FOUNDRY AUTOMATION

A MAGAZINE FROM **ABB**

APRIL | **2005**

Edelbrock wins with automation, producing manifolds for NASCAR.

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Technologies AB

721 68 Västerås, Sweden
Tel. +46 21 325 000
e-mail: abb.robotics@se.abb.com
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Editorial

Heading downstream

> Welcome to the current issue of ABB's *Foundry Automation*, a magazine for those interested in the latest trends in robot-based automation for foundry and aluminium parts manufacturers. Published in conjunction with CastExpo '05, the magazine covers the same topics that are on everyone's lips in St. Louis, issues such as flexibility, quality and the increasing need for automation downstream in the manufacturing process; areas such as cleaning and pre-machining that haven't been automated much before.

Whether it's a smaller job shop such as Lethbridge Iron Works in Alberta, Canada (*page 4*) or the foundry of a huge manufacturer such as BMW in Landshut (*page 10*), the challenges are the same. Production that was previously done by hand can be done more efficiently by robots that have become increasingly flexible, easy to integrate and easy to use. With the life cycle of products getting shorter, and an increased demand for customization and maintaining the highest quality standards, it's no longer cost-effective to use hand applications or inflexible hard-wired machines. As Klaus Urbat, secretary general of the European Foundry Association says: In order to maintain competitive, foundries need to become more precise in how they handle their products. Of course, Urbat has more to say about this (*page 8*).

From production of manifolds for NASCAR racing cars, like those manufactured by Edelbrock in California (*page 12*), to zinc die casting done by PMS in Yorkshire, U.K. (*page 16*), we hope the innovative solutions featured in this issue of *Foundry Automation* provide some new thinking when it comes to your own automation challenges.

Mathys Pirk
Segment Manager, Foundry
ABB Automation Technologies
mathys.pirk@de.abb.com

Better robots for better foundries

> As car production continues to ramp up – nearly 54 million cars are expected to be manufactured in 2005 – foundries have to respond with ever more efficient processes. Automation at all stages of the process is a key factor, and ABB has responded by continuing to add to its line of robots that can handle the entire process chain.

The latest robot released is the IRB 4450S, one of three shelf robots being introduced by ABB (*see story page 19-21*) to help address current and future needs of the industry, especially as automation moves downstream from spraying and extraction into areas such as cleaning and pre-machining.

ABB's broad range of arms for die casting, its groundbreaking foundry protection for the entire robot, plus its ability to provide a complete offer either directly or through partners is part of what makes it the most global player in the market.

CastExpo held in St. Louis

> CastExpo '05, the first joint exposition of the American Foundry Society and the North American Die Casting Association, is being held April 16-19 in St. Louis in the U.S. The largest metalcasting exposition in North America, CastExpo '05 will showcase the latest research, the newest technology and the most current process information.

Over 300 exhibitors are expected, among them ABB.

CastExpo'05
St. Louis, Missouri April 16-19, 2005

Taking the weight off

Text: Graham Chandler
Photos: Joey Podlubny

ABB robot system brings a safer and more productive working environment for Canadian foundry.

Iron casting at Lethbridge is made easier with the help of robots, who have taken over the heavy job of grinding, right. At left, the sand used in the casting.

> James Ronald has never minded hard work – after all, this fit young man from Lethbridge Iron Works does martial arts in his spare time. But he's still relieved the company bought the ABB Foxall robot that has made his job a whole lot safer and more pleasant. "You'd feel it for about a month, mostly in the hands and chest," he says of his old job lifting iron castings weighing up to fifty pounds and holding them against a grinding wheel.

Those days are no longer. Now he places those same castings onto a rotating table and the new robot does the grinding in less than half the time. "It's a challenge to keep up with it," he shouts as the bright orange robot rapidly moves the grinding wheel around the casting, sparks bouncing like fireworks inside its safe enclosure.

Lethbridge Iron Works is pleased with the new installation. This family-owned foundry has been in business since 1898. Located in the city of Lethbridge, where winds howl off the foothills of southern Alberta, Canada, they manufacture a broad range of iron castings like tie plates for railway builders, cab support brackets and radiator cross members for automotive firms, pump housings and boxes for the oil and gas industry and gearbox housings for windmills, to name just a few.

The company is known in the industry as a "job shop" – they make many different castings to order; whereas many other foundries target niche markets like only engine blocks or fire hydrants. Lethbridge does the entire process, from melting the raw materials to shipping out the final product. In between are the tricky jobs of making sand molds, filling them with molten metal, cooling the resulting castings and breaking and grinding off the "gates" and "part-line fin" – industry terms for the excess metal resulting from the molding process, similar to those on plastic model airplane parts.

It was the tough grinding job that set Lethbridge searching for a robotic solution. "It's the worst job in the foundry," says Dylan Davies, Projects Manager. He says the position is rife with back problems, carpal

"We can actually reach into areas with this robot that other systems couldn't."

Dylan Davies, Lethbridge Iron Works

tunnel problems, and grinding of fingers. "A lot of our injuries come from this area," he says. So they started researching automated grinding about a year and a half before installing the Foxall in August 2004.

Along with safety considerations, Davies says the other major attraction was production improvements. The new system is up to four times as fast as manual grinding. "We chose the Foxall for its faster recycle times," says Davies. "The spindle is very powerful so we can take material off quicker, and it has flexibility – we're able to hold up to twelve different tools that we use for different castings. With other automated grinding systems you can only use the main grinding wheel and one other tool."

These are important considerations for a job shop like Lethbridge, who need to grind several different castings on the system every day. But until a few years ago, robotic grinding applications were tailored to the niche foundries who didn't need the high frequency of changes. "What made the big difference was technology like Vulcan's Tru-Teach system and robot controllers that are easy to program," says Davies.

