. With the strength of R&D capabilities, Buffalo has received more than 40 patents in Taiwan, US, Europe and some Asian countries.

Buffalo is fully committing itself to the development of high-speed 5-axis machines and Industry 4.0 technology. With innovative products and technologies, Buffalo helps manufacturers reduce production cost and boost productivity. Buffalo will continue to expand the global market and hope to occupy 10% of the global 5-axis machine market share by 2024.



The 74th Golden Merchant Awards

Dr Paul Chang is honored to receive this award. This is not only the personal achievement of Dr Chang, but also the recognition of Buffalo's contribution to Taiwan machine tool industry. Under the leadership of Dr Chang, Buffalo is going to develop more excellent products and technologies and is willing to contribute in industrial development and enhance the image of Taiwan's machine tool industry in the global market.



Group photo with 74th outstanding entrepreneur



Group photo of the winners with the president

Digital twin- "Virtual" genes for machine tools - Part 2

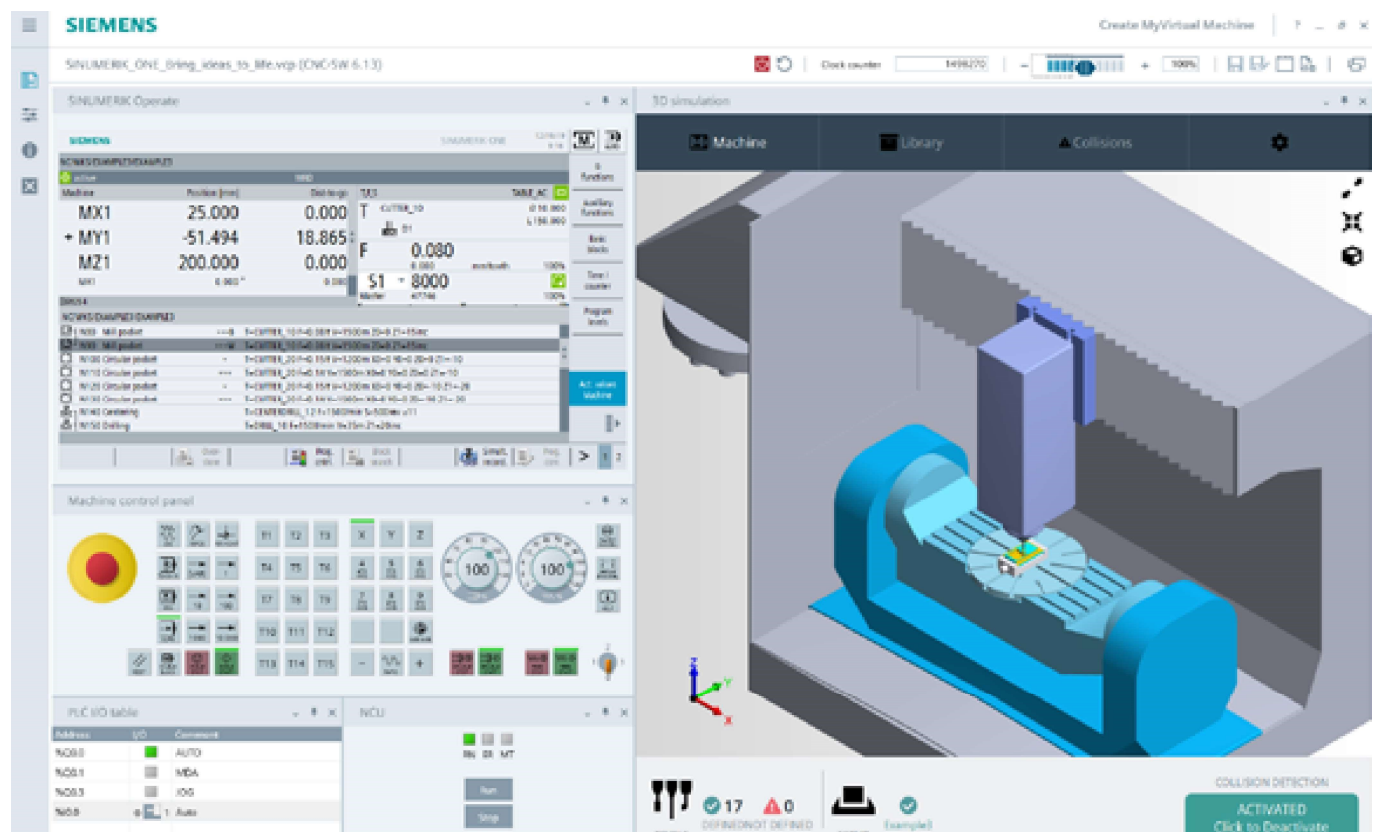
Andreas Grözinger

* Find the article Part 1 in Issue 47

The processes of machine tool manufacturing and operation are moving closer together. "Virtual spaces" are being created where machine builders and operators can design, coordinate, and implement customized solutions.

As I explained in my last article, machine tool operators – and especially contract CNC manufacturing companies – will need to reconfigure their businesses in order to handle ever-smaller batch sizes. The social trend toward more customized consumer products will also impact machine-tool manufacturers

by extension. In the future, more and more machines – at least on the detail level – will be tailored to the requirements of their operators. This means that machine manufacturers will also have to get ready for a paradigm shift in their production processes.



Today mechanical design is already being done primarily on CAD systems. However, designing and commissioning automation systems – in essence, the CNC equipment – is mainly being performed on the “live object,” meaning on real prototype machines. In light of increasing customization and shorter times to market, this process is no longer efficient. That’s why some manufacturers are gradually starting to virtualize their automation design and commissioning. In this context, however, full-featured digital twins are still out of the question. The actuators and sensors and the machine’s mechanics are simulated on a simulation computer, but the CNC equipment is still real. That’s why we talk about “hardware-in-the-loop.”

Hardware is becoming software-in-the-loop

This is where the software portfolio of the latest generation of Siemens CNCs, Sinumerik ONE, comes into play. Create MyVirtual Machine is an important step toward the full-featured digital twin. A virtual model of the CNC is now available. In addition to the NC core and user interface, this model also contains the PLC as well as central components of the drive software, which allows most of the software development to be done entirely virtually. Hardware is now becoming software-in-the-loop!

As a result, engineering processes can be performed much more efficiently – in other words, faster and more economically – and this is a key factor as machines are increasingly customized. However, several discussions that I’ve had with machine manufacturers’ corporate and sales managers have revealed other extremely interesting perspectives on software-in-the-loop, which is supposedly only intended for engineering automation.

