FOUNDRY

A MAGAZINE FROM **ABB ROBOT**

NOVEMBER **2008**

RELIABLE & RUGGED ROBOTS

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ABB

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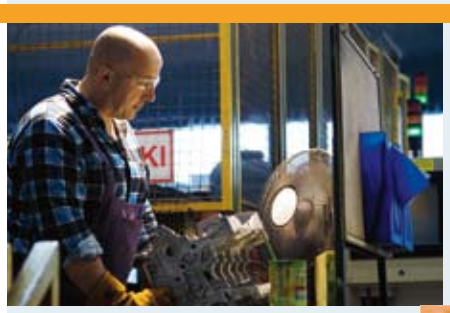

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Wider markets

> There is no denying that the current economic turmoil affects us all, but the situation could have more impact on the foundry industry than on any other industry, in part because of its connection to the automotive industry. The trend toward lighter metals and plastic has long been a factor, but it will be awhile before more extensive changes to the industry fall into place. So foundries are increasingly looking for business from general industry instead. Other industry segments such as home appliances, earth-moving equipment or transportation, for example, are all becoming significant for foundries.

High costs of fuel and energy for consumers as well as for manufacturers are a big factor no matter what the industry. Still, energy savings – through smarter production processes that use robots, effective and user-friendly software – is one of the biggest forces driving the foundry industry today. Foundries need smart solutions that improve production, decrease waste, and require less heavy demands on workers.

Foundries are also needing to follow their customers around the world – and they need suppliers with them who can provide the service and extend their capacity in ways they simply cannot do themselves. Whether it's at places such as Nemak in Poland in Eastern Europe, at Caparo in India or Nyrstar in Tasmania, all of which are featured in this issue of *Foundry* magazine, key to improving production are robotic installations that guarantee a quality, provide an ease of use, and the service backup that we at ABB can help provide – wherever you are in the world, chances are that we have someone close by who can provide the support you need.

Mathys Pirk
Segment Manager Foundry
ABB Robotics

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Calendar

2008

Dec 3-6
Euromold
Frankfurt-am-Main, Germany

2009

Feb. 4-5
2009 Osaka Encouragement of Industry Exhibition
Osaka, Japan

March 10-13
Industrie 2009
Lyon, France

April 7-10
Metal Casting Congress
Las Vegas, US

May 6-10
Metaltech
Kuala Lumpur, Malaysia

Sept. 14-16
China Casting International
Donguan, China

Oct. 25-27
Aluminum Annual Meeting
Charleston, US

Green light for robots at Jaguar and Land Rover

> After 11 tries and four years of hard work, ABB has achieved Green Status for Ford's Five Point program for Jaguar/Land Rover. ABB is now the only Tier 2 robot supplier worldwide who has achieved this important mark of distinction. Through the Five Point program, Ford ensures that its suppliers have reached a certain high level of quality control, particularly when it comes to Reliability & Maintainability.

"The toughest challenge was to show that our robots in Jaguar/Land Rover factories had become more reliable over time," says Johan Kronlöf, who was responsible at ABB for achieving the Green Status. "We went in with a goal of 60,000 hours for mean time between failure (MTBF). That means, roughly, that in a plant of several hundred robots, an average robot system should be down only once in 15 years because of failure." In spring 2008, ABB was able to show a MTBF of 75,400 hours for the robots at Jaguar/Land Rover.

Force Control wins the prize

> ABB's new Force Control technology is not only be recognized by foundries for the new opportunities it provides in automated machining. It has also been recognized by leaders in the industry – at the recent Industrie 2008 industrial manufacturing technologies trade show held in Paris in spring 2008, the new technology was one of five innovations to win a prize competing among 23 entries. The newly patented version of Force Control, with its autopath learning possibilities, has a simplified user interface that allows for an 80 percent reduction in programming time.

Prizewinners from ABB – left to right: Marie-Pierre Picard, Serge Nadreau and Laurent Fluxa.

Mett supplier of the year for GM

> The family-owned Mett Pty Ltd in Australia has been named a supplier of the year to the General Motors group. Mett has been nominated as a GM supplier of the year four times before. Mett produces oil pan assemblies, engine front cover assemblies and various brackets for GM. Mett has some 50 robots, which do the work for 300 people, according to the company. To qualify for the award, Mett had to beat a specified reject rate and meet standards in service, reliability and technology, as well as price. "Our current target (reject rate) was 150 parts per million, or 0.15 percent, but this has been reset to 71 ppm," says Mett executive manager Erwin Schulter.

ROBOT DESIGNED FOR MACHINING

> The new IRB 6660-205/1.9 from ABB is a robot for high-performance machining applications – milling, grinding, cutting and sawing – where robot stability is a key factor for success. The results are higher productivity with an improved material removal rate, higher accuracy due to the stiff, compact and robust design. Ultimately, this will mean shorter cycle times.

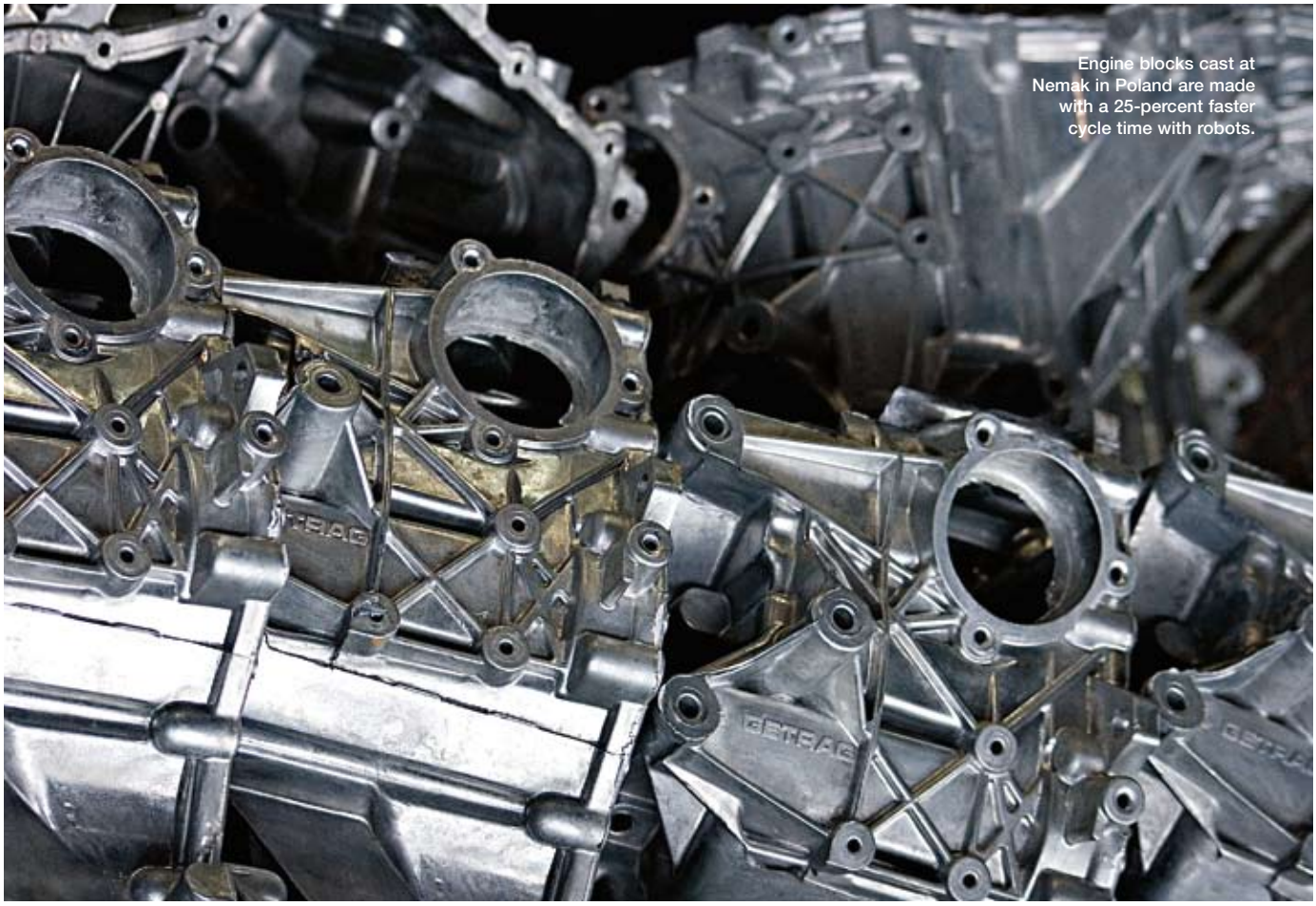
The IRB 6660-205/1.9 provides efficient and flexible solutions for the machining cast parts processing. For example, fettling as a direct step after casting is an area that tends to be neglected when it comes to automation, even though the bulk of working hours, up to 50 percent, are expended in the casting post-processing area. Combined with other innovations such as ABB's new RobotWare Machining FC (force control) with its FC Pressure and FC SpeedChange features, the IRB 6660-205/1.9 can improve quality and cycle times for automated fettling and other machining significantly. Plus the system becomes significantly more flexible.

Remote Service wins M2M Award

> ABB's unique service innovation, Remote Service, won the Smart Services award at the June 2008 M2M United Conference in Chicago

The awards honor successful corporate adopters of machine-to-machine technology and highlight the process of combining multiple technologies to deliver high-quality services to customers.

With Remote Service, if problems arise, the robot can automatically alert an on-call service engineer, who can then immediately access a data error log and quickly identify the root cause of failure. At any time, from any location, customers can verify robot status and access important maintenance information about a robot system.



Engine blocks cast at Nemak in Poland are made with a 25-percent faster cycle time with robots.

Faster casting

Ultra-modern technology helps Nemak meet increasing demands for production of engine blocks and other aluminum parts in Poland.

By Margo Cygielska
Photos Manuel de la Cruz

> The tiny IRB 2400 is busy passing liners to the IRB 6650S, which towers over the new Ford Sigma station in the high-pressure die casting foundry at Nemak Poland in Bielsko-Biala, in south-west Poland. This is one of four new stations installed over the last three years and using ABB's latest-generation robots for die casting car engine parts from aluminum.

"By February 2009 we will have one more station working for the same client," says Jacek Kwiatkowski, Automatics Department Manager, "as the estimated production volume in 2010 should be 600,000 engine blocks."

With another big project on his hands – ten different casts for Hyundai car manufacturer – Kwiatkowski is busy supervising the existing stations and coordinating upcoming ones. He is the person responsible for new project development and works closely with Nemak's engineers and the station's manufacturer on the layout, the technical solutions and the final installation.

"Such a station usually consists of die casting machine and robot as a peripheral installation with different applications, depending on the needs," Kwiatkowski explains. "The dies for high-pressure die casting, which are extremely complicated devices, are mainly constructed at the foundry's tool shop following the client's instructions. It takes a few months from signing a contract to having the station up and running."