He's referring to Vulcan Engineering Company of Helena, Alabama, who designed and built the entire system for Lethbridge; around ABB's 4400 Foxall robot. David LaRussa, Vulcan's Sales Manager – Action Group, is on site here and explains: "It was difficult for a job shop to justify robotics because they don't have the production quantities to justify the cost of all the programming of different parts. That's why we developed Tru-Teach. Along with the Foxall it allowed quick-change tooling which permits even short runs of say a dozen castings of one part then shifting to a dozen of something else. It's why we chose Foxall to integrate into our system."

The secret of the Tru-Teach system lies in a clever computer program run on a regular PC – combined with a 6-axis digitizer arm that sits on a desk beside the casting to be programmed. It looks like a miniature >

Lethbridge makes products to order, such as these exhaust elbows and spring drive brackets.

robot arm and LaRussa sits and demonstrates. "It's extremely accurate," he says. "We mount a simulated grinding wheel on the end of it and simply trace the casting." The digitizer arm picks up the electrical signals which are recorded into the computer. "Then that code gets transferred to the ABB robot path, which is turned into the actual move sequence."

And that movement is true 6-axis, adds Davies. "We can actually reach into areas with this robot that other systems couldn't. It would mean we'd have to have another jig for that casting. With the Vulcan system we can get at the whole casting with one fixture."

An added advantage of the Foxall for Lethbridge's wide range of casting products is the ability to store all the different programs. "We're eventually going to have a couple of hundred programs where the other systems would only allow you to store up to 99," says Davies. The whole robot package is making for happier and safer working environments at Lethbridge. Soon, workers like Ronald will be even happier. "With the new robot we'll be re-designing the whole grinding area so Foxall operators won't have to wear the breathing protection," says Davies.

>FACTS

Lethbridge Iron Works' IRB 4400 Foxall Industrial Robot

The IRB 4400 is a fast, compact robot for medium to heavy handling. It is suitable for a variety of manufacturing applications. A load capacity of up to 60 kilograms at very high speeds usually permits handling of two parts at a time. Its patented TrueMove function provides smooth and fast movement throughout the entire working range, ensuring high quality in applications like cutting or grinding, where speed and flexibility are important. The compact design enables use in situations where conventional robots cannot work, such as foundries and spraying applications. Lethbridge's IP 67 foundry version can be washed with high pressure steam, ideal for the foundry's harsh operating environment. Reliability is high with a Mean Time Between Failure (MTBF) of 60,000 hours.

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Trottäcker 71
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Tel.: +49 (0)7761 93973 0
Tel.: +49 (0)7761 93973 59
www.robotec.de

ROBOTEC

Klaus Urbat sees change in the future.

Automated advantage

Text: Michael Lawton
Photos: Juergen Schwartz/Getty Images

European Foundry Association Secretary General Klaus Urbat says that in order to stay competitive, foundries need to move beyond casting into areas such as finishing and even logistics. And flexible automation can offer an advantage.

> Globalization affects the foundry industry as it does every other industry. The process of sourcing products where they are made most efficiently and cost effectively is a feature of daily life in the business, and there are many foundry products that Europe has given up manufacturing because it makes more sense to produce simple products in countries where costs are low.

But as the pace of globalization quickens, what is the future for the 3,000 foundries in the European Union with their 230,000 workers? Klaus Urbat, secretary general of the European Foundry Association, says that Europe is coming to terms with the new international competitive situation. "The challenge is for the foundries to be competitive worldwide on the basis of their European locations," he says. "We're in an accelerating process of globalization, and the European foundries aren't in a bad situation internationally. I can well imagine that, if they realize they're in a globalized world, they've got a good chance to hold on to their position."

If they realize … and therein lies the problem. The industry in each country has realized the challenge to a different extent. "People are becoming aware that the changes in the structures of the industry are happening very quickly," Urbat says. "One has to do more than just casting. You have to extend the production chain from the drafting and designing of components all the way to finishing and then beyond that to distribution. Logistics is now part of the business. Casting is now only about a third of the total process."

But the casting itself has to be optimized if European foundries are to retain a competitive position, he says. "The trend is to lightweight construction," Urbat continues, explaining that that means two things: materials and design. You can reduce weight by using lightweight materials such as aluminum and magnesium, but you can also reduce weight by designing iron more efficiently. According to Urbat, "iron foundries are profiting from the lightweight trend. There are new materials, such as compacted graphite iron (CGI), which can be cast much

thinner than traditional materials, while remaining very strong. So there's no general trend towards aluminum or magnesium. Aluminum is much more expensive than iron, and magnesium is much more expensive than aluminum. Every material has its proper field of application."

Urbat notes that magnesium is being used in some high-end automobiles, but, he says, that's not always an economic decision. Sometimes it's more a matter of image or fashion. "A high-power engine block made of CGI can be lighter than one made of aluminum," he points out.

In line with his view that the future of the European foundry industry lies in extending the chain of production, Urbat says that automation must offer more than it currently does. "Most automation in foundries is currently in the form of manipulators or robots, which move castings around inside the factory," he says. "I understand automation slightly differently, more as process control. That's where the future lies, and especially with ensuring increased precision within the casting process itself. In each stage of a process, there should be automatic error correction. The important thing in casting is that the whole process, from smelting to cooling and on to fettling and finishing, has to be completely under control."

Even in the traditional automation areas of handling and manipulation, Urbat wants improvements, with machines that incorporate visual recognition. "They should be able to recognize a part and load the right program for handling it," he says. "In other words, we need an automation that is independent of the size of the series — even down to a series of one." While it won't be viable to program a machine to deal with a single piece, it should be viable to program a machine to deal with a piece that comes through just once in a while, he says.