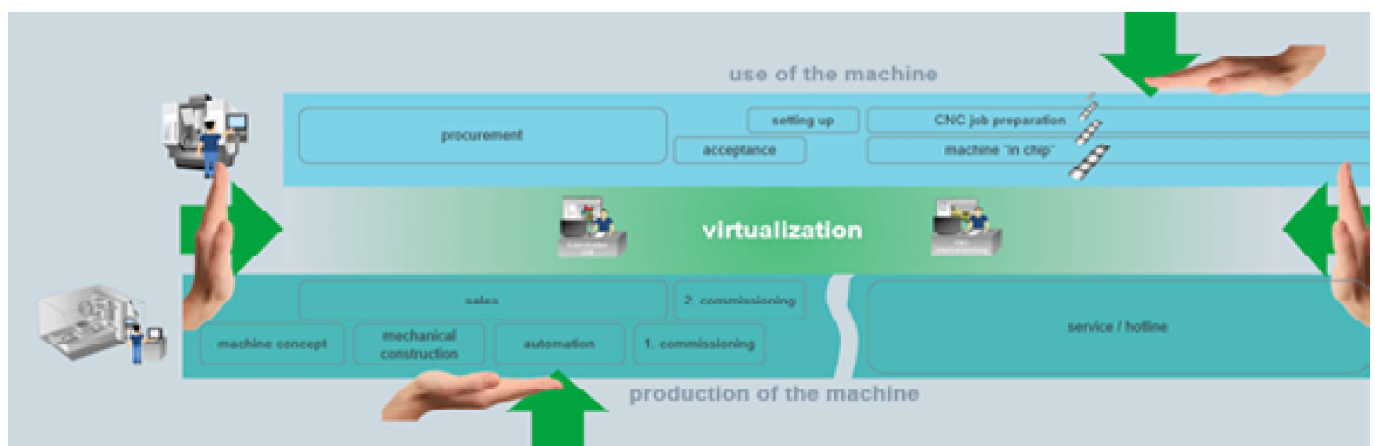
“Virtual showroom”

The “virtual showroom” has always been a central theme. Individual solutions can be discussed with potential customers much earlier in the process. In other words, the sales process for machines is initiated much sooner. Another topic of discussion has been the machine acceptance test. Obviously, the final acceptance test is performed on the operator’s shop floor with the machine in operation – but at least a preliminary acceptance test of the machine can be conducted virtually. This is hugely beneficial, especially in the case of large machines that first have to be assembled at the operator’s premises.

Software in the Loop is also a very useful tool in the event of a problem. Malfunctions in automation can be diagnosed even more efficiently than on the real machine from the service center. For overseas transactions, the benefits are enormous.

This is how the processes of machine manufacturing and operation – which are largely separated today – can be brought closer together.

BREAKTHROUGH would like to acknowledge SIEMENS for the contribution of the materials



Leading Canadian Machine-Tool distributor to lead AXILE in the Eastern Canada Provinces

As the AXILE distribution network expansion continues in North America, the COVID19 lockdown brought an opportunity to start building a partnership with Ferro Technique Ltd to represent AXILE in Eastern Canadian Province of Ontario, Québec, New Brunswick, Nova Scotia, PEI & Newfoundland/Labrador.

Ferro Technique (Ferro) is one of the leading Canadian machine distributors with their head quarter located in Mississauga Ontario, a community within the Greater Toronto Area (GTA) region and also with a branch in Montréal to serve the mostly French spoken Province of Québec. Just recently, Ferro increased their presence by the acquisition of our current AXILE distributor Lomar Machine Repairs in Windsor, Ontario adding the new location to service clients and increase their presence in the most active region in the DieMold industry in the country.

Established in 1952, Ferro began as an importer and distributor of tooling for the metalworking industry and since 1992 has been the Doosan distributors in the region, with over 3000 installations. Ferro also represents other global machine-tool manufacturers such as Brother (Japan), TRAK (USA), Muratec (Japan), Promac (Italy), Hartford (Taiwan).

A true full-service distributor experience

Working hand in hand with clients, the sales team and the in-house engineers ensure the clients chose the product that provides them with an ongoing return on investment for a long-term profit. To that end, the product offerings range from stand-alone machine, tools and accessories, installation of custom options to full turnkey automation solutions. With their expert service program staffed with 15 service and 4 applications engineers, Ferro remain committed to their customers' success long after the machine-tool sale. Machine calibration, Laser alignment, preventive maintenance programs, Cycle-time studies and fast phone support are a few of the reputable service Ferro provides their clientele.

Canada: A Vibrant Manufacturing Community

Eastern Canada has a long history of manufacturing with roots in Mold Making, Aerospace, Defense, Mining and Automotive. In fact, Ontario produces more automobiles than any other single American State or Canadian Province with factories producing cars for Ford, FCA, GM, Honda, Toyota and all supported by tier 1 suppliers like Magna, Linamar, MartinRea and others. Furthermore, 6 of the 10 largest Mold Makers in North America are also located in Ontario.



Ferro office in Eastern Canada Provinces

In the Aerospace sector, Québec holds a prominent position on the international stage as one of the world's top three aerospace hubs alongside Seattle, USA and Toulouse, France. Companies include Bell Helicopter Textron, Bombardier, Pratt & Whitney, Rolls-Royce, Safran, Heroux-Devtek, Macaer, and GE Aviation are all located within a 45-minutes radius of Montréal.

Technology advancement is in Canada's DNA with many world innovations. From the telephone, the International Space Station Canadarm, the original smartphone BlackBerry, Pacemaker, snowmobile, and many others, Canadian inventors and engineers are always looking for ways to better our way of life.



Technology seminars

AXILE: a natural fit to Ferro Technique's portfolio

As most understand, Canada is a large country and, in the machine-tool industry, it can be very difficult to have the right partner to serve our customers as needed as the distances to travel can have an effect on the service that can be provided. With Ferro's extended coverage and the current line-up, the AXILE machine perfectly fits in the line-up to provides them with the technology needed to compete with the largest 5-axis manufacturers.



Ferro office in Eastern Canada Provinces

In touch with the marketplace

With a long-standing presence in the market, Ferro has built life-long relationships with their customers. As one of the original partners in the annual Joint-Open House event, in the GTA, Ferro has always found a way to connect with their customers. Hosting technology seminars, participate in the local tradeshow and their continued support in all trades associations has help them maintain and continually grow their customer base.

Leadership with a bright future ahead

Ferro is currently managed by Brian Donnelly, president since 2015. He joined the company in 1987 and was originally responsible for sales in Southwestern Ontario which he gradually evolved as the sales manager and later as vice president. In 2007, he became a partner in the business.

Brian also served as a director on the CMTDA - Canadian Machine Tool Distributors' Association's Board of Directors from 2005 until 2012 where he served as president of the CMTDA from 2009 to 2011. His leadership and knowledge of the Canadian manufacturing market will help point Ferro Technique toward continued success and growth. The combination of highly skilled support team, knowledgeable sales team, great company culture and a strong structure is the guarantee for success and will lead them well in the years to come.



AXILE G6 in showroom

AXILE iAutomation

AXILE develops a smart automation system to help manufacturers enhance competitiveness. The design concept is based on the 5-axis machine, G6, and further develops APC and Robot types to offer manufacturers flexible production. It is equipped with the AXILE ART™ to achieve intelligent automation production. With the capabilities of higher reliability, predictive maintenance- and production control, adapting AXILE Smart Automation in the plant can optimize production up to 30%-200%.