The foundry's history goes back to the 19th century. Between 1970 and 1991 it cast parts for the Fiat 126 and Fiat Cinquecento. In 1992 it became a part of Teksid Italy and went through extensive modernization. Two years ago the plant became one of the 16 units owned by the Nemak Group worldwide. It's spread out over 122,976 square meters and consists of a high pressure die casting foundry, gravity foundry and tool shop. The main production stays the same – car engine aluminum parts. The three biggest clients in 2008 are Fiat – 31 percent, Ford – 27 percent and Toyota – 11 percent.

"The estimated production volume in 2010 should be 600,000 engine blocks."

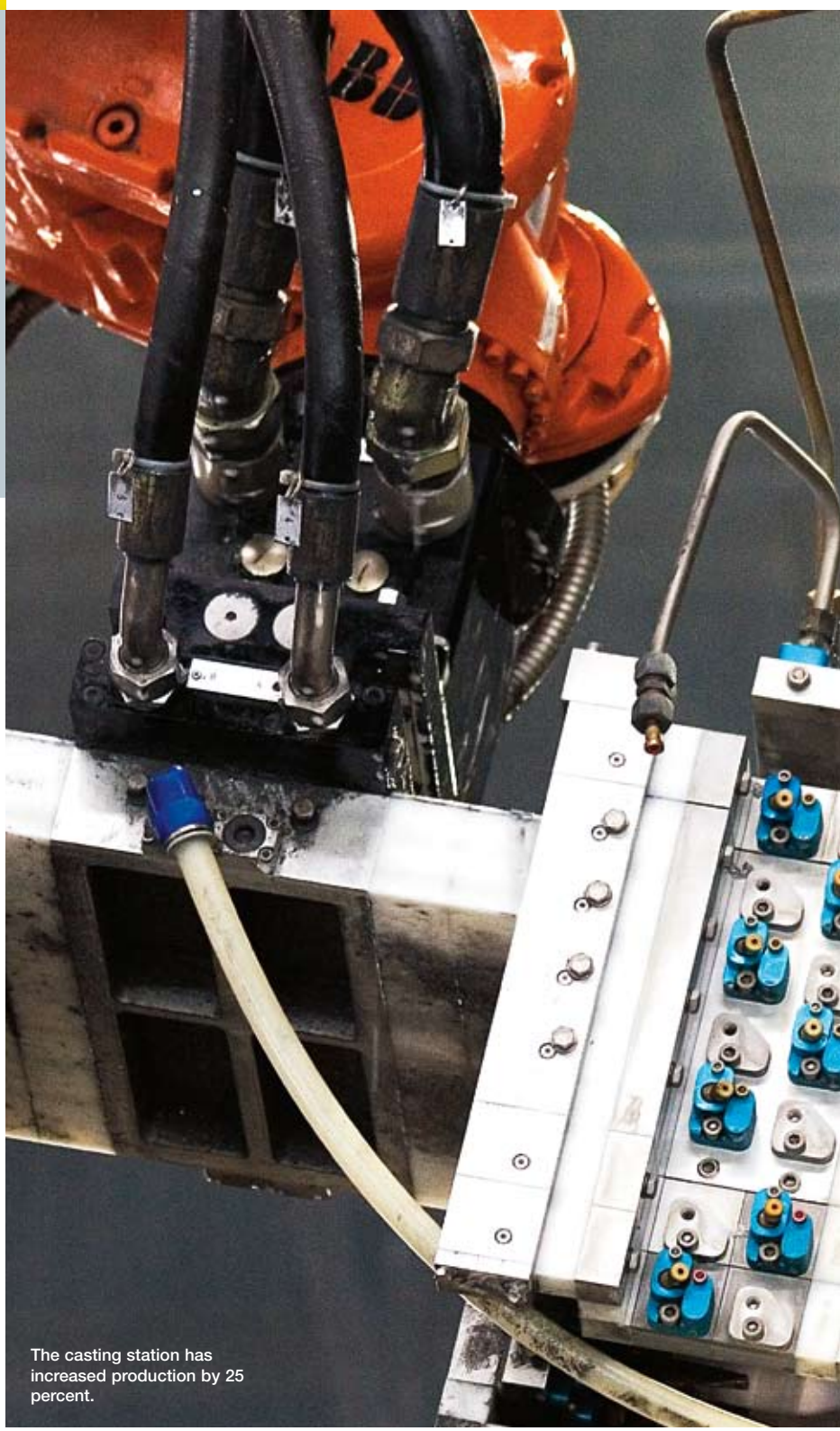
Jacek Kwiatkowski, Automatics Department Manager

>FACTS

Better with robots

Benefits for Nemak Poland of casting stations automation with the ABB's IRB 6650S, IRB 6600, IRB 2400 and IRB 6640 include:

- Reduction of production cycle by 20-25 percent
- Increased casting station efficiency by 20-25 percent
- Safer working environment and less physical stress
- Higher automation, easier maintenance and better work flow



The casting station has increased production by 25 percent.

"The production volume has been growing slowly since 2002, but it has risen sharply over the last two years thanks to big contracts with Ford and Hyundai. The production value for Toyota is also expected to go up," says Kwiatkowski. "We are going through big organizational changes as well as [making] large technical investments in new machines and automation. The Nemak Group has a corporate contract with ABB, so we are buying their robots for the new stations as well for the old ones that need replacements."

Kwiatkowski explains that dealing directly with ABB Poland's sales department is very helpful and thanks to the corporate contract the two companies have, the price is very competitive. "We have had a few of the older models like the IRB 6400 on the casting stations since 1999 and we are very happy with its performance," he adds.

The Nemak Poland foundry operates a total of 50 robots.

"With such a fast production growth we will be purchasing more robots," says Kwiatkowski. "One of them will be an IRB 6640 for the Hyundai program. Its application will be pulling out the casts from the press. Automation of the stations is one of our team's top priorities. There are no production lines in the foundry so we still need employees working the stations, but with the robots it's a much safer workplace and 20 to 25 percent more efficient. Every robot reduces the production cycle by 20 to 25 percent."

He also explains that the ABB interface is user >

friendly and the steering panel is small, compact and easier for programming as well as unproblematic for maintenance.

"In addition to the ABB robots in the foundry, we also use an ABB RobotStudio offline program for computer simulations of production stations. ABB Poland organized a workshop for six Nemak employees this year based on specific problems and solutions that came from our close business relationship."

As the foundry suffered serious underemployment under the previous management, the ongoing automation of the stations is not reducing staffing levels. "To the contrary," Kwiatkowski says, "we need to hire more engineers and technicians to be able to meet our clients' expectations."

Currently Nemak Poland has 809 employees, who work on three shifts turning out a production valued at 121 million euros in 2008, which is expected to rise to 169 million euros in 2011.

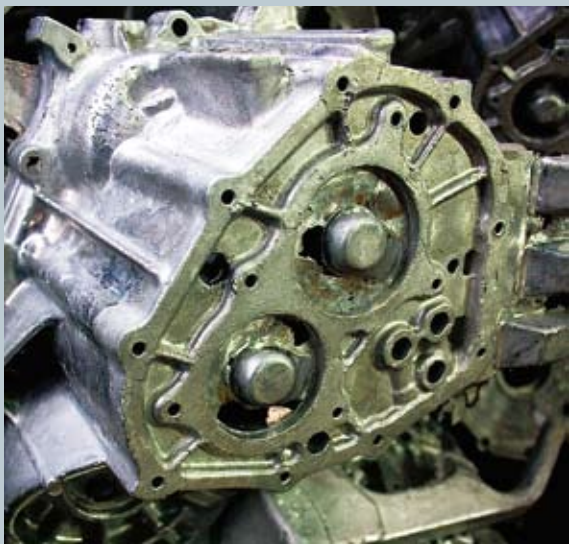
Kwiatkowski points to the IRB 6650S with a spraying head application.

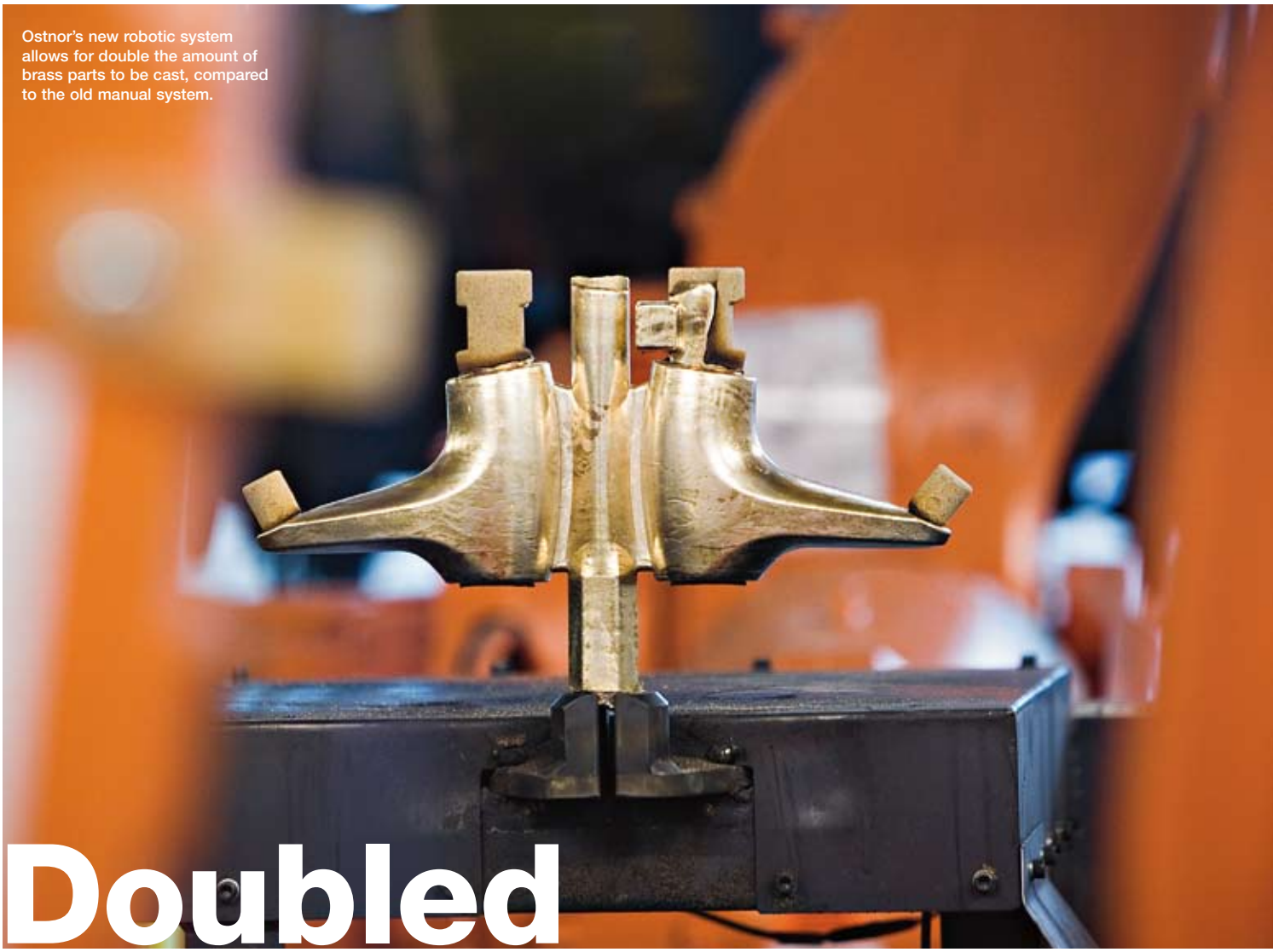
"This is one of the most advanced stations in the world," he says. "We were able to assemble it together with the Italpresse team, which manufactures casting presses, in nine weeks."