Urbat stresses that the European foundry industry must hold a position at the top end of the technological ladder. Automation has already helped it to reach this position. Not only has it saved on staff costs and kept productivity levels high, but in many fields it has also lowered error rates and allowed greater precision, resulting in a more rational use of energy. "The machines are much more precise than humans are when it comes to tasks such as making up the core packets and laying them in the mold," says Urbat, "but here too it could be useful if they had visual recognition. The more flexible the automation and the shorter the adaptation times from one job to the next, the more advantageous automation is."

But good machines are not enough. "It's a combination of know-how and automation that gives us our advantage," says Urbat. And that's why he's not afraid of competition from countries with lower wage costs. "Labor may be cheaper in India or China," he argues, "but the cost to the customer may not be. Energy and raw material costs may be higher, work may be imprecise, there may be a lot of reject parts, order tracking and logistics may be a disaster. That's why we're competitive."

The EU certainly does remain competitive. Its foundries turned over 28 billion euros in 2003, growing by 2.3 percent in the ferrous sector and 3.4 percent in the non-ferrous sector. Only China grew faster, but that was because of China's explosive general economic growth in that year.

> "...we need an automation that is independent of the size of the series..."

Klaus Urbat is Secretary general of CAEF, the European Foundry Association
Born in 1943 in Plauen, Germany, near the Czech border
1971 doctorate in political studies at the University of Cologne
1972 joined Thyssen AG as a trainee
1980 joined the German Foundry Association DGV
1989 managing director of the German Foundry Association
1997 became secretary general of CAEF, the European Foundry Association
Based in Düsseldorf, married with one daughter
Hobbies are hunting and antiques.

But countries such as India and China will not stay far behind for long. Urbat says he expects that in 10 years such countries will have moved along the same road of technical and process development that Europe has moved in the past. "But I don't expect that Europeans will remain still," he says confidently. "They'll develop too."

Robots do the heavy lifting at BMW in Landshut.

Taking on tough jobs

Text: Lois Jones
Photos: Reto Zimpel

At BMW's foundry in Landshut, Germany, cylinder heads and crankcases get top treatment with robots.

> The sleek BMW cars that grace the world's motorways can't fail but impress even the non-automobile enthusiasts among us. These sophisticated machines become even more impressive when you witness how the engine parts that power them are made. BMW's light-metal foundry at the Landshut plant, near Munich in southern Germany, is responsible for producing many of these vital engine components.

Blocks of metal, typically aluminum or the alternative, magnesium, are cast, processed and machined at the Landshut plant and its light-metal foundry to produce BMW engine parts. These components are then delivered to BMW Group engine plants in Munich, Steyr in Austria and Hams Hall in the United Kingdom. The light-metal components produced at the plant are used in almost all of BMW's range of vehicles. The plant employs some 3,300 workers, 1,350 of them in the foundry.

"Robots make sense where the prevailing working conditions … make it unreasonable for humans to do the job in compliance with industrial safety regulations," says Johann Wolf, BMW.

"The production of the light-metal foundry focuses on cylinder heads and crankcases for the BMW 2-, 4-, 6-, 8-, 10- and 12-cylinder engines," says Johann Wolf, head of the light-metal foundry.

The Landshut plant has been part of the BMW Group production network since 1967. A special feature of the Landshut light-metal foundry – in operation since 1990 – is the ability to use five different casting processes for series production: sand casting, low-pressure and gravity die casting, as well as pressure die casting and lost-foam casting.

BMW aims to produce 1.5 million light-metal components per year at Landshut. The foundry processes some 35,000 tons of light metal alloy each year.

ABB robots, predominantly IRB 6600 models, play an important role in nearly every part of the foundry. "ABB robots are used in die casting, lost foam, core handling and cleaning shops at Landshut," says Wolf. "Robots are used to help with production and with the unloading of cores from the mold in the casting process."

ABB robots have been used in various applications

>FACTS

Landshut foundry

- Established in 1990
- Produces light-metal components for almost all of BMW's range of vehicles
- Production focuses on cylinder heads and crank cases for BMW 2-, 4-, 6-, 8-, 10- and 12-cylinder engines
- Production aims are 300,000 cylinder heads per year and 500,000 crank cases
- Processes some 35,000 tons of light metal alloy each year
- Employs around 1,350 workers in the foundry

"We couldn't do it without robots."

Ewald Hellberg

at the plant from about 1990. BMW selected ABB robots, in particular, as they are "recognized products in this field with well understood maintenance requirements," says Wolf.

BMW particularly values the application of ABB robots for carrying out tasks in working conditions that could be dangerous for employees. "Robots make sense where the prevailing working conditions, (air, noise, component weight and temperature) make it unreasonable for humans to do the job in compliance with industrial safety regulations," says Wolf. "Robots reduce the risk of accidents at work."

The robots operate with ease amid high temperatures and where chemicals are in use. They handle large numbers of components and carry parts that are too heavy for humans. The foundry would need far larger floor space for the employees if the workers were to carry out their work manually, says Wolf.

ABB Robots also guarantee accuracy at work. The robots are employed for tasks that demand "a high rate of repetition and a low cycle time," says Wolf. "Robots mean accurate repetition, high availability and a reliable system without us having to worry about it."

Workers in the aluminum foundry value the roles that ABB robots play in the core handling process. Heinz Hayer, a team leader in charge of a group of 29 people producing cylinder heads, praises his robotic workmates. "The robots are more efficient and reliable than people," he says. "They never get sick. The robots currently work 21 to 22 hours per day, five, six or even seven days per week. They can also do dangerous work."