Flexible Production Line

AXILE Automation offers manufacturers a few types of pallet changers, automated pallet system, robotic pallet system and a robotic loader system for smaller parts to increase machining efficiency. AXILE automation system transfers the workpiece between the backside and the front. And the loading station is at the rear of the machine for operators to load and unload workpieces while the machine is doing machining at front. When the machining process is finished, it will transfer the workpiece to the back for the inspection. At the same time, the raw material will be transferred to the front and ready to work again. AXILE iAutomation helps manufacturers reduce time loss when machining and increase labor efficiency, cost-saving in electricity and material and furthermore to increase overall productivity.



G6 Robot uses a 2-axis robotic pallet system that can handle up to 20 pallets and loading from 30 kg up to 220 kg. 8, 10, 16 and 20 pallets are freely selected by users to better meet their production requirements.



G6 APC offers a 2-pallet or a 6-pallet changer for users. This can also be integrated with 12-pallet up to 36-pallet FMS System. When working with the FMS System, it can be expanded to 1 to 3 machines and 2 loading stations for more flexibility.

ART™ System

AXILE iAutomation is integrated with ART™ to enhance productivity. ART™ is an intelligent monitoring system for 24/7 fully automated production. It offers predictive maintenance, energy efficiency and production control to optimize overall production. By using the sensor technology, ART™ detects the signals of all wearing components on the machine for further analysis to predict machine lifetime. This helps ART™ with the ability to send the notice before machine failure. In addition, when ART™ connects with organizations' intelligent ERP or IT systems which can do automatic re-stocking for just-in-time supply without delay. Thus, users can always arrange maintenance or service in advance to avoid unplanned downtime



Smart Automation Production

AXILE iAutomation presents intelligent pallet changer system with dynamic 5-axis simultaneous machining capacity and i4.0 smart functions for automated production. AXILE iAutomation not only improves flexibility and precision of the machining processes but also offers the following benefits to the manufacturers.

- Optimal productivity

The automatic pallet changer helps manufacturers with continuous machining process to reduce time of non-productive manufacturing which brings better ROI for machine.

- Flexibility

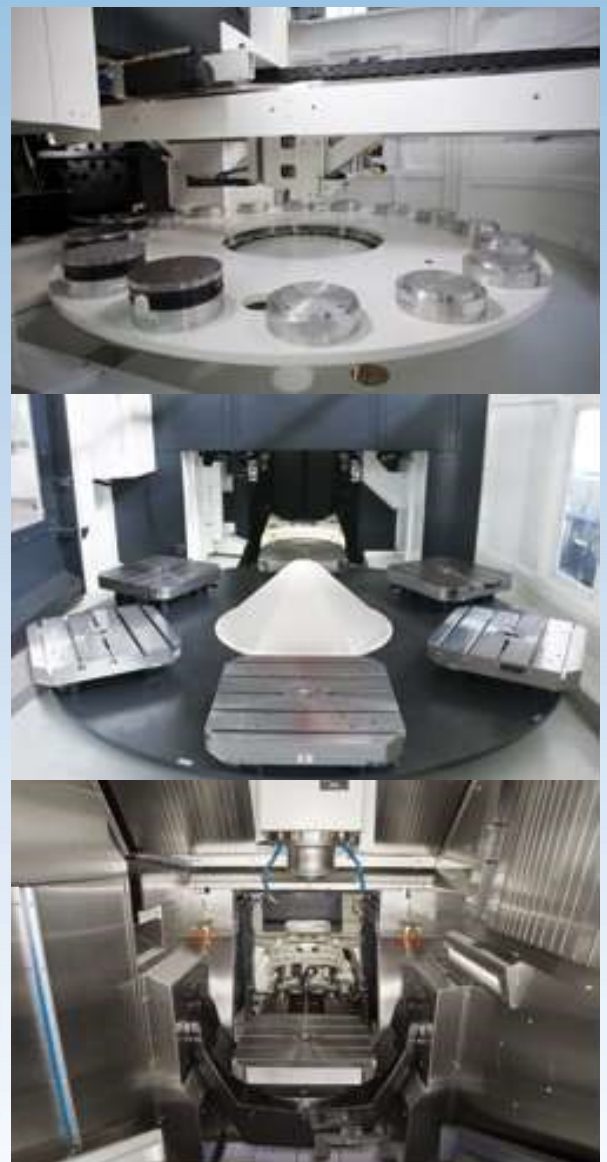
A single machine with multi-pallet to deploy multiple functions which increase the flexibility and automation capability. Moreover, ready to connect with FMS provides more flexibility for manufacturers need mass or multi productions and more storage.

- Fully automation

AXILE iAutomation offers predictive maintenance service for users to deploy just-in-time service arrangement and re-stocking to avoid unexpected downtime on machine and reach 24/7 automated operation.

- Transparency

Users can access all machine data via the ART™ management platform, this helps them easy supervise machine status and production floor anytime and anywhere. Even during the outbreak of Covid-19, with ART™ System the managers can work from home with an ease of mind.



BLUM brings surface roughness measuring to machine tools



The new TC64-RG Surface Roughness Gauge from BLUM now enables the automated testing of workpiece surfaces in machine tools.

Blum-Novotest, the leading manufacturer of innovative and high-quality measuring and testing technology, is presenting the TC64-RG Surface Roughness Gauge. With this new product, the company now makes it possible to automatically test workpiece surfaces in machine tools.

"If we look at a technical drawing in detail, we can see that almost all quantifiable measures can be automatically measured in machine tools," explained Winfried Weiland, Head of Marketing at Blum-Novotest. "An exception to this is the measure of a surface's roughness. Until now, such a test could only be performed on a manually clamped workpiece, or it had to be tested in the course of external inspection outside of the machine. Neither approach is really suitable for automated production, as they interrupt the serial production process and are prone to errors. With the TC64-RG, we close this gap in the process chain. Poor-quality surfaces are now detected when the workpiece is first clamped in place."

Given the harsh conditions prevailing within machine tools, the automated, machine-internal measurement of surface quality was considered to be technically impossible for the longest time. Moreover, customers in the high-production serial manufacturing sector expect extremely short measurement times but also maximum reliability and precision. BLUM decided to tackle this challenge. Based on the DIGILOG technology first presented in 2010, the company's engineers developed the new TC64-RG. Like all of the other TC touch probes, the TC64-RG is fully suitable for use in machine tools, is resistant to coolants, and has IP68 protection. It performs measurements at a remarkable speed too. Standard milled, turned or ground surfaces can be tested with μm precision in just a few seconds and analysed in terms of the roughness parameters Ra, Rz and Rmax. The detected roughness values can either be documented for later use, output as a status value, or displayed via the GUI.

It has already seen some early adoption in the production of motor components such as impellers, connecting rods and cylinder bores. But the focus is not always on having a perfect surface quality. The latter examples named above, for example, are 'functional surfaces' – they have to comply with a precisely defined roughness value. If this value is too low, the surface no longer performs its

function of 'storing' lubricant. The TC64-RG is also used in the production of transmission housings and in the machining of aviation components such as turbine blades. As movements are controlled by the NC system's axes, it is also possible to test free-form surfaces, unlike external apparatus.