He is proud of this ultra-modern technology on the grounds of a foundry that goes way back in time. With new contracts and more engine parts to be cast for the car manufactures spreading across Central Europe, Nemak Poland's future looks bright – and quite orange.

At a Glance: Nemak Poland

- Founded: 19th century - beginning of industrial activity, various owners, since spring 2007 part of the Nemak Group
- Location: Bielsko - Biala, Poland
- Number of employees: 809 total, 510 in the high pressure foundry and gravity foundry
- Production details: Aluminum casts for car manufacturers - engine blocks, transmissions, cylinder heads. Biggest clients in 2008 are Ford, Fiat and Toyota
- Total sales in 2008 – EUR 121 million; forecast for 2009 – EUR 140 million





Ostnor's new robotic system allows for double the amount of brass parts to be cast, compared to the old manual system.

Doubled without trouble

A robotized foundry enables Sweden's largest manufacturer of sanitary fittings to raise productivity and stay ahead of competitors.

By Tom Sullivan
Photos Carl Johan Erikson

> When Thomas Mangs, production engineer at Ostnor, in Mora, Sweden, began automating the factory's foundry, he could not find the application he wanted on the market.

So he enlisted the help of a local automation company, Marab, to design a highly innovative production cell using four ABB robots.

"The system is unique in this industry," says Mangs. "The whole concept of a fully integrated production line for placing, casting and clipping is new. This is the only factory I'm aware of that picks up hotbox sand cores with robots. They are very delicate, so the robots need precise gripping points and very smooth, accurate movements."

The new robot cell, containing three IRB 4400 robots and one IRB 7600 robot, was installed in April 2008, boosting the capacity of an older cell, in operation since 2005, and doubling the foundry's output of castings.

While five to six workers used to produce 200,000 pieces per year with manual machines, the robot cells are manned by three operators and produce 400,000 pieces per year. Man-hours have fallen from 168 to 48, and the foundry has reduced operating costs by 10 percent.

The foundry produces more than 70 different products. Eight of the highest volume items are made in the robot production cells, representing 70 percent of total output and helping to improve the working environment.

"It was difficult, strenuous work handling brass ingots by hand," says Mangs. "The manual machines were hotter, dirtier and smokier, and the fumes got into >

"It was difficult, strenuous work handling brass ingots by hand."

Thomas Mangs, Production Engineer, Ostnor

the foundry. Now the fumes are confined to the robot cells and extracted. The whole foundry is a lot cleaner."

The robot cell is operated by ABB's MultiMove system, which controls three robots with one computer, thereby reducing costs, explains Marab's chief technician, Mikael Johansson. It also reduces downtime.

"With the manual machines you had to stop the process to clean the dies," he says. "Now it's automatic. We run two sets of dies and two furnaces around the clock. While one furnace is being cleaned the other is operating. Also, when we change over to a different product, the robots can change appendages automatically within 10 minutes. It took 40 minutes with the manual system."

The automated casting process has four main stages.

The first robot uses robot vision to locate and pick up sand cores. It places the cores in dies held by the second robot. The second robot closes the dies and places them on the furnace for casting. When the castings are completed it brings them to the third robot, which clips off risers and places them on a pallet for cooling. Finally, the fourth robot loads scrap material from the clippings into the furnace along with new brass ingots.

The entire cycle takes 73 seconds and produces two items, compared with a 50-second cycle for one item with the manual system.

Marab CEO Sten Bastman says he chose ABB robots because he had good past experiences with them. Before setting up Marab in 1999, he was responsible for automation at the Ostnor factory, where more than 100 robots have been installed.

"Every part of the factory has some level of automation," he says. "There have been ABB robots here since the late 1980s, and they're accurate and reliable even in dirty conditions. We also chose them for the foundry because they are user-friendly and easy to adapt."

Bastman attributes the success of the foundry project mainly to good communication.

"We spoke the same language as Ostnor and understood what was needed," he says. "And we're located two minutes away so, we could be up here at short notice to meet face to face."

Since the instillation, ABB has stepped up support to Marab in response to requests for more technical backup and details of new product innovations, says ABB Robotics sales manager Tobias Holmquist.

"We are working together very closely to ensure that the application continues to be a success," he says.

Since installation the robot cell has run without a hitch, says Mangs, adding that it should pay for itself within 2½ years.

"Competition, particularly from cheap Asian imports, is extremely tough right now," he says. "But this system brings our costs down and raises productivity. And that's certainly helping to keep us ahead."

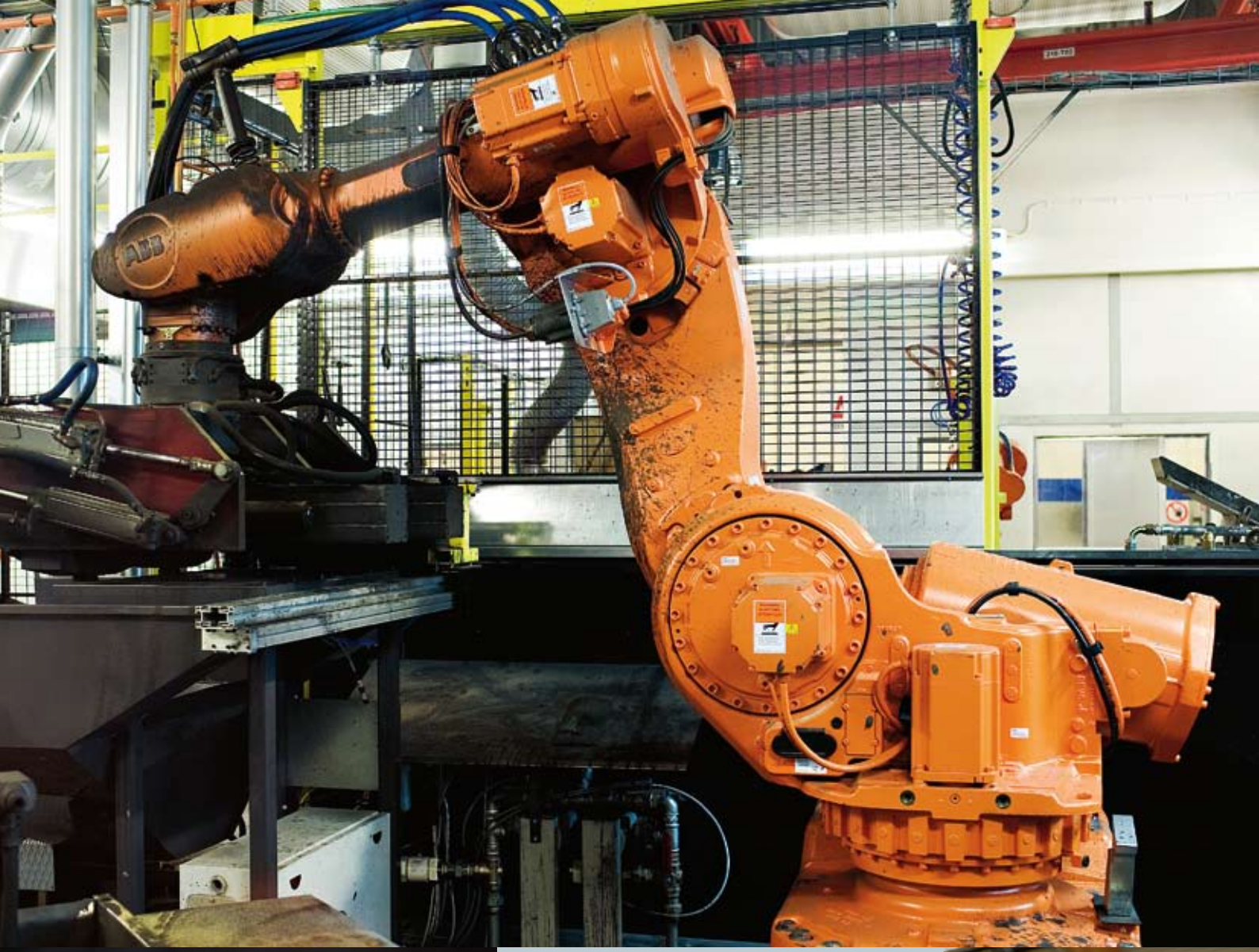
>FACTS

All about Ostnor AB

- Established 1865
- Produces FM Mattsson and Mora Armatur sanitary fittings for domestic market and export to Europe, the United States and Asia
- Sweden's largest producer of bathroom fittings
- Produces 25,000 taps per week
- 680 employees
- USD 200 million in revenues

All about Marab AB

- Established 1999
- Produces automation and robotic systems
- seven employees
- USD 2.5 million in revenues



Benefits of robotization at Ostnor

- Doubled output from 200,000 to 400,000 castings per year
- Reduced man-hours from 168 to 48
- Improved working conditions
- Foundry operates without stopping for cleaning
- 10 percent lower production costs
- Cycle time decreased from 50 to 35 seconds per item
- Changeover time for new products cut from 40 to 10 minutes

Making custom propellers requires a precision finish that despite the uniqueness of each propeller, is best done by robots.

Big ships big propellers

By Bob Emmerson
Photos Ruben Keestra

> Big products with fine precision. That's what the Finland-based company Wärtsilä is all about. The company designs and produces controllable pitch propellers for the commercial, military and superyacht market. These are unique products, the first design of which dates back to 1903. Controllable pitch propellers are custom-designed for each ship and in turn they form part of a custom-designed propulsion solution that includes the rudder, gearbox, and engine. It's an A to Z solution that starts with the control system on the bridge and ends with the propeller. The pitch is controllable in order to accommodate different speed and load requirements. Wärtsilä works closely with the owner of the ship and the yard in order to ensure that the propeller delivers the optimum performance in all operating conditions. More than 10,000 propulsion solutions have been deployed and Wärtsilä is market leader in this sector.

The blades are cast, machined and assembled in Drunen, the Netherlands, as well as Rubbestadneset, Norway. There is a wide variation in size: heights go from around 80 cm up to 3 meters and weights from 100 to 4000 kg. Propellers have four or five blades, so the final product can be very large and heavy.

The manufacturing process is very demanding. It starts in the foundry where a block of high-density (60 kg per m^3) Extruded Polystyrene (EPS) is milled using an ABB IRB 6400 robot. The profile is not that of the blade since EPS could not support the high temperature of the molten metal. Instead, it is used (via an interim process to produce a sand copy) to create one half of the mould. Two halves are then clamped in a metal frame, into which "cunial" — a copper-nickel-aluminum bronze is poured and the casting is left to cool, which can take several days.