Ewald Hellberg, an associate in the lost-foam production area, is equally as positive about how ABB robots help him in his work. "The robots are an enormous advantage," says Hellberg. "We couldn't do it without robots. The workload would be 20 percent to 30 percent higher without robots. It would be an enormous job, as we would have to do everything by hand."

The Landshut plant not only makes use of innovative technology but, thanks to ABB robots, it also has become an innovator. BMW has made a breakthrough in technology by developing the world's first composite crankcase made of magnesium with an aluminum insert for the straight-six engine. This makes the BMW Group the first manufacturer of a water-cooled combustion engine, fully exploiting the substantial weight benefits of magnesium. This means the weight of future cars can be reduced. And that equals lighter and therefore more fuel-efficient BMWs powering down our motorways in the future.

Automation advantages

Using robots for a number of production tasks creates a variety of benefits:

- Ability to carry out tasks in dangerous working conditions
- Reduced risks of accidents at work
- Ability to work in difficult working conditions, such as high temperatures and where chemicals are present
- Guaranteed accuracy for repetitive tasks
- High availability
- Reliability

Text: Carmelo Gomez
Photos: Loramendi

Getting to the core of the problem

IRB 6600 robots in production.

Loramendi makes cylinder block production in Mexico easy with the help of robots.

> Quality and reliability were key for Loramendi when it chose to install ABB robots in a completely automated core line for a manufacturer of cylinder blocks in Mexico. The close collaboration between Loramendi and ABB has been vital for the success of this complex project.

Established more than 30 years ago, today Loramendi is a world leader in core making equipment with the capacity to undertake a variety of projects, from the manufacture of single core machines to the design and manufacture of completely automated core making and assembly systems, as well as vertical and horizontal molding lines. In the project, Loramendi machines are used as part of a fully automated line for crankcase, water-slab, side and top core manufacturing. A technology that combines the key core process with ABB robots has been developed to manipulate and assemble the cores.

The core manufacturing plant consists of three lines: crankcase manufacturing and assembly; waterjacket and slab manufacturing and assembly; and core dipping, drying and final assembly.

Another of the facility's main features is the sophisticated level of automation, which allows for full production by just six operators. This line produces 110 cylinder blocks per hour.

The line for crankcase manufacturing and assembly uses the key core process (sand core to lock crankcase cores together) and involves various pieces of equipment. There are two SLC3-60L Loramendi machines for vertical core blowing. These types of machines may use vertically or horizontally parted tooling. There is also a Loramendi key core machine as well as two IRB 6600 robots. The line includes a core transporting conveyor, a dipping manipulator and dimensional control equipment for core blowing and key core verification, and an IRB 2400 robot with artificial vision to check crankcase cores.

For the waterjacket and slab manufacturing and assembly, the line consists of two identical cells, each producing waterjackets and slabs to reach the required rate of 110 packs per hour. Each cell consists of one SLC2-30+30L Loramendi machine to manufacture waterjacket and slab cores using different sands depending on the core type, as well as one IRB 6600 robot for core manipulation. In addition, the cell includes a waterjacket core deburring station, an artificial vision unit to check waterjacket cores, an IRB 2400 robot for automatic core screwing and waterjacket to slab assembly, and a core transport conveyor to dipping area.

Finally, the core dipping, drying and final assembly line has an IRB 6600 robot for waterjacket and slab core dipping, a waterjacket and slab core dipping tank, plus two IRB 6600 robots for side and top core dipping, three IRB 6600 robots for side, top and waterjacket core assembly in the main core block, one IRB 6600 robot for final core block manipulation at line exit. Of course, also included is artificial vision control equipment to check correct core assembly.

Text: Matts Franck
photos: Gunnar Stener

Smart investment

Production of trees, left, increased from 1,400 to 1,800, says TPC's Jan Johansson, far right.

At TPC Components, the manufacture of high-quality shells has been robotized for many years. But output has been increased by 30 percent with the help of a new robot.

> The foundry industry has seen steady growth in recent years, and investment casting companies are no exception. Growth has been reaching a healthy 6-10 percent per year, and the automobile, aerospace, gas turbine, food, medical and process industries continually increase the demand for components produced with the lost wax method.

"There are a number of reasons why this is so," says Bertil Bredin, CEO of TPC Components in Hallstahammar, Sweden. "Complex parts are possible to manufacture very close to their final shape. This means that the need for time-consuming and costly post processing is reduced to a minimum. The part can also be produced in a wide variety of materials, which means that designers can optimize part characteristics. Finally, the high precision of the lost wax method means that you get a very high-quality casting result with an excellent surface finish."

Along with the high part quality, a large degree of freedom regarding design and material choice puts investment casters in a favorable position when it comes to producing parts.

Investment casting is still a labor-intensive industry. Manufacturing series are often short, and even large batches require the flexibility and precision of skilled workers to achieve the high-quality castings that customers demand. But, there is a definite automation trend in the industry.

In shell making, individual wax patterns that are made via injection molding are commonly wax-welded to a central sprue in order to cast as many parts as possible in a single larger mold; this whole assemblage is called a "tree." The tree is then dipped in an alcohol or water-based slurry and continually builds up the ceramic shell using special sand. It is this end of shell making that is often robotized.

Robots are also used for post-processing applications, such as grinding and polishing of the cast part. And progressive companies are now looking at automating the wax tree mounting area of the shop floor.

TPC Components produces some 1,000 different articles every year – some in very small, prototype series and others in series of up to 250,000 parts per year. Practically all ceramic shell making is automated.

Previously, the large shells were produced by an old hydraulic Unimate robot. Because of its outstanding reach and large handling capacity it was kept in production for ages. It was only recently possible to replace it with ABB's new IRB 7600 long-arm version, which features a reach of 3.5 meters and a handling capacity of 150 kilograms. The new robot was integrated into the existing production line without making changes to the machinery. Only minor changes of the control system were needed and the new robot reduces cycle time, which so more parts can be handled in the robot cell.