As with all of the company's measuring instruments, the measurements are generated using a wear-free, optoelectronic measurement sensor inside the device. The TC64-RG also operates using the patented shark360 measuring mechanism. The integrated face gear enables the use of a defined deflection direction while maintaining a constant deflection force. Any torsion that may arise is absorbed by the face gear and therefore does not affect the measurement. For data transmission, the roughness testing device uses the tried-and-tested BRC Radio Technology that is already utilised in many of the company's other measuring systems. The advantage of this is that, if the user is already using a system from the extensive range of BLUM radio products, this generates cost savings and aids integration, as the required receiver unit is already present.

"The use of the TC64-RG in machine tools is not aimed at replacing traditional roughness measuring instruments. It's more about helping customers to achieve the goal of producing 100% approved parts in as short a time as possible. Especially in chained production lines, it can sometimes take a very long time for the first reject parts to be discovered. In such cases, the use of the machine-integrated surface roughness gauge pays off quickly," Weiland summarised.



Using the special measurement insert, BLUM's TC64-RG detects surface roughness in mere seconds with μm precision.



The calculated roughness values are documented, output as status values or displayed via the GUI.

BREAKTHROUGH would like to acknowledge BLUM for the contribution of the materials



Source: Waymo.

On The Way to Autonomous Vehicles

Films, television shows and literature have portrayed “Autonomous Vehicles” for years. Those materials present the futuristic transportation system, and now this imagination becomes a reality. With recent advances in technologies, we are experiencing the transition from human-driving cars to self-driving cars. Many automakers and technology companies have developed their prototypes. For example, Alphabet’s Waymo and GM’s Cruise have impressive achievements in self-driving cars development. And BMW and Daimler have been working on driverless vehicles as well.

Autonomous vehicles, is also known as self-driving cars and driverless cars. All refer to vehicles having the ability to drive from one place to another without human assistance. The SAE (Society of Automotive Engineers) International also defines six levels of driving automation from “no automation” to “full automation” in 2016. And these levels have been adopted by the U.S. Department of Transportations and become the common standard.



We are experiencing the transition from human-driving cars to self-driving cars.

SAE Level	Name	Narrative Definition
0	No Automation	The full-time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems.
1	Driver Assistance	The driving mode-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the dynamic driving task.
2	Partial Automation	The driving mode-specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the dynamic driving task.
3	Conditional Automation	he driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene.
4	High Automation	The driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene.
5	Full Automation	The full-time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver.

* The summary table is provided by SAE International.

The SAE International defines six levels of driving automation from “no automation” to “full automation”.

From level 0 to level 2, the human driver monitors the driving environment, moving to a higher level, the automated driving system monitors the driving environment. In level 5, that is full automation and this is what automakers and tech giants are pursuing. Vehicles take complete control for all driving modes, so passengers might not find steering wheels or pedals in level 5 cars.

How do autonomous cars work?

The development of the self-driving system is very challenging. This system requires many sensors, data testing and machine learning systems to ensure the vehicle has the reliable ability to travel between destinations without a human driver.

The self-driving car combines exteroceptive sensors such as camera, Radar, LiDar (light detection and ranging) and ultrasound to detect the external environment. While deploying those sensors come with its own unique challenges. For example, although cameras provide accurate visuals of the world, even with a wide field of view, they have their limitations. It is difficult for cameras to detect objects in low-visibility conditions, like thick fog and heavy rain. While Radar sensors work better in low-visibility conditions, with this ability, the driverless car detects objects at every angle and they are able to provide data on the speed and distance of the object. But Radar sensors are poor at object classification which means when Radar sensors detect large numbers of vehicles, they tend to identify many cars as a whole. To drive better, sensors must work together and provide the car with sufficient data about its surroundings to help the car detect nearby objects and drive safely.



Unlike human drivers, self-driving cars do not have an instinctive reaction to the surroundings. So, they rely on data training to learn about conditions they may encounter and how to react to those conditions. Software engineers will replicate a virtual map that includes the intersection, buildings, lanes, curbs, and traffic lights. And create challenging scenarios, for example, a busy intersection, flashing yellow signals and wrong-way drivers. And teach driverless cars how to drive. To make the scenario to become more complicated, engineers will add different variations into the scenarios. For example, what would the driverless car react when the traffic light is broken at a busy intersection, or the oncoming vehicle veered onto the wrong side of the road? With countless



testing, driverless cars can practice various scenarios thousands of times. Then, engineers can see how the car changed the way to drive in extreme traffic scenarios.

Self-driving cars also need to practice at real-world. With the GPS and HD Map, self-driving cars can know more about the environment, and then they will record everything that they encounter on the road, and the real-world testing provides engineers with continuous feedback. Engineers will extract useful information from the huge amount of data collected from sensors. And refine the self-driving system and teach cars to make proper driving decisions.

With the help of recent advances in software and technologies, the self-driving car can detect the surroundings and identify the object, then make the driving decision to ensure safety under driverless conditions.

Benefits and challenges

It is believed that autonomous vehicles have a great impact on mass transportation and solve many traffic problems in cities in the long term. For example, make roads safer and reduce traffic crashes. Here are three benefits.

-Reduce traffic crashes

Vehicle crashes have become a public safety concern worldwide. According to WHO, 1.35 million people are killed by road traffic worldwide each year, and road traffic injuries are the eighth leading cause of death globally for all age groups and the leading cause of death among children and young adults aged 5-29 years of age. Almost 90 percent of car accidents are caused by human errors. For example, speeding, drunk driving, drug-driving, and distraction. And self-driving cars offer higher levels of autonomy by taking over the driving task to prevent injuries and deaths caused by driver error. As a result, self-driving cars make roads safer and reduce the number of crashes on the road.

-Get more free time

On average, drivers spend approximately 50 minutes per day at the wheel. And they need to focus on the road to prevent traffic accidents. But in the future, when fully automated cars can drive itself, the commute time in the car can be put to good use, for example, passengers can respond to email, take a nap or use their phones without safety concern. Eventually, passengers have more free time.

-Enhance mobility for the disabled

A self-driving car offers transportation service for disabled people, especially for the inability to walk. When sitting in a wheelchair, it will be very challenging to use public transport, for example, taking the bus or the train. Fortunately, in the future, they can take self-driving cars to commute between their destinations. The advance of self-driving cars eases the burden of transportation to the disabled and enhances their mobility.

While autonomous vehicles have many benefits for individuals and societies, here are some challenges remaining to solve.

-Cybersecurity

Cybersecurity becomes another challenge. What would happen if the self-driving system is hacked by cybercriminals, and how could passengers react to this situation? Cybersecurity is a vital issue for companies to deal with.

-Regulation issue

Who needs to take responsibility when accidents are caused by an autonomous car? Is the carmaker? Is the human passenger? This is a question from the general public. Also, the relative regulations and rules still need time to discuss and establish. Most of the rules assume that a human sits behind the wheel of each car, but in the future, the car will drive itself, people are not sitting behind the wheel, moreover, there is no steering wheel in the car. So, it needs further adjusted rules to regulate self-driving cars and ensure road safety.

Conclusion

The move towards autonomous vehicles relies on advanced hardware and software. Many tech giants and carmakers release the prototype and service of self-driving cars to the market. Passengers can see the benefits that self-driving cars will bring to the public, the safer transportation system, more freedom and independence. At the same time, there are some challenges that need to be solved, such as rules and hacking issues. Although tech giants or automakers won't release fully autonomous cars this year or in the next few years. We are much closer to this advanced technology today.