Blades are then transported to another part of the factory complex where the blades are ground and polished using two ABB robots, both of which have a linear track. Both sides of the blade have to be ground. They are turned using an index turning table. The edges of the blades are then machined by hand. Grinding and polishing can be done by hand, and it was done by hand in the past, but it requires specialist staff and they are no longer available.

Robots are ideal for this application since no two solutions are the same. The blades are curved, so a 5-7 axes robot has to be employed.

The grinding process automatically accommodates progressive reductions in the depth of the grinding material. The pressure is controlled, together with the robot feed or speed. This process is complex because of the different angles and material stock.

The milling process will typically take six hours. Grinding will depend on size but eight hours is a typical figure. In addition some manual work is needed.

>FACTS

Special needs for special products

Blade profiles are determined by the design of the solution. They are generated automatically and translated into instructions for the robots. There are no production runs: each solution meets an individual set of requirements. ABB robots are ideal for this type of application since everything is linked to that design.

Manual grinding is tedious and it is difficult to ensure that the requisite amount of material is removed. It is very hard to find employees having the necessary skills. Robots work round the clock and deliver consistent results. Availability is very high and with low production downtime due to the robots.

The first robot has been in use for nine years and it is still going strong.

ABB robots were selected because they combine reach with rigidity and are protected against foundry dust (Foundry Plus Protection).

Wärtsilä at a glance

Wärtsilä is a Finnish company whose roots date back to 1903. The company offers reliable, cost-effective solutions for all marine power and propulsion needs. The relationship starts with the initial design concepts and continues throughout the lifetime of the vessel.

The company markets power plants and ship power systems with propulsion solutions having controllable and fixed pitch propellers.

More than 10,000 solutions have been installed and the company's propellers are in use around the world.

Wärtsilä has 130 locations in 75 countries around the world. There are 900 employees at the Delivery Center Propulsion factory in Drunen and a total of 17,500 worldwide.

The grinding process is done two-up so the robot line will typically produce four blades a day.

The ABB IRB 6400 robot has been operational since 1999 and a second robot, an ABB IRB 6600, was added in 2008. Says André Janssen, Manager Manufacturing Technology & Tools at Wärtsilä: "We gained a lot of automation experience with the first robot and the second was needed to increase our production capacity. The new model employs an electric high-frequency motor instead of hydraulics and this allows tools to be changed using a standard HSK tool adaption system, as in a CNC (computer numerical control) system. In December 2008 a fourth robot, an ABB IRB 6640 will be installed for manufacturing EPS patterns."

The A to Z solution determines the finished profile, i.e. it is an integral part of the design. A computer system is used to take inputs from the CAD/CAM system and translate them into robot language instructions. The robots can be programmed to grind and polish the same blades or those of different propulsion solutions. The process complies with ISO-484 manufacturing tolerances.

"Apart from the complexity of the shape, robots are the only way we can meet our production schedules," says André Janssen. "Our order book is full and to meet the demands of our worldwide customers we run the production line 24 x 7 with minimal downtime."

A matter of time

As India's market for automobiles grows, so does its auto industry. And at Caparo Engineering's die-casting plant outside Chennai, robots help provide state-of-the art production.

By Jean Macfarlane
Photos Simon de Trey-White

> The highway from Chennai airport in South India provides vivid proof of the country's love affair with the car. Aged autos with rusted bodywork vie for space with luxurious new limousines and, regardless of their age or condition, there's a deafening passion for the horn.

India's economic growth has resulted in more vehicles on its roads than ever before. By 2010 it's estimated one in every 100 Indians will drive – double the number a decade earlier.

It's hardly surprising, then, that the auto component industry has been one of the country's fastest growing manufacturing sectors. And the spiraling domestic demand is boosted by a hungry international export market.

Chennai and its environs are South India's car and component manufacturing hub. And it's here, some 40 kilometers from the city center, that global manufacturing group Caparo recently opened a state-of-the-art aluminum die-casting production plant as part of its subsidiary, Caparo Engineering India Private Limited.

Headquartered in London, the Carparo group was founded in 1968 by Indian-born British industrialist Swraj Paul, now Lord Paul of Marylebone, while he was in the United Kingdom seeking

Caparo Chief Executive A V Nandakumar (left) and engineer Kannan Mohan inspecting aluminum parts.

and quality

medical treatment for his daughter, Ambika. Sadly, Ambika died, but the company went from strength to strength and the Chennai complex is now one of 21 Caparo operations in Lord Paul's homeland.

Built on 120 acres of greenfield land, the plant was inaugurated in October 2007. Based on current performance and orders, a 25 million U.S. dollar turnover is forecast by the end of 2009 and the company's 200-strong workforce is expected to triple.

The plant is the first and only Caparo operation in India to offer die casting. Key to the venture's ambitions has been the purchase of two ABB robots – an IRB 6600 and an IRB 4400.

A V Nandakumar, Chief Executive at the Chennai plant's aluminum foundry, says: "The auto component business is a highly competitive market. We are using ABB robots because consistency in production >

>FACTS

Caparo Engineering India Private Limited at a glance

Headquarters: Gurgaon, India – outside Delhi
The company: CEIPL was set up in 2003. It is a subsidiary of the Caparo Group, founded in the UK in 1968 by Swraj Paul, now Lord Paul of Marylebone
Locations: Caparo currently has 21 plants operational in India of which 18 come under CEIPL and the remaining three under Caparo Maruti Ltd.
Annual Turnover: INR 7 billion (USD 148 million)
Employees: Approximately 4000 (including permanent as well as contract labor)
Products: Automobile components (stamping, die casting and forging), fasteners, tubes and tubular parts

is a priority for us. It's our aim to be No. 1 in quality and also in technology.

"Our customers are very demanding and they do a lot of analysis before they select a partner to provide them with auto parts. We do the same thing when we select a company to supply us with robots. We compared various brands and manufacturers and we finally selected ABB."

Components in production at the foundry include clutch and transmission housing units, bracket casing, bed plates and oil pans. Among the company's clients are Hyundai, Volvo, General Motors, BMW, Cummins, and Tata Motors.

Center stage on the foundry floor is ABB's 6-axis IRB 6600 robot working in a production cell with a high-pressure die-casting machine.

The three-meter-tall robot first extracts the cast from the die and then holds it against a photo sensor to ensure it has been fully removed. Still controlled by the robot's gripper, the cast is then tapped to break off any overflow, dipped in a cooling tank and trimmed before being placed on a production chute.

The length of cycle varies depending on the component but the company estimates that, using ABB robots, production is increased by 5-10 percent.

This increased productivity is vital for the company's return on investment.

"The cost of HPDC (High Pressure Die Casting) machines is high," explains Nandakumar. "We need to use the machines in the most productive manner possible and that's why we are using ABB robots."

In the making of a transmission housing unit, the ABB robot completes a cycle in two minutes – 30 seconds less than it would take two, or possibly three, workers doing the same job manually. The robotic cell can produce 30 transmission housing units per hour compared with 25 using manual labor.

But there are advantages above and beyond those from increased production and time saved.

Nandakumar says: "Robots are especially useful when the environment is not good for manual operators. In this region summer temperatures rise to 42° C - add to that the fact that the temperature of the molten metal is around 650 to 700° C. These are not comfortable conditions for an operator to work in.

"In plants where this job is done manually, the productivity isn't as high as it is here."

Caparo in Chennai now intends to invest in two more ABB robots and to increase their applications by using them for fettling and placing cast iron inserts in components before the dies are cast. There are plans to introduce an around-the-clock Monday-to-Saturday operation by the end of 2008.

"Robots never get tired and they repeat the cycle in the same way every time so there is complete consistency in the operation," says Nandakumar, "These are the things we look for in order to produce a good quality component.

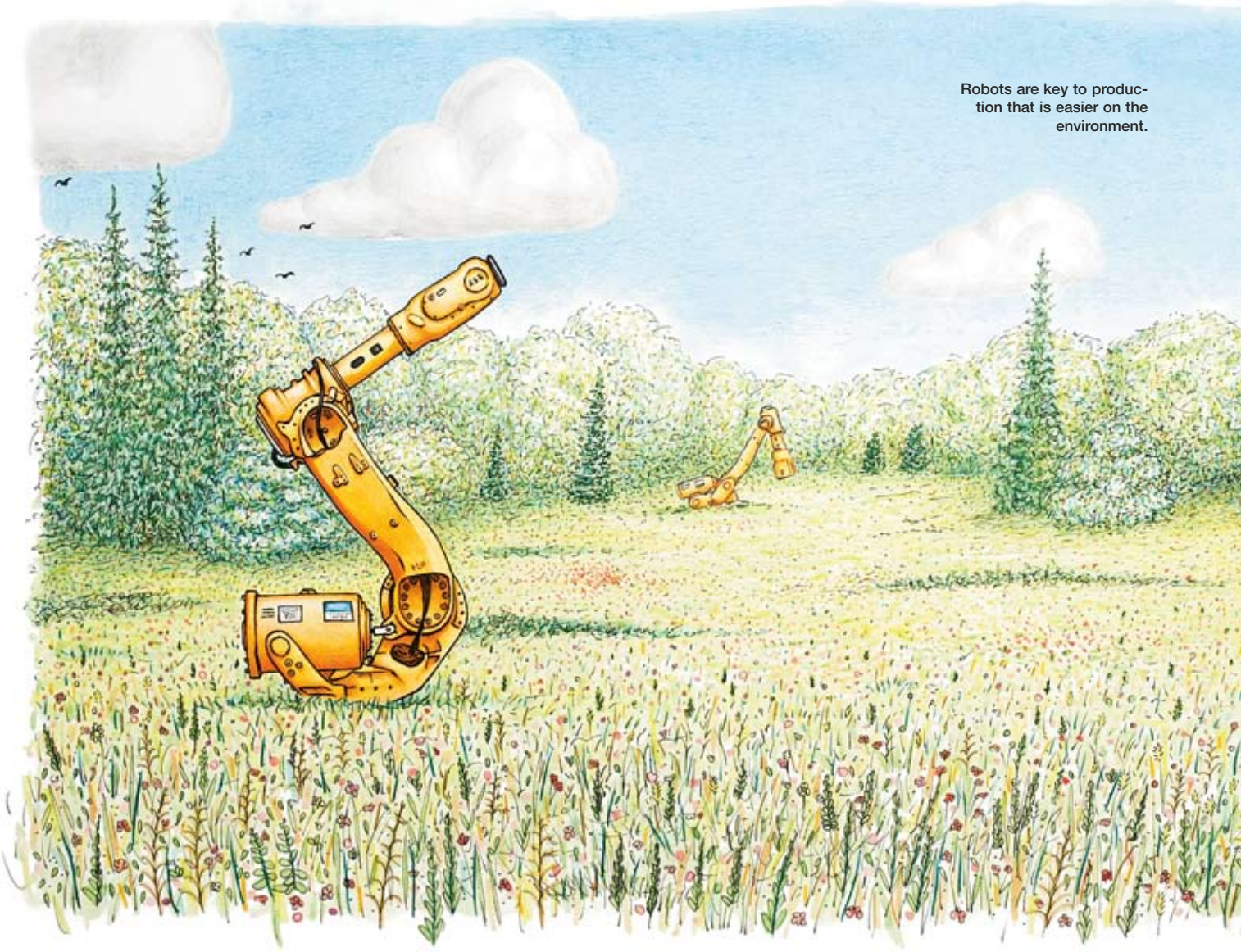
"Today the salaries in India are low but year on year they are increasing. So maybe the time will come when there will be more robots in India than manpower."