"The number of manual operations is reduced and final output has so far increased from 1,400 trees per day to 1,800. When the production cycle is optimized, we plan to produce approximately 2,300 trees per day," says Jan Johansson, manager of the shell department at TPC Components.

"We chose ABB's IRB 7600 for a lot of good reasons," says Johansson. "The long reach and high payload were necessary prerequisites. On top of that we were interested in ABB's Foundry Plus protection, including its IP 67 tightness, since we don't want our explosive, alcohol-based slurry to enter the machine."

Both technically and economically, the IRB 7600 is a success. "Our investment in new automation was basically limited to the robot itself, since we could introduce it without rebuilding the production line. Because of that, pay-back time is not much more than a year and a half," says Johansson.

Making the most of a robot

TPC Components found that it paid off to replace an old robot with a new IRB 7600 robot featuring a long arm with a reach of 3.5 meters and a handling capacity of 150 kilograms. Benefits included:

- **Reduced cycle time**
- **Output increase from 1,400 to 1,800 trees per day**
- **IP 67 tightness requirements mean the machine not exposed to dirty and dangerous slurry**
- **No need to rebuild the production line**

Think zinc

Gordon Panter, PMS, and Nigel Richardson, Geku.

Text: David Marshall
Photos: Abal Studios

The combination of an ABB robot and a Frech real-time control die casting machine has improved efficiency at one U.K. die casting company.

> High-volume zinc die casting manufacturer PMS Diecasting, based in Rotherham, South Yorkshire in the United Kingdom, has automated part of its plant by installing an ABB IRB 140 FoundryPlus 6-axis robot to tend a Frech DAW 20 RC (real-time control) zinc die casting machine.

The installation, carried out by robot integration expert Geku Industrial Automation Systems, is unusual in that the ABB robot is tending a relatively small machine. The 20-metric ton Frech is one of only four such machines operating in the U.K.

The cell was the brainchild of PMS director Gordon Panter, who realized that a fully automated facility could bring significant productivity and cost benefits, particularly when applied to a new contract awarded by Gripple, a wire rope component manufacturer based in Sheffield, U.K.

The robot cycle is short and relatively simple, with little scope at present for adding extra downstream tasks. The IRB 140 FoundryPlus robot picks up the casting assembly from the Frech die casting machine using

specially designed pneumatic grippers, and transfers it to a part-separation station. A pneumatic press then separates individual castings from the runner, and the robot directs the runner to a chute for reprocessing, before returning to the starting position for the next cycle.

Installed in the summer, the PMS investment appears to be completely justified, with the automated cell increasing manufacturing efficiency and reducing costs. Benefits include: total reliability in a harsh environment; release of skilled manpower; maximized space; improved quality and accuracy of castings; and a complete "closed loop" for zinc waste.

Plans are in place for Geku to install an automatic feed for zinc ingots, so that a total "lights-out" operation can be established.

PMS director Panter has previous experience in the plastic injection-molding industry, where automated production is commonplace, and when he decided to automate, an ABB robot and a Frech die casting machine were the first items on his acquisition list.

"The efficiency of our operation is achieved by eliminating variables, wherever possible," says Panter. "I felt that by buying the most efficient and reliable brands of robot and die-casting machine, a considerable number of variables would be totally eliminated."

Having decided on an ABB robot, the IRB 140 FoundryPlus robot was specified after consultation with Nigel Richardson, joint managing director of ABB preferred partner Geku.

The IRB 140 robot is ideal for harsh environments and features full IP 67-classified seals, which withstand pressure steam cleaning and liquid impacts up to 25 bar, as well as complete immersion in water for short periods. In addition, each robot is treated with tough, two-component epoxy coatings to prevent corrosion.

"As well as operating in a relatively harsh environment, the cell needed to be both space saving and portable, so the IRB 140 FoundryPlus with its compact dimensions was ideal for the PMS operation," Richardson says.

"To achieve portability, we mounted the cell on castors, so it is highly transportable and can be moved away in seconds for access to the Frech for tool changes and servicing," he continues. "Interfacing the DAW-20 die casting machine to the IRB140 robot was also a relatively simple task, as Geku engineers have a wealth of experience with both Frech and ABB systems."

Commenting on the impact of the Geku/ABB automated cell on PMS Diecasting, Gordon Panter says: "We are a relatively small business, and to be highly competitive we must also be highly efficient. This means that every square foot of workspace needs to be utilized and every employee 100 percent effective. To these ends, the Geku-designed cell has had a most significant effect. It is very compact and highly efficient; scrap is reprocessed immediately – rather than allowed to build up in bulky skips – and an arduous, boring and labor-intensive task has been fully automated, allowing our staff to use their skills on much more challenging and fulfilling operations.

"The introduction of full 'lights-out' operation is the next milestone," he says. "[That would be] a significant development for the future success of our business."

>FACTS

Making zinc better with robots

The benefits for PMS of automating zinc production include:

- **Improved quality and accuracy of zinc castings**
- **Closed loop for zinc waste – no more build-up in bulky skips**
- **Skilled workers released for other jobs**
- **Reduced costs**
- **Space savings due to portability and compact size**

Software puts filters in their place

Filters for liquid aluminum and iron can now be inserted automatically into casting molds, thanks to a robot controller that makes sure they are positioned accurately.

> The insertion of filters into casting molds has always been a manual operation to date. Previously, any attempts to automate the insertion of filters have failed so far because the filters had to be positioned accurately before loading. This was difficult considering the packaging that they come in from the manufacturer. Therefore a manual operation was necessary to place the filters from the packing into the centering or magazines of a filter loading device.