It is not easy for the disabled to take public transportation and self-driving cars offer a new transportation way to reduce obstacles for them.

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AXILE ART™ - An Intelligent Monitoring System for smart manufacturing

Abstract

An Industry 4.0 compatible machine tool is going to dominate the manufacturing industry. A reliable machine with an advanced software solution which allows 24/7 automated operation without unexpected downtime has become extremely important to keep the organization maintaining the competitive advantage in this changing market. Buffalo Machinery as a metal cutting 5-axis machine tool builder, has developed AXILE ART™ with diverse functions and services to support the organization achieving this goal. In addition, by using European standard OPC UA data transmission, and through the German umati (universal machine technology interface), when machine is equipped with AXILE ART™ system can be connected to other brand machines, making it easier for users to manage machines of different brands in the factory area.

AXILE ART™ the intelligent monitoring system is developed to optimize the production by the applications of high reliability, energy efficiency and production control. By connecting to the organization's intelligent ERP, MES and IT systems, AXILE ART™ prepares high-tech interfaces for the manager, operator, and service easy access the machine data, practicing the predictive maintenance, decision making facilitation, and automatic restocking. With the visible ART™ platform, users can directly access the machine data and production process with PC or mobile devices which makes users can easy retrieve the synchronized machine data worldwide. The easy accessibility of synchronized machine data can facilitate manufactures to provide the immediate solutions to the customers and to maximize the organization profits.

Keywords: 5-axis machine, umati, intelligent ERP, ART platform, data

Introduction

AXILE ART™, the intelligent monitoring system is using high-end "sensor" application technology to monitor the status of the whole machine in real time, using its "Internet of Things IoT" characteristics and "artificial intelligence AI" calculations to

comprehensively monitor the wearing components of the whole machine and improve machine reliability, productivity and machine life. It can also be connected with ERP or IT systems for a real-time supply and the 2 weeks in advance machine failure notice for predictive maintenance to avoid unexpected downtime. It also can ensure 24/7 intelligent automated production, and to increase production capacity for better benefit.

The main elements of AXILE ART™ are listed as follows for smart manufacturing:

✓ Equipped with intelligent sensing system

It contains many self-developed sensors to monitor machine tool components and to detect the status of wearing components.

✓ Equipped with Smart Machining Technology, SMT™ to ensure that the machine is working at its most optimization of high-speed processing state.

✓ Intelligent ERP integration

Consumable automatic procurement system, AXILE ART™ can determine the remaining capacity of machine tool consumables. (such as spindle and guide ways lubrication material) When the remaining amount is used up, the system will actively send information to ERP to order. It can save manpower records and contact time and to ensure the in-time ordering of consumables and reduce the risk of parts wear. This system cooperates with intelligent ERP to assist the fully automated factory to carry out the automatic and timely feeding system to avoid the burden of inventory and improve the cash flow of the organization.

✓ Provide predictive service to ensure smooth 24/7 automation.

AXILE ART™ offers proactive after-sales service, so machines can be maintained at 24/7 working conditions and optimize the production efficiency. The capability of predictive maintenance allows users to maintain their machines under carefree production



Fig. 1. ART™ Framework

conditions. By using the sensor technology to monitor the lifetime of wearing components, AXILE ART™ system can send the feedback to the service to arrange the maintenance in advance to avoid unexpected downtime.

✓ **Smart compensation system to improve accuracy without being affected by temperature.**

✓ **Spindle vibration supervision, SVS**

To monitor the spindle vibration, when spindle vibration exceeds a set value for an adjustable continue period, the feed rate can be actively reduced to protect the tool and the spindle bearing.

✓ **Tool tip positioning control, TPC**

With displacement sensor to perform the real-time compensation and to reduce the spindle thermal growth, which can improve the product accuracy by 5-6 times. Different from the thermal growth compensation of the traditional PT100, with the technology of TPC, there is no necessary for machine warmup to save time and ensure high accuracy.

✓ **Axial accuracy control, ACC**

By Using the temperature sensing network to monitor the thermal deformation of the machine casting. With the ACC application to perform the real-time compensation and improve the machine accuracy.

✓ **Energy management**

24-hour tracking of machine energy consumption information, so the users' machining energy consumption are monitored. AXILE ART™ provides machine energy consumption data for management to optimize energy efficiency.

✓ **Increase user competitiveness and support the sales**

With the AXILE ART™ system, the sales personnel can check the production data at anytime and anywhere to secure the order as soon as a sales meeting is concluded.

The structure and solutions

The mechanical reliability is considered the most important factor to further converge the advanced technologies on machine tool, such as AI, IoT, IT/OT convergence, etc. The machine tool with predicible lifetime capability which allows the machine user can always make proper maintenance arrangement in advance to avoid unplanned downtime and the full automation capability for 24/7 operation is essential for an automation line. However, as all the advanced technologies related to this industry transformation, all the managements have to be well connected, from field level (vendors), control level to production level, operations level (sales support) and further to enterprise planning level, they cannot stand alone, to make them possible and enable them to converge in all the frameworks and the expanding frameworks of Industry 4.0. The design concept is shown in Fig. 1

AXILE ART™ the intelligent monitoring system framework is shown as in fig. 1, and the 3 core functions and 7 sub-applications are illustrated as below:

Reliability Maintenance:

With the machine lifetime monitoring and components diagnosis functions, the Reliability Maintenance application which conveys the signal notice to the user prior to machine failures and by connecting to the organization's intelligent ERP system for necessary orders, restocking and for maintenance service scheduling automatically.

➤ Machine components diagnosis

ART™ APP Examples



Fig. 2. Visible data of Machine Components Diagnosis

- ✓ Reliability Maintenance application provides the components diagnosis function to identify the machine abnormal status.
- ✓ Sensors/detectors are installed to collect data of all the monitored wearing components and through ART™ analyzer to diagnose machine components performance.
- ✓ The abnormal value will be displayed to notify the user further action requirement and to be sent to the ERP system (if connected) to schedule the maintenance or restocking automatically.

Fig. 2 shows an example of captured data has been transformed to visible information of machine components diagnosis on ART™ platform. The second stage is to show the condition in figures.

➤ Machine lifetime estimation

- ✓ Reliability Maintenance application provides the estimation lifetime of machine bearing components.
- ✓ The time base on machine life is defined by the recorded usage time of the bearing components.
- ✓ The life status of monitored components is displayed in different colors for the user to easy identify the problem and take necessary actions.

ART™ APP Examples

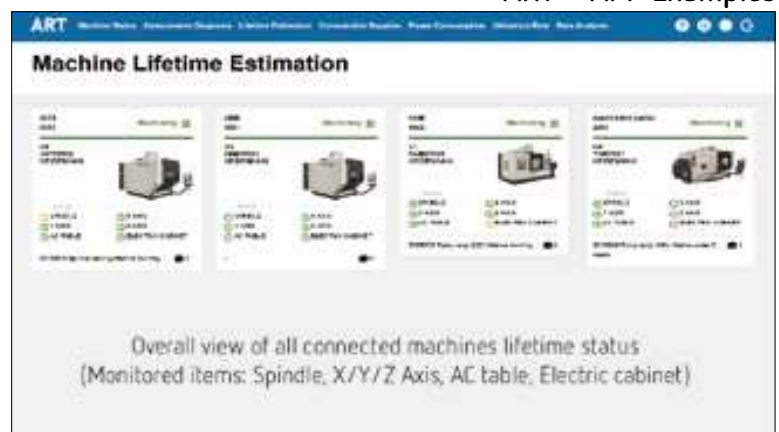


Fig. 3 shows an example of captured data has been transformed to visible information of machine lifetime estimation on ART™ platform. And page following is to show the condition of each components.