"It's our aim to be No. 1 in quality and also in technology"

A V Nandakumar, Chief Executive

Why robots?

- 5 to 10 percent increase in productivity - which helps in faster ROI for the die casting cell
- 30 transmission housing units produced per hour – as against 25 units with manual labor
- 120-second cycle time for transmission housing case – as against 144 seconds with manual production
- Consistency of quality
- Reliability
- Safer working environment



Robots are key to production that is easier on the environment.

Greener with robots

Sustainable production is more than just a slogan. Manufacturing processes that use robots can not only save on energy and reduce waste, they can save money.

By Bert Menninga
Illustration by Linas Alsenas

> Green thinking. Environmental friendliness. Call it what you will, the foundry industry, like most other heavy industries, is under increasing pressure to improve its manufacturing methods. The move is strong towards what many call sustainable production – minimizing the use of natural resources and toxic substances, reducing emissions of waste and pollutants, all so that future generations are not negatively affected by today's production processes.

Sustainable production, however, is not merely a matter of the environment. It is also a matter of cost-savings: It pays to think green. Rising energy prices and the cost of wasting materials affect the bottom line of foundries and their profitability directly.

Indirectly, foundries are affected by automobile manufacturers who are under increasing pressure to produce cars that are more energy efficient. This means primarily lighter parts made of aluminum >

instead of steel, and even metals such as magnesium, not to mention plastic.

"So far, hybrid cars have not had a big impact on foundries," says Mathys Pirk, ABB segment manager for Foundry. "The vast majority of cars still have combustion engines, so there have not been significant changes in what foundries produce other than the continual move toward lighter materials. But electro drives are going to change the power train, and that will mean bigger changes for us working in the industry. But we have a ways to go before that happens."

For Pirk, the issue today is not yet new, greener parts and products that are driven by consumer demand. The production process itself is where foundries need to focus.

"Foundries should look into their production process and see how they can make it more efficient in terms of consumption, reducing waste and using recylced energy (heat treatment)," Pirk says. "I'm talking about less power, less compressed air. They need to reduce power peaks. It requires thinking about this issue as Power Management – a more holistic approach that takes all aspects of production into account."

For ABB, providing foundries with the proper tools for reducing energy consumption is key to the sustainable production problem. "ABB provides products and systems that save energy and help manage factory efficiency," says Pirk. "From motors, frequency converters, steering systems for furnaces, drives and power management systems, our focus is on better solutions that help companies be smart about how they manufacture parts, whether they are zinc ingots or aluminum suspension arms."

Greener production isn't just about power-savings, however. Using robots can also help in significantly reducing waste, says Pirk. By providing a consistent quality on a high level that is unachievable any other way, foundries can really reduce the amount of scrap, which means less material circulating, less energy and less capital. Pirk cites the example of Mett, a big Australian supplier to the auto industry, which through the use of robots was able to cut its reject rate from 150 parts per million down to 71 ppm – earning the company a coveted spot as a supplier of the year to automaker GM.

Production is only one area where companies are thinking green. Increasingly, the issue of supply is a key factor – specifically, having suppliers nearby. Which is also in part an energy issue – having suppliers close by means cutting costs on shipping parts around the world. Of course, it is also a matter of practicality. Having suppliers close by, who speak your own language and understand local issues often makes things go more smoothly.

"Having a global presence is paramount," says Pirk. "As production moves to Brazil, Russia, China, India and other places, manufacturers expect suppliers who can follow them around. They are increasingly relying on companies such as ABB to provide a level of service that hasn't existed before. They are working much closer with their suppliers to come up with workable solutions, and want longterm partnerships that can follow them wherever they go, something that ABB is ideal at providing."

> "Foundries should look into their production process and see how they can make it more efficient..."

>FACTS

The energy at the heart of ABB

"The need for energy efficiency is huge and immediate, and ABB is dedicated to doing its part. Through almost all its products and services in the automation and power areas, ABB contributes to the more efficient management of energy," writes Peter Terwiesch, Chief Technology Officer at ABB, in the ABB Review 2/2007.

Sturdy but flexible

To make pre-machining and machining of parts even easier, ABB introduces the IRB 6660 robot, designed specifically for post-casting foundry processes.

> Manual pre-machining of parts means inconsistent quality, more scrap, tough working conditions which make it difficult to recruit workers. So, for forward thinking foundries, the days of manual machining and pre-machining are over. Robots can handle the job, doing it quicker and with more consistently. To make pre-machining processes even easier, ABB has developed the new IRB 6660, the first robot on the market that is dedicated to pre-machining, machining and other post-casting applications for the foundry industry.

The new IRB 6660 robot is perfect for pre-machining and is designed for high-performance applications where robot stability is a key factor for success.

The superior stiffness and robustness of the IRB 6660 allow for high productivity in challenging applications in tough environments. With the IRB 6660, it's possible to achieve a higher removal rate than before, which gives a shorter cycle time and higher productivity. The greater accuracy of the IRB 6660 also makes for consistent and better part quality, even process forces are high and/or fluctuating. In addition, the relatively heavy robot structure reduces both high and low frequency vibrations.

For machining applications, the best combination is a heavy robot with a light spindle. The high productivity and accuracy of the IRB 6660 increases the application scope of robotized machining, which will save investment costs for the customer, since investments in robots are normally less than in expensive dedicated machines.

RobotWare Machining Force Control, Foundry Plus and Absolute Accuracy are available as selected options for even better performance of the IRB 6660.The IRB 6660 is a combination of ABB's well proven technology and design and along with some new features making it the stiffest articulated robot to date in its class.

This unique combination makes the IRB 6660 very reliable, accurate, cost-efficient and easy to install and maintain, as well as ideal of a wide variety of pre-machining applications.

>FACTS

The IRB 6660 at a glance

- 6-axis robot
- Payload: 205 kg
- Reach: 1.93 m
- Protection such as Foundry Plus option and including chip protection - mechanical protection reduces chips entering axis 2
- Complete Robot IP67
- Floor mounted
- Based on selected high-performance components from ABB Power Robots

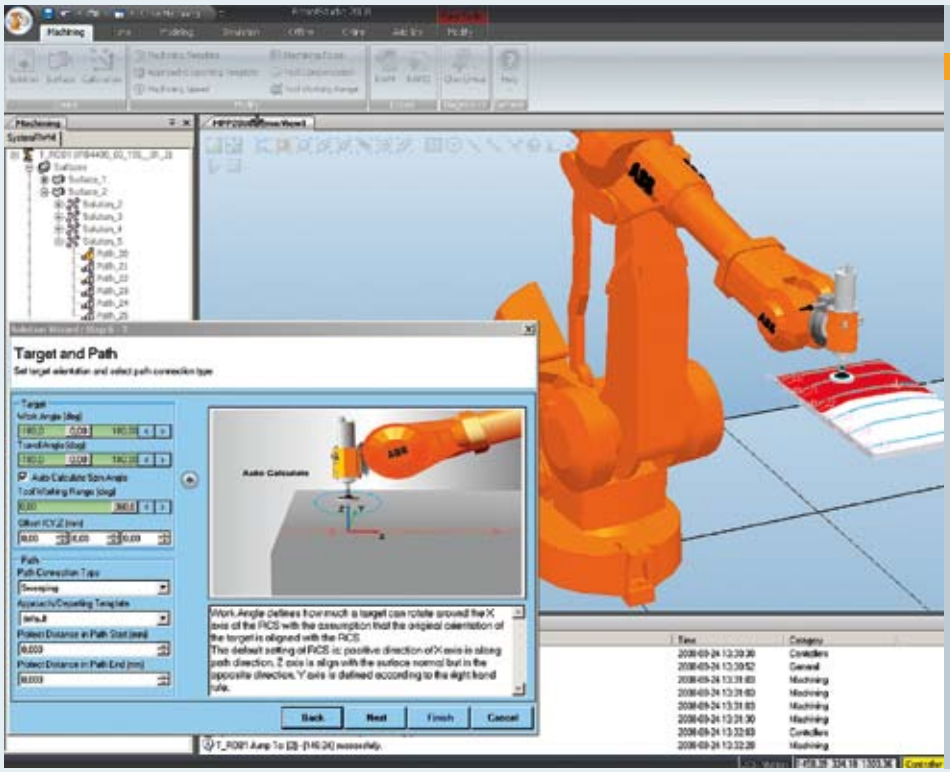
Ideal for…

The IRB 6660 robot is ideal for any part – of aluminum, iron and magnesium alloys, as well as other materials – that needs post-processing after a casting operation. Applications include:

- Deflashing
- Degating
- Grinding
- Sawing
- Cutting
- Pre-machining
- Machining

With the IRB 6660, pre-machining is even more efficient than ever.

Easy automated machining



RobotStudio uses an exact copy of the software used to run the robots in production.

>FACTS

Important features of RobotStudio Machining PowerPac

- Path programming wizard
  - Create/select surface or edge to be machined
  - Set machining process parameters
  - Pre-defined path generation patterns
  - Set path and target parameters
- Path and target optimization and modification
- Path simulation
- Program export as RAPID or RW Machining FC
- Calibration
- Pre-defined and configurable machining templates
- Check/heal CAD models

With the RobotStudio Machining PowerPac, robots can be programmed offline for complex machining operations with less risk – and in less time.

> Machining of parts has long been done manually by the foundry industry – the irregular surfaces and flexibility required were considered best done by hand. But robots are ideal for machining applications, with their ability to work efficiently and provide an unparalleled consistency. To ensure easy robot programming, which is key to optimizing the potential of automated machining, ABB has developed the RobotStudio Machining PowerPac.

RobotStudio uses an exact copy of the real software that runs robots in production, so realistic simulations can be performed, using real robot programs and configuration files identical to those used on the shopfloor. Time and risks are reduced by programming robots offline, in addition to more accurate paths being created.