However, Robotec Engineering GmbH has developed a flexible filter loading system designed to pick up Seedex filters (manufactured by Foseco, Borken) from the packing stack and insert them into a molding line.

This filter loader consists of two small robots who share the filter insertion operation. The first robot picks up the palletized filters from the packing stack, while the second robot inserts the filters accurately into the mould.

A key element of the new filtersetter is the ABB robot controller IRC5. Both robots used in the application are integrated as a multi-move system in one controller. This reduces the required floor space for the control cabinet, which was mandatory for this compact production cell. Both robots share the controller resources such as I/O cards and profibus couplers. Sharing those components reduces the hardware costs in comparison to a system which requires a dedicated controller for each robot. All necessary information for both robots is handled inside one controller. This makes the interfaces between these two robots and their interfaces much easier, because the interface information doesn't need to be handled with different controllers.

The new FlexPendant, which is part of the IRC5 controller, allows for the integration of user-defined applications. Robotec has developed its own user interface for the filtersetter. All necessary functions to control the robots and their periphery are incorporated into this interface. Foundries normally operate their molding lines (in which the filters are set) with lots of different products, which also means lots of different filter coordinates.

These coordinates could be defined in a screen inside this application. The user can add, change or delete new products and their coordinates in an easy way, using the Windows-based program without any robot programming skills. If a new product needs to be produced on the molding line, the operator is able to make all necessary adjustments without changing anything at the robot programs.

Robotec has developed its own user interface for the IRC5.

A key element of the new filtersetter is the ABB robot controller IRC5.

All filter coordinates are stored in a database, which is integrated in the IRC5 system. Once a product is defined, it can be constantly reloaded if required by the molding line. This prevents an expensive learning curve for customers during the start up for hundreds of different products and guarantees a cost-effective solution. All error messages and alarms are shown at the Teach-pendant within Robotec's user interface. All necessary switches and buttons for the operation modes and the actuation of the manual functions are incorporated into this application. This eliminates the cost intensive use of external operator panels and PLCs and reduces the overall costs of the filtersetter.

The filter loader is currently in operation with a DISA molding line with a cycle time of eight seconds. The complete system is mounted on rollers and can be moved from the molding line at any time. When it is in operation with the molding line, it is centered on the floor. The flexible design of the system allows the filter loader to be used for any casting filters and molding line types (also horizontally split flasks).

On the **shelf solutions**

For the ultimate in practical and flexible solutions, shelf robots are the answer.

> When it comes to flexibility, shelf robots have a reach and capability that are unique to the market. Specially designed to be mounted on structures either beside or above the die-casting machine, shelf robots have several distinct advantages that make them stand out. Not only does moving the robots up off the floor create space, but having the robots mounted above or beside the work space instead of on the floor means that it's easy to change the tooling and other elements as well as maintain them, while at the same time reducing the need for carts or tracks on the floor.

To meet the demand for this kind of flexibility, ABB is launching three new shelf robot versions of tried and tested robots with the ability to handle a wide range of weight: the IRB 6650S, the IRB 4450S and the IRB 1600, which is a totally new update of the IRB 1400. All of the robots come with the robot controller IRC 5.

The IRB 6650S

With upper arm extenders and a selection of wrist modules that allow for easy customization, the new IRB 6650S shelf robot is extremely flexible. The IRB 6650S has a handling capacity of up to 225 kilograms, a reach of up to 3.2 meters, and a wrist torque of up to 1320 Nm.

…the IRB 6650S has the biggest reach below foot on the market.

Space is a precious resource, not to be wasted. That's why the IRB 6650S can be mounted on top of the die-casting machine to save space. With a reach below the foot that is the greatest of any robot on the market, the 6650S gives the optimal working area.

A built-in Service Information System (SIS) monitors motion and load. Based on information received, the system anticipates the next service interval, making it easy to plan the service and maintenance requirements of either a single robot or an entire line. Adding WebWare, this can even be done offsite – on the other side of the globe even.

A safe investment through a range of software products – all falling under the umbrella designation of Active Safety - protects not only personnel in the unlikely event of an accident, but also the robot itself.

Collision detection, which reduces the collision force substantially, is especially useful on robots handling high payloads. There are a number of Passive Safety Features as well, such as load identification, movable mechanical stops, double-safe limit switches, for example.

The IRB 6650S works in compact production cells.

The IRB 4450S

With a reach below the foot of one meter and a payload of 30 kilograms, the IRB 4450S is ABB's newest version of its IRB 4400 series robot. The IRB 4450S is designed to work with, among other things, a medium-sized die-casting machine.

The IRB 4450S is the smart re-use of a proven success, with IP 67 protection of the complete robot that makes it well-suited for a number of applications within foundries and other harsh environments. This robot is ideal for integration in equipment for machine tending, die-casting operations, spraying, and other machine-tending applications.

A rigid, well-balanced design and patented TrueMove function provide smooth and fast movement throughout the entire working range. This ensures very high quality in applications such as cutting.

Rapid maneuverability makes the IRB 4450S perfectly matched for applications where speed and flexibility are important. The compact design and protected version enables it to be used in situations where conventional robots cannot work, such as foundry and spraying applications. The foundry plus versions are IP 67 protected and can be washed with high pressure steam, which make them ideal for use in harsh environments.

The robust, rigid construction means long intervals between routine maintenance. Well-balanced steel arms with double bearing joints, a torque-strut on axis 2 and use of maintenance-free gearboxes and cabling also

The IRB 4450S is designed to work with a medium-sized die casting machine. >

The IRB 4450S can reach up to one meter below the foot.

contribute to the very high levels of reliability. The drive train is optimized to give high torque with the lowest power consumption for economic operation.