Fig. 3 Visible data of Machine Lifetime Estimation

➤ Consumable suppliers monitor

ART™ APP Examples



Fig. 4 Visible data of consumable suppliers

- ✓ To prevent the unexpected downtime due to the insufficient supplies by calculating the usable time of consumable supplies.
- ✓ Consumable supplies monitor function provides the synchronized machining information of supplies usage status
- ✓ The consumable supplies usage status is displayed in different colors for easy identification.

Fig. 4 shows an example of captured data has been transformed to visible information of consumable suppliers monitoring on ART™ platform. And page following is to show the information of consumable usage status.

Manufacturing Process

With the big data collection and data analytics to assist management in decision making and creating better business profit. Manufacturing Process application enables real-time monitoring the machine status with data collection and analysis to assist manager to organize the production schedule proficiency. With the ART™ visible platform which allows the sales personnel can always check with the mobile device in any location for the real-time data analytics and provide the feedback to confirm the order at the first place without delay. This capability can always create a better business profit to the organization.

> Machine status

ART™ APP Examples



Fig. 5. Visible data of Machine Status

- ✓ All the connected machines production linked.
- ✓ Status



Machining is in process under automatic mode



Machine is at idle status. Machining program is completed



Machine is under abnormal condition.



Offline or machine or IPC (analyzer) is off. (with no light on)

Fig. 5 shows an example of captured data has been transformed to visible information of machine status on ART™ platform. And second page is to show the loading in percentage.

> Utilization Rate Monitor

- ✓ Utilization rate monitor function provides the real-time monitored utilization rate of all the connected machines
- ✓ Utilization rate is listed as the indicator of production status.
- ✓ Machining condition can be adjusted base on the utilization rate of all the monitored machines to increase the efficiency.

ART™ APP Examples



Fig. 6 shows an example of captured data has been transformed to visible information of machine utilization rate on ART™ platform. And the usage rate is shown in further page.

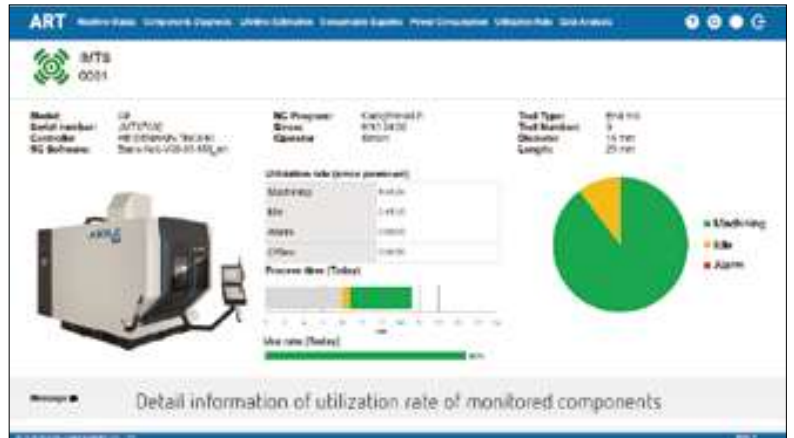
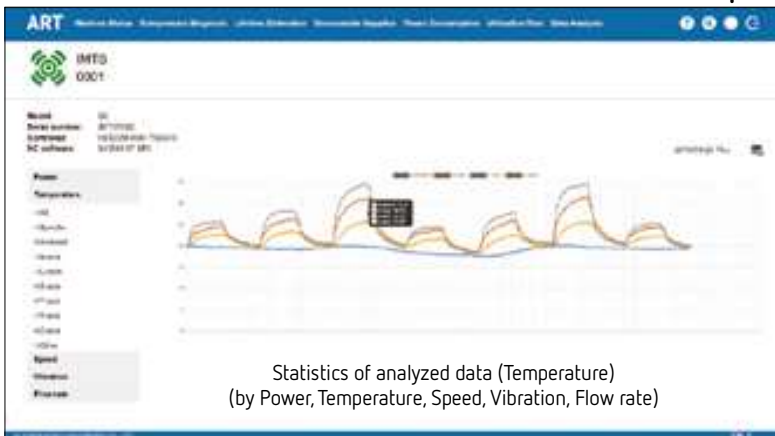


Fig. 6. Visible data of machine utilization rate

➤ Data Analysis

ART™ APP Examples



- ✓ Data analysis function provides further analysis of the mechanical condition.
- ✓ All the data collection is based on the 24 hours timeline of daily operation.
- ✓ The analyzed machine operation data can facilitate service personal to identify the problem without delay.

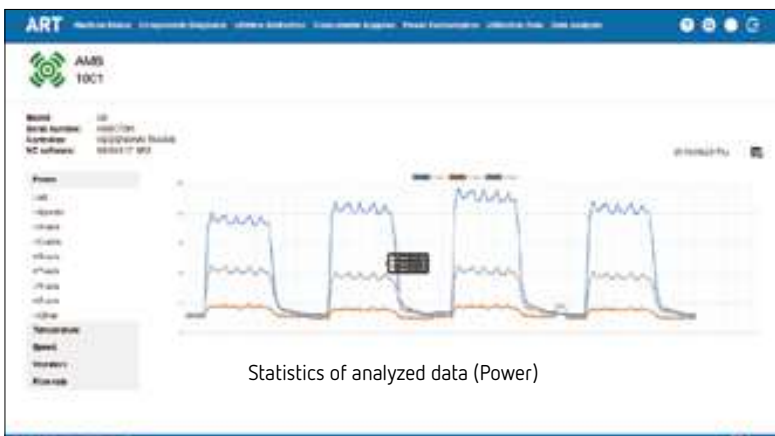


Fig. 7 shows an example of captured data has been transformed to visible information of analyzed tools loading condition on ART™ platform. It reminds the user to check the abnormal signals in order to have proper action for production efficiency.

Fig. 6. Visible data of machine utilization rate

Energy Management

Based on ISO 14955 standard and 24-hour observation, Energy Management is an application which supervises the machine energy consumption and usage condition to optimize the energy efficiency. Furthermore, the organization can be in contract with the energy authority base on the eco-friendly energy plan to moderate the electricity cost.