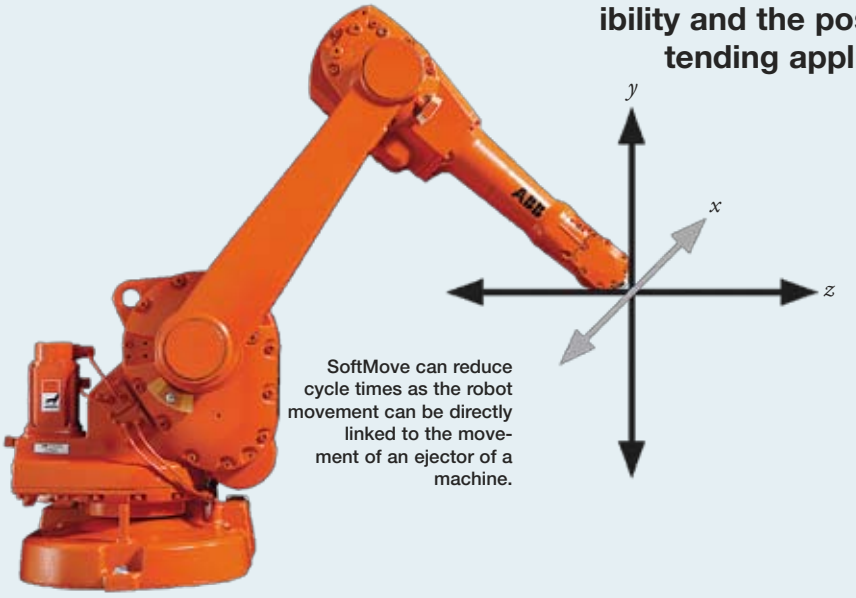
Using the Fluent user interface from Microsoft Office 2007, the RobotStudio Machining PowerPac features an intuitive wizard to guide users in creating targets and paths from surfaces and edges quickly, easily and accurately. Pre-defined path generation patterns are provided to support all possible machining types. All process setting such as tool width, overlap rate, machining angles, etc., can be defined in different pages of the wizard. All these settings will be used to generate the targets and paths. And wizard pages can be browsed forward and backward to adjust process settings. In the last wizard page, a preview is provided to show how the paths look like before they can be finally created.

The PowerPac includes three machining templates as default: NormalProcess, FC (Force Control) PressureProcess and FC SpeedChangeProcess. All of the parameters in the templates can be customized and reused among different cases.

Because the Machining PowerPac supports force controlled processes, it works seamlessly with ABB's software for force controlled machining, RobotWare Machining FC, and the program generated in Machining PowerPac can be imported into and recognized by RobotWare Machining FC.

Compliant and floating at the same time

New SoftMove software eliminates the need for mechanical compliance solutions and opens up flexibility and the possibility for a variety of machine-tending applications for the plastics industry.



SoftMove can reduce cycle times as the robot movement can be directly linked to the movement of an ejector of a machine.

> Robot compliance is key for producing precision aluminum, iron or other metal parts, but traditionally it has been solved with a mechanical compliance mechanism between the tooling and the robot's mounting flange. However, mechanical solutions leave little room for flexibility and require high-accuracy fixtures and advanced programming, which can be expensive and require specialized staff.

To eliminate the need for such solutions, ABB has developed a software option, SoftMove, that allows the robot to be compliant or floating as needed in order to adjust to external forces or variations in work objects. SoftMove means investment costs can be significantly reduced while reliability increases. The flexibility the software provides also allows smooth and inexpensive changeovers when introducing new parts. This can be used in a typical machine tending application where the injection moulding machine ejects a part.

With SoftMove, the robot is compliant in one direction only, which facilitates high accuracy and reliability. The option reduces robot programming time and enables efficient interaction between robot and machine, which ultimately reduces cycle time and saves money.

The robot can be set to be compliant in one Cartesian direction, either during a programmed movement or while standing still. The robot can either be floating or acting like a spring, which facilitates flexibility and multiple application possibilities. Then, when the robot is in floating mode it will be "free floating" in the specified direction and the position can be changed by external forces.

In spring mode the robot acts like a spring in the specified direction and the force needed to push it away increases with the distance from the start point. The compliance shortens programming time and improves productivity and quality.

SoftMove is a true Cartesian soft servo that considerably reduces programming time compared with conventional soft servo functionality. As the robot can be set to be soft in any Cartesian direction, know which robot axes move in a linear movement is not necesssary. SoftMove is ideal for simple assembly applications where some compliance in the robot is needed.

SoftMove is suitable for any application where the robot needs to be compliant to accommodate changes and tolerances created by tools, machines, fixtures, etc. It is also effective for applications where robot positioning needs to be adjusted due to variations in work objects, inaccurate fixtures or machines, or when the process requires compliance to be more productive and reliable.

Ultimately, SoftMove can reduce the cycle time as the robot movement can be directly linked to the movement of an ejector mechanism of a machine or other external forces.

>FACTS

Features and benefits of SoftMove

- Lowers the stiffness of the robot in a specified Cartesian direction while mainly maintaining the original behavior in other directions
- Robot can be "free floating" in a specified direction
- Robot can have a spring function in a specified direction
- Stiffness and damping parameters controlling the compliance
- Gravity compensation – The stiffness can also be lowered in a vertical direction
- Benefits include compliance in only one direction

The newest innovation in cleaning and deburring is not only friendlier on the environment, it saves costs as well.

Clean and green wash

> For as long as manufacturers have been drilling and grinding metal, they have faced the problem of burrs, grit and cutting oil left behind after the machining operation. This unwanted material has to be removed, and industry has always gritted its teeth in frustration at the cost, time and mess associated with part cleaning.

Assuring this washing/deburring operation is done well has become ever more critical, especially with high-precision cylinder blocks and other engine components of modern automobiles. Just one small burr could damage the engine right after assembly, requiring a rework of the part and jeopardizing the long term durability of the engine.

In the late 1990s ABB examined the large, inefficient washers then being used and committed engineering resources to finding a better way. Existing washers were inline single-path chemical systems that were large, energy gulping, unreliable and wasteful. The result of ABB research was a brand new generation of robotic flex washers that have revolutionized high pressure water deburring.

Jan Nielsson, ABB's FlexWasher Global Product Manager, ticks off an impressive list of benefits and improvements for the FlexWasher: decreased exhaust emissions, low and best-in-its-class noise level and cleaning capability, unequaled reliability with robust, low-maintenance components, and a simple setup that allows for quick reprogramming.

Says Nielsson: "What's unique about our systems is that we're using pure water. With your dishwasher at home you heat your water and add detergent to achieve a good cleaning. With our equipment, we have taken out the detergent and heat while achieving better cleaning than our competitors."

That superior cleaning without chemicals is achieved by combining an exact path velocity and precise water-jet attack angle to the surface of the part, made possible using a robot-held nozzle moved around the part or a robot-held part moved around a stationary nozzle.

Even while the FlexWasher design allows for processing of formerly unreachable areas of complex parts, the entire operation provides great benefits for both the environment and the manufacturer's pocketbook.

There's no energy outlay to heat the water, which is filtered and reused in the closed loop system. An efficient design means less power consumption, and there are decreased exhaust emissions since water vapor is the only byproduct.

Jan Nielsson points to stunning statistics on the operational cost of ABB's FlexWasher versus ultrasonic, injection-flood and fixed-nozzle washers.

With significant savings in power draw, fresh water usage, waste processing and zero chemistry outlay, the FlexWasher's annual operating cost is an amazing 87 - 93 percent less than these other systems.

ABB continues to supply auto manufacturers with custom-built FlexWasher systems while expanding its reach into the aviation industry and other production processes.

ABB programmer Sam Smith testing the new FlexWasher cell before it goes to a customer.

The do-it-yourself vent

By doing away with the cumbersome need for vents built into moulds, time and money can be saved.

> Sand casting is a technology that has been around for millennia. But the needs for today's sand casting in foundries are anything but old. In cutting-edge foundries, much of the production of sand casting has become automated, protecting workers and improving productivity.

A key issue is dealing with ventilation of the mould so that air or gases generated by the process can be released efficiently and safely. Traditionally, this has been done by creating moulds with vents in them. The downside is that not only does this create extra work, but it means a break in the model contour caused by cutting from the back of the mould. The resulting piece can then require extra cleaning to remove material left by the break.

However, ABB has created a new cost-effective solution that removes the need for pre-vented moulds. With ABB's new FlexMouldVenter, it's easy to create vents regardless of the mould.

The system uses an IRB 6620 robot, with a special punching head integrated onto the arm of the robot. The robot, which is positioned next to or over the mould, punches vents into the mould from above (model side), or can even cut from any angular direction. The cycle time for creating the vent is approximately one second per hole. The vents are 5-10 millimeters in size, and the precision is better than 1 millimeter. In addition, there is force supervision and if the needle bends or breaks, the robot checks for this after the cycle by moving to a needle-check station. The robot saves the position data for the form so it is possible to apply exactly the same vents for another application. Each form type may have different numbers of and/or positions of the holes.

There are many possibilities for upgrading as well. And the benefits are many: Reduced complexity of the system saves money since application-specific cutting devices are not necessary, for example. Time can be saved due to the simple programming via the graphical interface. Online processing also means that production doesn't need to be interrupted for programming.

>FACTS

FlexMouldVenter up close

- **Mounting:** Floor, wall or ceiling mounting is possible
- **Mould size:** 1250 x 1000 mm, maximum 1600 x 1900 mm
- **Vent punching tool:** integrated into the robot (7th axis)
- **Vent size:** 5-10 mm available (up to 20 mm on special request)
- **Angular venting is possible:** normally +/-30° with X and Y axis, +/- 90 degrees with Z axis
- **Cycle time:** approximately 1 second per vent
- **Needle speed:** maximum 2.5 meters per second
- **Power:** Punching force of 500 N up to 1400 N
- **Precision:** better than 1 mm
- Position data can be saved and transferred from a PLC via Ethernet to the controller
- **Automatic control:** if the needle bends or breaks it will be detected automatically.
- A needle can be changed in less than two minutes
- **Upgrading:** Can be upgraded to with integrated measurement of a force of +/- 2000 N
- **Data:** Can also be upgraded to save all data regarding the vents

Faster finish

In the tough environment of CTF in Norway, aluminum parts are cast, finished and inspected by robots who can handle the heat and radiation in a way no human being can, with four times the efficiency.

By Gwladys Fouché
Photos Truls Brekke

> The robot picks up a sand core from the conveyor belt and delicately places it in the casting machine. The mould closes its jaws around it, steam fizzling out, as liquid aluminum at 710°C is filled around the piece. Five minutes later, the IRB 6400 robot picks up a shiny silvery auto part and places it back on the conveyor belt, ready for the next step.

"A person could not do this job as thoroughly as the robot does," says Rune Almaas, the operational manager at Casting Technologies Farsund (CTF). "The core is made of compressed sand that can crumble at the slightest shock. It is very difficult to handle, since it weighs 17kg. With a robot, the process is faster and more precise."

At CTF, a foundry on Norway's south west coast that manufactures aluminum parts for the automotive industry, wheel carriers or suspension arms are shipped to car-makers such as BMW, Bentley, Saab or Volvo, who choose aluminum parts rather than steel because they are lighter and just as resistant – and therefore means their cars use less fuel.

CTF has used ABB robots since it was founded in 1996, because "they are the only way to compete in the market, as Norwegian salaries are among the highest in the world," Almaas says. The 45 ABB robots – 12 IRB 2400, two IRB 4400 and 31 IRB 6400 robots – are also more productive than human labor. "This robot can deal with eight parts in one 180-second cycle," says Almaas, pointing at an IRB 2400 nicknamed "Magda" by the staff. Magda's job is sawing and deburring. "A person could probably only do two in the same amount of time."