The extensive communication capabilities include serial links, network interfaces, PLC, remote I/O and field bus interfaces. This makes for easy integration in small manufacturing stations as well as large scale foundry automation systems.

The IRB 1600

The IRB 1600 gives you fast and reliable work cycles that boost productivity. It is an all round athlete, able to deliver plenty of performance for the money, combining compactness with a wide working range. Plus it is well-suited to either floor or shelf mounting: a standard robot but with the advantages of a shelf robot.

The handling capacity is 5 to 7 kilograms, with a reach of 1.2 or in the long-arm version, 1.45 meters. Plus, the IRB 1600 has all around mounting capabilities – it can be mounted horizontally, vertically, above or even at a 30 degree angle, for example. As shelf mounted, it has a reach below its foot of 0.7 meters. Superior levels of control and path-following accuracy provide excellent work quality.

> The IRB 1600 is an all round athlete, able to deliver plenty of performance ...

The ability to adjust process speed and position means optimum manufacturing accuracy with few if any rejects.

Like its predecessor the IRB 1400, the IRB 1600 has a stiff and robust construction that translates into low noise

Technical Data IRB 1600, IRB 4450S and IRB 6650S

Robot Version	Payload	Reach	Reach below foot
IRB 1600-x/1.2	5 or 7 kg	1.2 m	0.5 m
IRB 1600-x/1.45	5 or 7 kg	1.45 m	0.7 m
IRB 4450S-30	30 kg	2.4 m	1.0 m
IRB 6650-125/3.5	125 kg	3.5 m	2.1 m
IRB 6650-200/3.0	200 kg	3.0 m	1.7 m

Protection Options (IEC 529)

Standard	Complete Robot IP54 (IRB1600 and IRB 4450S)
	Complete Robot IP66 and IP67 (IRB 6650S)
Option	Foundry Plus and Wash– IP67 and high-pressure steam washable

Range of Movement [°]

	Axis 1	Axis 2	Axis 3	Axis 4	Axis5	Axis6
IRB 1600 1.2m reach	±180	-63/136	-235/55	±200	±115	±400
IRB 1600 1.45m reach	±180	-90/150	-245/65	±200	±115	±400
IRB 4450S-30	±165	-70/+95	-65/+60	±200	±120	±400
IRB 6650S all versions	±180	-40/+160	-180/+70	±300	±120	±300

Maximum axis speed [°/sec]

	Axis 1	Axis 2	Axis 3	Axis 4	Axis5	Axis6
IRB 1600 5kg versions	150	160	170	320	400	460
IRB 1600 7kg versions	180	180	180	320	400	460
IRB 4450S-30	150	120	120	225	250	330
IRB 6650S-125	110	90	90	150	120	235
IRB 6650S-200	100	90	90	150	120	190

IRC5 Technical highlights

- Multi-processor system
- USB memory interface
- High-level RAPID robot programming language
- Modular design
- Graphical colour touch screen

The new family of shelf robots – the IRB1600, the IRB 4450S and the IRB 6650S – offer foundries new flexibility.

The IRB 1600 has a wide working range.

levels, long intervals between routine maintenance and long service life. Several parts are exactly the same as those developed for already existing products that already have proven their reliability and high-quality design. The robot has a large working area and long reach and the compact design with a very slim wrist ensures high performance operation even in difficult and restricted locations. It is ideal for applications such as material handling and cleaning, among others.

The IRB 1600 is available in a Foundry Plus version, with IP67 protection for the entire robot.

Mathys Pirk says foundries face big changes.

Moving downstream

Photo: Ralf Orlowski

The need for flexible automation keeps moving further downstream in the foundry production process, says Mathys Pirk. The segment manager for the foundry division of ABB Automation Technologies, Pirk should know. He's been watching the trends closely in the past, since he's a real industry veteran.

> What are the biggest changes affecting the foundry industry right now?

– Foundries are not only getting bigger, they are becoming more global. Nemak and Georg Fischer are good examples. They are not only building huge new plants, they are also buying up smaller foundries around the world.

At the same time, the demands on foundries from the manufacturing sector have changed from merely expecting them to provide the casting of various metals, to needing finished manufactured parts that require not just casting, but cleaning and full downstream handling.

One specific example is Hydro Aluminum in Norway. The company was used to supplying ingots, but to gain a better position closer to the final market, it has looked more downstream, at the entire process starting with the raw materials, and even further forward, into research and development for optimized aluminum to meet the end users' needs.

How are changes in other industries affecting foundries?

– Take the automotive industry. Demand for aluminum is growing because consumers are buying more cars than ever – some 54-56 million automobiles were sold last year and the number will be more this year. But it's not just more cars that increase the demand for aluminum, it's also the need for lighter cars that are more fuel-efficient – and lighter cars mean that more of the car is made of light metals such as aluminum or magnesium. At the moment, roughly 150-200 kilograms of an average car is made of aluminum, and that trend is not going away.

Both these factors mean that more aluminum is needed, a demand that can be met by either having more

foundries producing the aluminum, or having current foundries work more efficiently and producing more.

What are some of the biggest competitive factors for the foundry industry?

– Quality is one of the biggest issues right now. In industrialized areas in particular, it's a very competitive market. Reducing cycle times and man hours, improving efficiency and not just having a good product but providing good service and having good connections along the supply chain are all key when it comes to competition.

What about flexibility?

– One of the biggest trends in the auto industry has been the growth of product portfolios – automobile makers have a much broader range of cars, each of which may have its own separate platform. There is a car for just about any taste these days.

For manufacturers producing parts for 20 different models rather than, say, five, this means not just much smaller production batches, but many more batches than before. And the only way foundries can respond competitively is to be more flexible in their production. It's no longer cost-effective to use a lot of hand applications or inflexible hard-wired machines capable of performing just a few fixed tasks with little room to push the parameters. On top of this, the life cycle of products is getting shorter.