➤ Power Consumption Monitor

ART™ APP Examples



Fig. 8 Visible data of machine power consumption

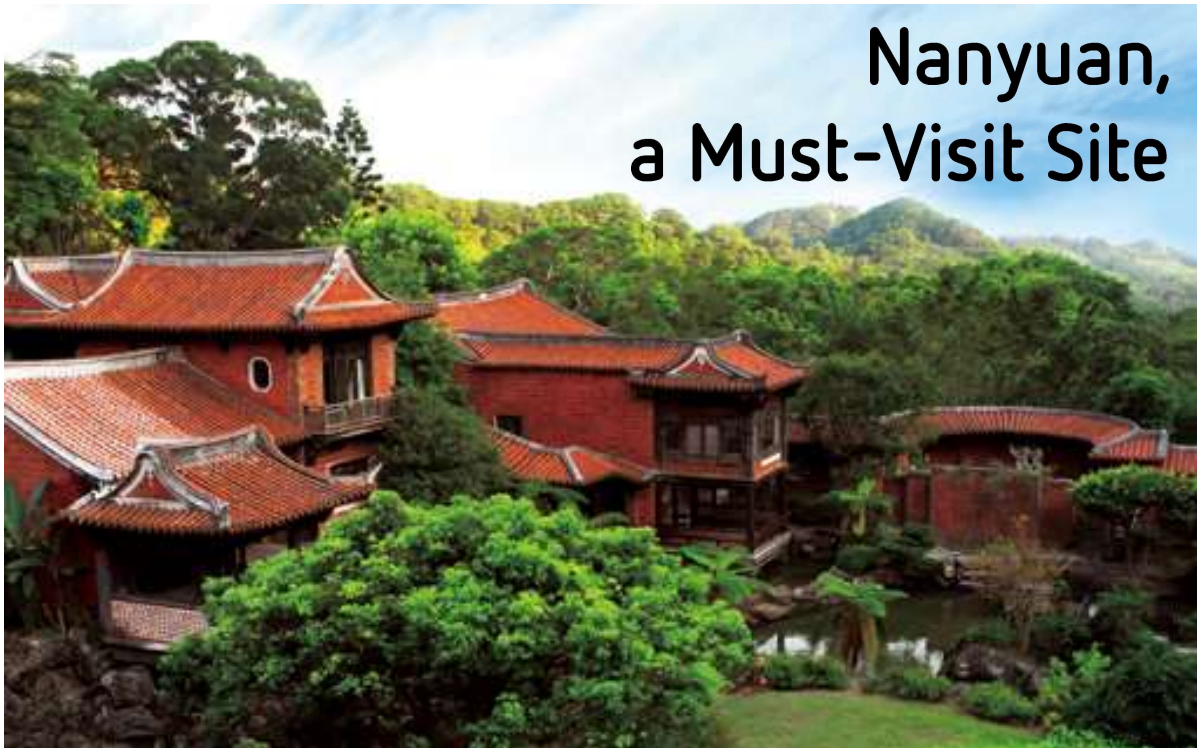
- ✓ Power consumption monitor function allows user to understand the energy performance of the monitored machine.
- ✓ User can adjust the machine daily operation to achieve the energy efficiency base on the analyzed data.
- ✓ Eco-friendly energy plan can be managed and by contract with the authority to have economic electricity cost.

Fig.8 shows an example of captured data has been transformed to visible information of machine power consumption on ART™ platform.

Conclusion

As a high-end 5-axis machine builder, AXILE ART™ is the innovation technology to provide the high quality 5-Axis machines with high-tech applications to adapt to the i4.0 intelligent digitalization automation.

The digitalization is important for both product and production to minimize the error appears. AXILE ART™ offers the best solution to the manufacturers not only enhance the productivity but also reduce service cost, inventory, and energy consumption. And finally, but not the least, AXILE supports the production line working 24/7 without unexpected downtime. A high reliable product is performed.



Nanyuan, a Must-Visit Site

Nanyuan (South Garden) is located in Hsinchu, Taiwan. Nanyuan was established in 1985 and owned by Mr Wang Ti-Wu (王惕吾), the founder of the United Daily News Group. It is designed by Mr Han Bao-De (漢寶德), the famous architect, educator and curator in Taiwan. Nanyuan used to be Mr Wang's retirement residence and his employees' gathering place. In 2008, Nanyuan was commissioned to The One hotel management group and transformed as The One Nanyuan and opened its door to the public. Now, people can enjoy deep recreational cultural and creative experiences here.

About Nanyuan

The design of Nanyuan combines Chinese Suzhou Garden and Minnan architecture with western style arcade and developed to its own style. Due to the superb woodworking and ingenious design, Nanyuan used to entertain quite a few head of state, such as former British Prime Minister Mrs. Chachier and former Soviet Prime Minister Gorbachev. Back to the time, you can image how the Magnificent Nanyuan perfectly reflected the broad and profound Chinese cultural to be able to host such distinguished guests. Nanyuan also reflects Mr Wang's life, born and raised in Zhejiang, China and then moved to Taiwan. After arriving in Taiwan, Mr Wang published United Daily News in 1951. In 1973, Mr

Wang established the United Daily News Group. Working hard for years, he decided to build a retirement residence. At first, Mr Wang asked Mr Han to design a Chinese Suzhou Garden to recreate the memory of his hometown, Zhejiang. So that Mr Wang could always feel the atmosphere from his hometown. In 1985, the construction of Nanyuan was completed with an area of 270,000 square meters. Nanyuan is named after Mr Wang's father, Wang Fei-Nan (王芾南). And Mr Wang spent many years in Nanyuan after his retirement.



Nan Building (南樓) is the main building in Nanyuan.

Classical Gardens of Suzhou is famous for its constructed landscapes mimicking natural scenery of rocks, hills and rivers with pavilions and pagodas. It features the white walls and grey roof tiles, but it was difficult to find those materials in Taiwan. Mr Han decided to use local materials, like red bricks and Taiwan Cypress to build Nanyuan. Considering the geography environment, Mr Han integrated Minnan and Taiwan elements into Suzhou Garden. This makes Nanyuan look brighter and livelier than the traditional Suzhou Garden.

The decorations in Nanyuan show exquisite craftsmanship and have various types of literary meanings. Mr Han used patterns to represent blessings and celebrations in Eastern culture. The woodcarving in the lobby shows the Jiangnan landscape, and it took 2 years to complete this masterpiece. The ceiling is richly embellished with woodcarvings, for example, visitors can find the crane on the ceiling, which is a symbol of happiness and eternal youth. The corridors combine Western-style with Taiwan elements, Mr Han selected red brick to build the arcade corridors. There are many different ornamental windows in Nanyuan, such as cloud, peach, melon and butterfly. Those patterns deliver blessings, for example, the cloud design stands for happiness and the melon pattern symbolizes inheritance. Mr Han also designed a door in the shape of a bottle to symbolize safety. The design in Nanyuan is rich in culture and worth a visit.



The design of Nanyuan is in harmony with the natural landscape.



Butterfly pattern stands for blessings.



The gable with fire design and the hanging fish.

Looking at the roof, the design is similar to swallowtail, this is the traditional roof design in Taiwan. The gable in Nanyuan looks like a horseback and the design conveys Wuxing philosophy. Wuxing is known as five elements, Fire, Water, Wood, Metal and Earth, and is widely employed in many fields of early Chinese thought. There are five gable designs at Nanyuan and have different meanings. The Fire design means the house is strong enough to against attack, Water symbolizes the house owner is friendly, Wood means the house owner behaves worldly, Metal is the symbol of wealth and Earth stands for a good harvest. Under the gable, there is the decoration which is called hanging fish. It not only played a decorative role, in the past, people believed that these hanging fish would prevent fire and protect the house. After many years, various forms of hanging fish have appeared, and some have even turned into bats, which means blessing. In Nanyuan, many different and creative hanging fish designs are waiting for visitors to discover.