Thanks to the robots, the staff's eight-hour shifts are made more varied. "Instead of sweating for hours

Operational manager Rune Almaas says robots help CTF beat the competition.

>FACTS

CTF at a glance

- Founded in 1996 in Farsund, a port on Norway's south coast
- 220 people work in the 22,000 meter-square factory
- CTF produces aluminum parts for the automotive industry, including BMW, Bentley, Volvo and Saab
- It posted a turnover of USD 65 million in 2007

RobotNorge at a glance

- Norwegian distributor of ABB Robotics' product line
- Founded in 2003, it is based in Klepp, on Norway's southwestern coast
- 22 employees
- It posted a turnover close to USD 11 million in 2007

on end and breaking my back, I am supervising operations, checking the machine is OK, making adjustments here and there," says operator Vidar Skarpeid as he checks the casting of a Volvo subframe. "It makes my job more interesting."

Another advantage is that robots can do jobs too dangerous for human beings. At the end of the production line two IRB 2400 robots place finished parts in front of X-ray machines to inspect for internal flaws. "A person doing this would constantly be exposed to radiation. We could not have anyone doing this," says Almaas. "But it's a very important job, because these parts are essential safety features on cars. So they must be of the highest quality."

The robots at CTF were supplied by RobotNorge, ABB's Norwegian distributor. "We picked RobotNorge because they answered the requirement we were looking for," says Almaas. "An additional advantage is that they're located near us [in Klepp, 175 km north of CTF]. It has been a great advantage when we need to develop new applications for the robots."

"CTF is one of our biggest customers," says Per Mauritzen, RobotNorge's managing director. "It's our most important clients in terms of the number of our robots located in one single place."

After supplying the machines and doing the initial training in 1996, RobotNorge has trained CTF staff to do their own follow-up, thus saving the foundry time and money. "The aim was for the CTF staff to be capable of using the robots' full range of capability. Now they are so well trained that they are robotic specialists themselves," says Mauritzen. CTF is now looking for new robots. "We're considering buying a couple of IRB 6400 robots from RobotNorge," says Almaas.

The benefits of robotization at CTF

- Robots do jobs that are too dangerous for humans to do, such as repeatedly handling car parts in front of an X-ray machine that emits radiation
- It can handle heavy but delicate sand cores that are used for moulding aluminum into car parts
- Robots offer higher productivity than human beings – eight parts per cycle compared to two parts when done manually
- They also avoid employees the risk of hurting their backs, from lifting loads of up to 30kg, or from strain injuries that result from constantly repeating the same movements

Senior Project Manager Michael Kupsch and Nyrstar's zinc ingots, which are used for everything from automotive production to suntan cream.

Zinc in synch

Zinc smelting began in 1917 on the site of Nyrstar's Hobart plant in Tasmania, Australia. For generations it has involved hard, dirty and risky jobs.

By Peter Woods
Photos David Callow

> One of the toughest - skimming the waste dross off molten zinc just poured into ingot moulds - was done by hand, with a rake, until four ABB industrial robots took it over in 2008.

Now the work of 16 men, who sat beside the 600° C molten metal around-the-clock in 30-minute spells, over four shifts, is automated - and Nyrstar is producing cleaner, smoother, correct weight ingots with unprecedented consistency.

Nyrstar Senior Project Manager Michael Kupsch led the 40-strong team, from Nyrstar and systems integrator Lewis Australia, who installed the robotic cells on four lines producing 25 kilogram zinc and 9 kilogram zinc alloy ingots.

"We make special high grade, 99.995 percent pure zinc and EZDA, a zinc alloy," says Kupsch. "It's used in galvanizing, alloying and die-casting, in battery casings, car panels - even zinc cream," to keep sunburn at bay. "Most now goes to China and India."

In Australia, Nyrstar also operates a smelter at

>FACTS

Nyrstar at a glance

- World's biggest zinc producer, smelting more than a million tonnes, worth USD 1.8 billion, annually – and third largest lead producer
- Created in September 2007, when Australian-based Zinifex's and Belgium-based Umicore's smelting operations merged
- Operations in Australia, Belgium, China, France, Netherlands, Thailand and USA, employing 4000 people
- Hobart smelter employs 500 people and produces 250,000 tonnes of zinc and zinc alloy, worth USD 450 million, plus sulphuric acid, copper sulphate and cadmium metal annually.

Port Pirie, South Australia, and is by far the biggest zinc producer – with only one, smaller, competitor.

Molten metal from the furnace is first pumped into pouring bowls on the four casting lines.

Until robotization, a pneumatically controlled system then poured just enough metal into each mould on a conveyor, and operators raked off the waste dross, for re-processing.

Pouring speed could be changed, manually, to improve consistency, but the process was complex.

"Four fulltime operators each shift just sat beside the conveyor, for 30 minutes at a time, in cocoons of safety clothing, with hard hats, face visors, hoods, gloves, coveralls and with a rake," says Kupsch. "We got quite a bit of reject-weight zinc. Imagine, pouring a 10-liter bucket of water into a mould in six seconds, repeatedly, without splashing. That's quite difficult."

Robotizing the process was "like putting an SL500 Mercedes engine into a Model T Ford," he says.

> "Typically, in the robotics industry you don't have a moving target.."
>
> **Michael Kupsch, Senior Project Manager, Nyrstar**

Each robotic cell comprises: an automated servo-control system for the pouring bowl; an ABB IRB 4400 robot, with 1.95 meter reach and 60 kilogram payload; a vibratory conveyor for the dross; and lasers which check the zinc level in the moulds and adjust the pouring system.

The project cost AUD 3 million, the robotic component about AUD 1 million, says Kupsch – and an awful lot of development and testing.

"The new and existing equipment in the plant communicate seamlessly, through Devicenet" says Lewis Australia's Senior Project Engineer Graeme Little.

"The existing Allen Bradley PLCs (Programmable Logic Controllers) and touch screens have been upgraded to run Contrologix Version 16," says Little.

"Each casting conveyor has a robot tracking system matched to the robot via an ABB IRC5 robot >

The zinc ingots cast at Nyrstar are made of either special high grade 99.995 pure zinc or of EZDA zinc alloy.

Robot advantages

- Eliminated 16 of the dirtiest, riskiest jobs in the plant
- Waste recycling reduced by 60 percent with 85 percent an achievable target
- End-product shape, size and unit weight consistency – and transportability – all improved significantly

Lewis Australia Pty Ltd at a glance

- Founded 1968 in Victoria, Australia
- Industrial automation system and robotic cell specialist
- Employs 26 and has annual turnover around AUD 10 million
- Projects in Australia, Asia and North America

A die-casting cell at Nyrstar with its IRB 4400 robot.

controller. This was a particularly complex robotics application," says Kupsch. "Typically, in the robotics industry you don't have a moving target."

Two IRB 6600 6-axis robots, with 200 kilogram payloads and 2.75 meter reach, were commissioned in Hobart in 2007, for stacking ingots. So familiarity was one driver for choosing ABB equipment, says Kupsch.

"Also, we are a partner with ABB," says Little. "We tend to use a lot of their robots, they provide good service and our guys are familiar with them. We completed full workshop set up and testing at our base in Melbourne, before we started bringing over the cells. The only thing we couldn't test in our workshop was molten zinc."

The first new cell went in at Nyrstar in February, 2008, the last in mid July.

"It was a staggered process," said Kupsch. "You can't just walk into a hot zinc area whenever we like - there's permits, risk assessments, job safety analysis, a lot to get through. In fact, the installation window was only four days for each robot."

Nyrstar will do most ongoing work on the robotic cells itself, says Kupsch.

"But for specific warranty on software and components, Lewis or ABB will be coming back in to do the work on those – depending on the component."

Eliminating manual skimming was a key benefit in itself - but Nyrstar also was looking for quality gains, says Kupsch. "Overall, we're seeing a 60 percent decline in reject-weight ingots and we're aiming for the project deliverable target of 85 percent," he says.

"People who mind the stacking end now look after the pouring end as well," Kupsch continues. "The new pouring bowl system prevents 'flash' – splashed metal which cools on the sides of molds and interferes with the shape of the slabs. Now we have a clean, smooth consistent-size product."

The robots will pay for themselves within two years, says Kupsch. "We've considered having the robots perform other functions, such as mould spraying and wire buffing, for example. We'll discuss that in the second half of next year."

Aluminum cylinder block from Form.

Why Form follows function

Robots that can take the extreme conditions at Italy's Form foundries are key to production success. >

By Claudia Flisi Photos Maurizio Camagna

> Foundries in general are not very hospitable places to work. They are hot, noisy, physically demanding, and potentially dangerous. Plus, any occupation that puts you in close proximity to 600° C of molten aluminum has got to be stressful.

Therefore, it's no surprise to find robots hard at work in forward-thinking foundries such as Italy's Form, a leader in aluminum pressure die casting and machining, primarily for the automotive industry. Form currently has 200 robots in its three Italian plants, of which most used in Form's toughest environments are from ABB.

Form has been using ABB's Foundry Prime line of robots ever since they were introduced in 1983. Foundry Prime was designed specifically to withstand the high-stress demands of the foundry environment: dirt and debris as well as wax lubricants used in die-casting. The line is laminated with a special coating to minimize corrosion and has special features developed for foundry use.

"We have had experience with other robotic equipment, but in the foundry environment they weren't as reliable as ABB," notes Stefano Rossetti, automation department manager at Form. "We never felt fully protected with other brands. Foundry Prime is our line of choice. We amortize them in five years, but continue to use some of our original robots. They may have a few marks on them, but they continue to be reliable."

To understand the advantages of Foundry Prime in action, a visitor is invited to follow several of ABB's 33 robots in the company's Cormano (Milan) plant.

In one cell, an IRB 6650 picks up a hot aluminum component that will become an automotive cylinder block. The robot controls the unit's contours and perforations, removes excess metal, holds it in a vat of water to cool it off, stamps the date and time on it, and deposits it in a chest on a pallet, which will be moved to the next cell when the pallet is fully loaded.

An IRB 6650 can handle 30 components per hour, compared with 10 when handled manually.

In this particular cell, the IRB 6650 handles about

Some 33 robots from ABB work at Form's Cormano plant.

>FACTS

Form at a glance

- Founded as Form in 2005, the fusion of four companies working with aluminum die-cast products: SIMI, SIME, SIS, and FIM S.p.A.
- An Italian leader in aluminum pressure die-casting and machining
- Specializing in automotive parts (about 90 percent of production)
- 900 employees in four production plants in Italy, plus a joint venture in Poland
- More than 35,000 metric tons of aluminum alloy processed annually
- ISO certification TS 16949
- Annually turnover of more than 180 million
- Growth last year of 7 percent

Robotic benefits at Form

"We use robots for a series of reasons – environment, security, performance, quality," says Stefano Rossetti, Form's automation department manager. "First, our robots handle the most tiring and monotonous tasks, ensuring better security for our employees." (Not by chance, Form boasts one of the country's best safety records for foundries, according to Silvio Mirata, technical support engineer for ABB's Robotics Division in Italy.)