Are there areas that are in need of more flexible automation?

– Of course. One area that immediately comes to mind is cleaning and pre-machining, which includes applications such as deburring, milling, sawing – any kind of fettling operation. This has traditionally been done by hand or by dedicated inflexible machines, but it doesn't make sense to do it this way anymore.

Interestingly, even for foundries in countries where labor costs are low, robot-based cleaning cells are being used because a robot can do a more consistently high-quality job, and do it in significantly less time.

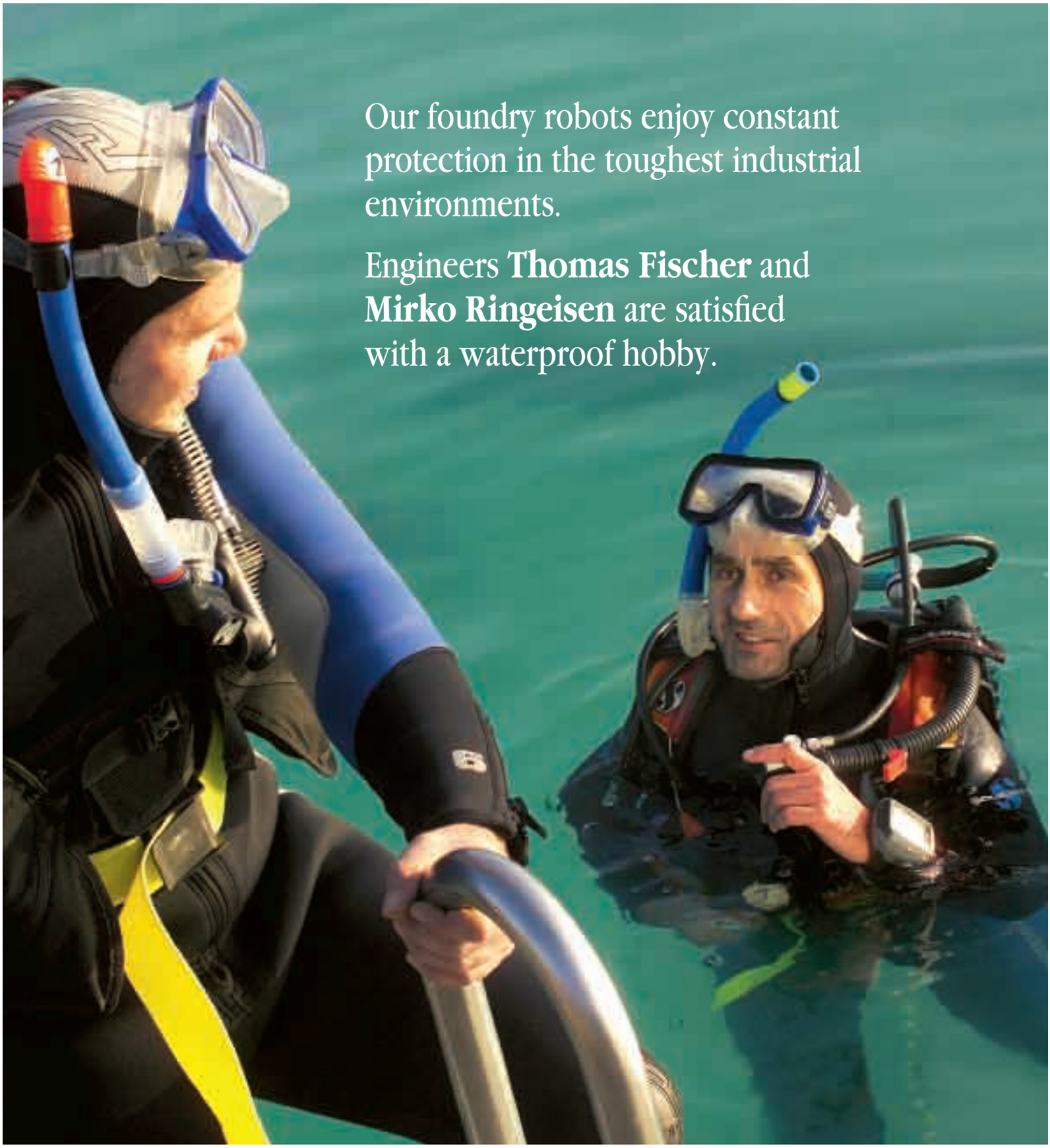
What can ABB offer foundries considering further automation?

– ABB is the only company that can supply almost any application for the whole downstream process of foundry-making. We have not only a complete portfolio of robots for foundry, but we work globally so we can provide the service with local staff worldwide. Plus, ABB can facilitate business through its own network of partners. We can truly provide the whole package like no one else.

With original equipment manufacturers' higher product portfolios and shorter product life cycles, the demand for the most flexible and high-performing foundries isn't going away.

"It's no longer cost-effective to use a lot of hand applications or inflexible hard-wired machines capable of performing just a few fixed tasks with little room to push the parameters."

Mathys Pirk



The heart of Robotics

Our rugged, foundry adapted robots are the product of more than 30 years experience from the roughest industrial conditions imaginable. In fact, armed with ABB's industry proven Foundry Plus protection, these machines can withstand everything from dirt to hot spits and flashes. Wiring, cables and other sensitive components are kept out of harm's way.

What's more, this tightly sealed equipment takes to water the way it takes to heat. Because it's IP67 and Foundry Plus classified, the whole robot is hot steam washable and can be sprayed with industrial detergents. Needless to say, you'll get unsurpassed up-time and availability. For more information on ABB's unique robot protection, dive in at **www.abb.com/robotics.**

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