Various designs deliver hidden blessings, for example, the bottle symbolizes safety.



The view in Nanyuan is similar to traditional Chinese landscape paintings, the traditional garden design, such as water, stones, plants, bridges and buildings, makes visitors feel like going back to the ancient time. Moreover, visitors can stand at pavilions to see breathtaking vistas of the whole garden and rolling hills. Nanyuan is the most delicate landscape garden in Taiwan.

The One Nanyuan

When the construction of Nanyuan was completed in 1985, it was only used as Mr Wang's retirement residence and a vacation center for the employees of the United Daily News. It was not until 2008 that The One took over the operation, and the door was opened to the public.

Before that, the first step was to carry out huge renovation work. The renovation team decided to maintain the original appearance, so they had to respect the environment and original design. Therefore, they invited many domestic skilled craftsmen and used original materials and techniques to restore this garden. After repairing, the curved beams and dedicated painted decorations in Nanyuan reappeared.



In the autumn of 2008, Nanyuan was officially named "The One Nanyuan - LAND of RETREAT & WELLNESS" and re-opened its door. Visitors can enjoy the garden, accommodations and catering here, each space is designed with beauty and local culture. For example, the chef selects locavores as ingredients to create conceptual culinary experiences for visitors. The One Nanyuan believes that this dining experience can help visitors taste the original flavors from the earth and become their special memories.



Wind Eaves in The One Nanyuan.



The One Nanyuan uses locavores as ingredients to make creative cuisine for visitors.

*Menu will change with the season.

More information



LINE



Website

Wind Eaves

Taking a walk to visit Nanyuan then visitors will find the “Wind Eaves” made by the Japanese architect, Mr Kengo Kuma. He is famous for his architectural style that respects the surrounding. Mr Kengo Kuma uses natural materials such as wood and bamboo to replace concrete and steel. He designs the architecture with the aim of naturally merging with its culture and environment.

Inspired by Hsinchu local landscape features, Mr Kengo Kuma designed the Wind Eaves to connect the natural landscape. Wind Eaves comprises a cypress wooden framework clad with a transparent ETFE membrane. 738 blocks of wood interlock to form a Wind Eaves, this process required craftsmen to mark, cut and assemble one by one to create this artwork. Nowadays, The One Nanyuan hosts various events here.

Nanyuan expresses the hidden philosophy, literature, art and craftsmanship via architecture and gardening. The design here reflects the combination of culture and aesthetics. Nanyuan is definitely the most delicate landscape garden in Taiwan.

BREAKTHROUGH would like to acknowledge The One Nanyuan for the contribution of photos.

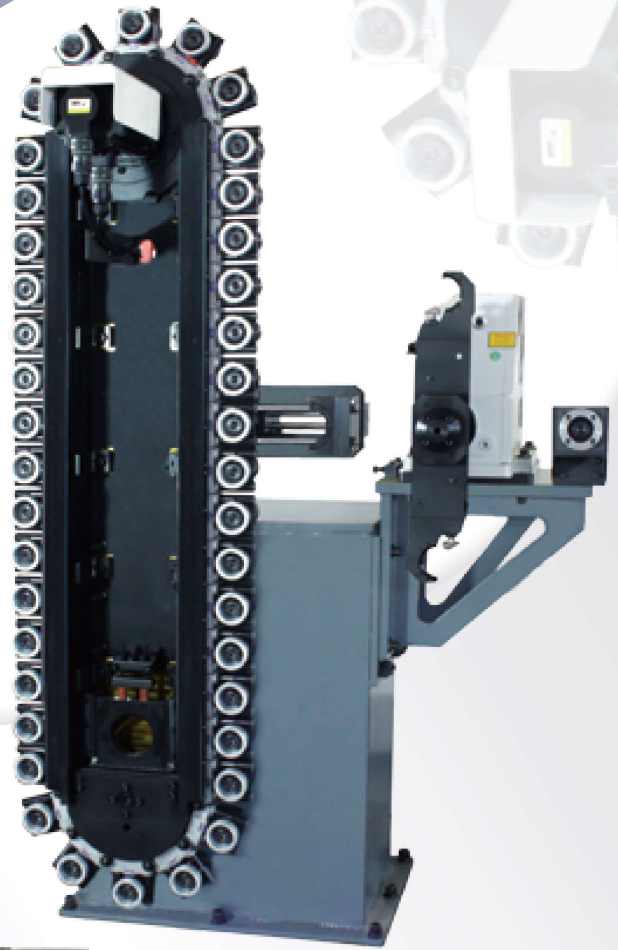


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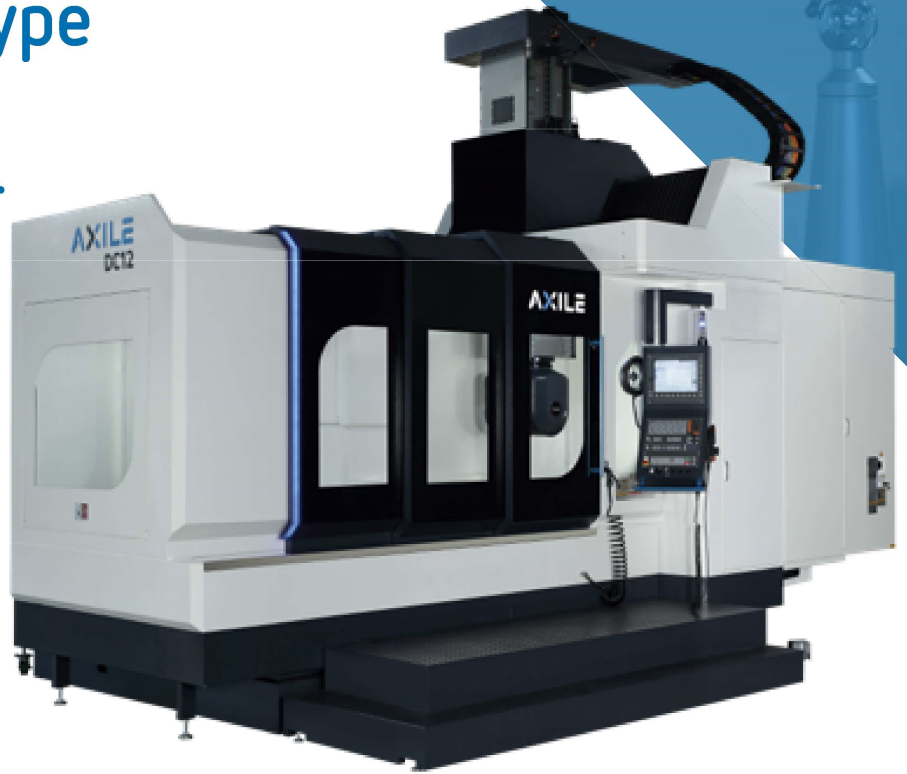
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