"Second, the performance of our robots is more consistent and reliable," Rossetti continues. "Third, robots work faster so overall productivity increases. Finally, the quality of the final product is better. With consistency in timing along the production line, the temperature of the metal is more consistent and this has a direct impact on product quality."

Stefano Rossetti, Form's automation department manager, with some of Form's aluminum parts.

30 components per hour, whereas manpower would have handled roughly 10 units in the same period.

In a different cell, another IRB 6600 receives semi-finished aluminum components at one end. It shapes and perforates each block with a shiver press, places the unit in a sand-blasting oven (the blasting in this case is done with fine metal pellets rather than sand for technical reasons), removes the unit and drills a hole for oil lubrication, places one out of every six components onto a platform for quality control testing, and places all the completed components onto an assembly line for transport to the next process.

A decade ago, this cell required two men per shift to do what the IRB 6400 handles today under the supervision of one man. Since Form's Cormano plant has three shifts a day, the robot has cut manpower requirements by more than 50 percent, in addition to taking on the hottest, dirtiest, least pleasant work in the foundry and doing it with consistency and precision.

Form's motto is "traditionally avant-garde," reflecting both the company's history (its predecessor companies were founded in the 1930s) and openness to new technologies (it has been using ABB robots for 30 years). About 90 percent of Form's output is for the automotive industry: 1/3 of this is power steering units, almost ¼ is electro-mechanical systems, with the rest consisting of chassis, engine blocks, power trains, and engine parts.

Major clients read like an ABC of car manufacturers: Audi, BMW, Chrysler, General Motors, Mercedes, Nissan, Opel, Peugeot, Renault, and others.

The other 10 percent is for a variety of applications, from public lighting to casings for electrical motors. Ducati Motorcycles, for example, order Form engine blocks for their limited editions and prototype models.

High performance customers like to stay in Form.

In Almelo, a small city of 72,000 inhabitants in the eastern part of the Netherlands, the Cirex company makes small, precision castings that are mainly used in the automotive industry, which means that they need to be produced in volume and to a consistent quality.

By Bob Emmerson
Photos Ruben Keestra

Bake it to make it

This IRB 60 robot has logged up 100,000 hours, which means that it has been in operation for around 18 years - since before the merger of Asea and Brown Boveri that created ABB - hence the ASEA logo It will be replaced next year, but only because spare parts are no longer available.

> Precision parts are what Cirex is all about. The company's cast iron foundry is used to make the actual castings, but the 14-step process starts with injection moulding, which creates a wax model of the product and an extension that allows them to be placed on a tree. An IRB 2400 robot removes the moulds and creates the tree, each of which can carry up to about 80 moulds. These trees allow other robots to transport the moulds to the various parts of the manufacturing process, the first of which is to clean the wax patterns.

Finished trees are dipped into a bath of molten ceramic, they are rotated in order to allow the excess liquid to fall back into the bath, and then the same robot takes them to a rainfall sander. The trees are then left to dry, which takes around two hours. Heating cannot be used to accelerate drying since at this stage the ceramic shell is very thin and it could crack. This is the most critical part of a manufacturing process that requires tight quality control and an IRB 60 robot that has been in operation for over 100,000 hours handles it.

Dipping and sanding is repeated seven more times, but now the process is less critical since a hard shell is in place so heating can be employed. The final result is a thick, protective covering that can withstand the 1000° C temperature of the furnace. However, before casting the wax has to be removed: this is done using high-pressure steam.

After casting there are various machining operations. The first involves degating, which is followed by a vibration process that removes the coating. We now have metallic castings that are: sand blasted, machined, visually inspected, ground, heat-treated and then they receive a final inspection. The whole process, from wax mould through to finished products takes around two weeks and it involves seven robots. Throughput is a thousand castings a week.

The furnace and other parts of the plant are around 20 years old. They are not being replaced: Instead, the company will implement a new production line in a brand-new building that is being built alongside the current plant. Two new IRB 7600 robots having a lifting capacity of 500 kg will be used, one for picking and placing the trees and the other for pouring the molten material.

Says Jeroen Spoelder, Director: "The new production line will be state-of-the art, but we only need to replace the casting part of the plant. Right now it is the production bottleneck. The new 750 kW furnace will increase capacity by 50 percent and at the same time the use of heat exchangers means that it is environmentally friendly."

>FACTS

About Cirex

- Established in 1963 as an in-house manufacturing facility for Philips
- 60 percent of the castings are for the automotive industry
- Products sold throughout most of Europe
- 110 employees in the Netherlands and 170 in the Czech Republic

Why robots?

Cirex has found a number of advantages with using its ABB robots for production:

- Durability of the old IRB 60 robot means it has worked 100,000 hours over 18 years
- New production line will increase production by 50 percent

Text and photos
by Bert Menninga

Forum looks to the future

Foundry industry insiders mingle and find out about cutting edge trends and applications at ABB's Global Alu-Motive Automation Forum.

> While the economic outlook may seem grim right now, all is not doom and gloom, even for the foundry industry. "There is a loss in dynamic in the traditional market," says Helmut Becker of the Institut för Wirtschaftsanalyse und Kommunikation (IWK – the Insitute for Economic Analysis and Communication), speaking of the auto industry. "But there is a lot of dynamic everywhere else." And foundries can expect to continue to get much of their business from automotive companies and their suppliers. Klaus Schmitz-Cohnen of consulting company Knight Wendling predicts that for the future "65-70 percent of castings are for automotive." He says that specialists will need plants all over the world wherever the automotive industry is active, and automation will only increase in emerging markets such as India and Russia in order to supply Western customers.

These are some of the important messages that some 75 representatives from ABB customer foundries and system integrators, analysts and researchers as well as ABB staff got when they joined together to hear the latest trends in the foundry industry at ABB's second Global Alu-Motive Automation Forum. The forum was held in Basel, Switzerland on Nov. 29-30, 2007.

Sponsored by the foundry segment of ABB Robotics in conjunction with Cemafon and WFO, the forum covered a range of topics, such as worldwide trends in automobile manufacturing, the current and future use of robots in foundry and forging, and next-generation IT issues that will affect planning and operations. Technical sessions focused on innovative applications and areas such as vision systems, magnesium moulding, grippers, machining, die casting and cleaning, among others. In addition, there was discussion of development of a future skilled workforce and the challenges it poses for not just foundries but education systems worldwide.

Along with hearing about new trends and technologies, participants also got a chance to network. "It's great to have a chance to talk to so many people in the industry," said Matthias Garmisch of Fill.

The forum also featured a visit to the nearby PSA Peugeot Citroën factory to see in action the foundry with its production of HPDC cylinder blocks for new generation gasoline and diesel engines. The visit was hosted by Michel Singer of PSA Peugeot Citroën

Participants represented a wide range of countries, including Austria, France, Germany, Italy, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United States.

Mathys Pirk, Foundry Segment Manager for ABB and organizer of the forum, reported that many participants thanked him and ABB for facilitating such an event, both at the forum and in letters afterwards. "The balanced selection of lectures was highly appreciated," he said.

The next ABB Alu-Motive Forum will be held in 2009. For more information, contact ABB.


Matthias Garmisch

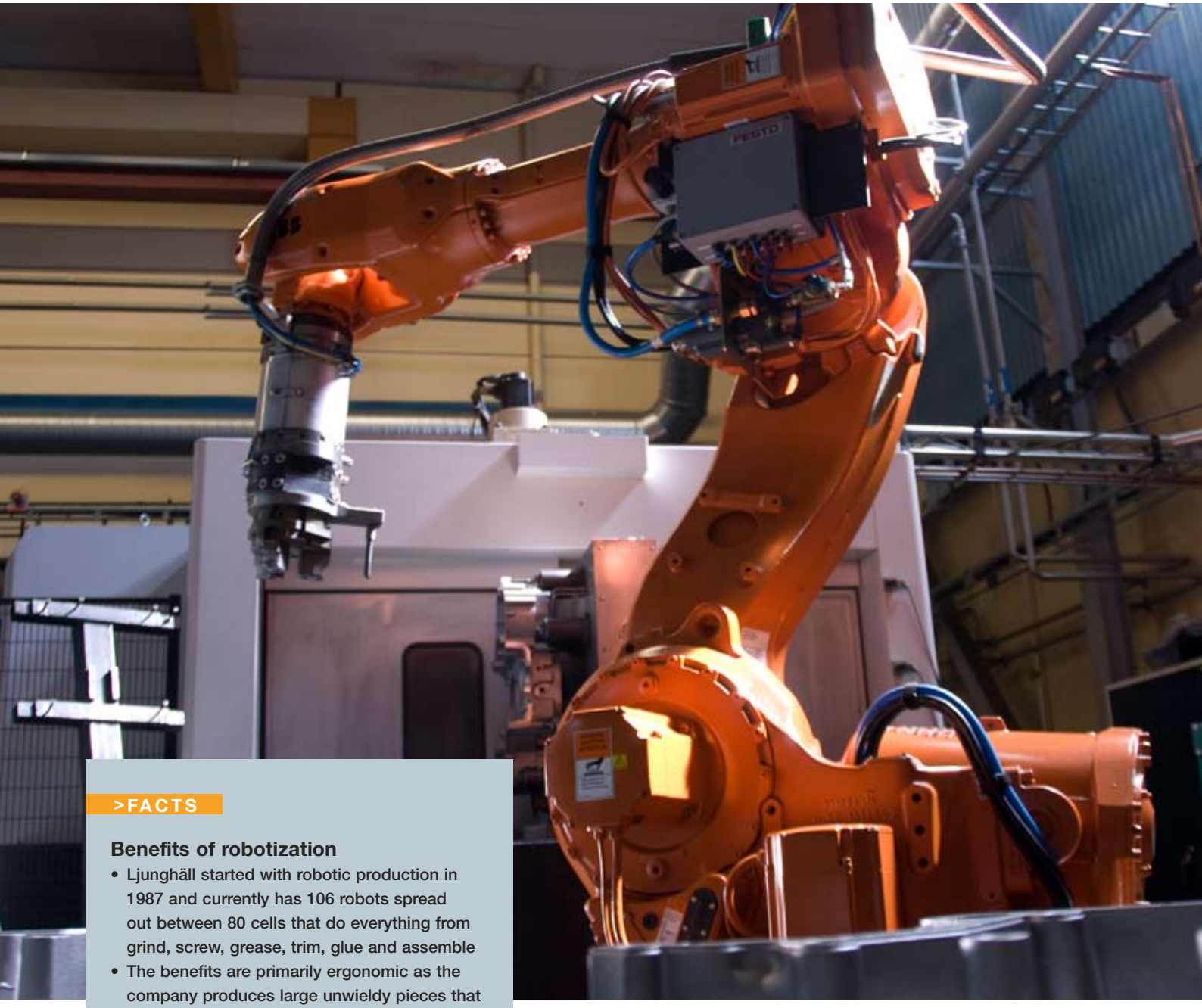

Helmut Becker


Klaus Schmitz-Cohnen

>FACTS

People in the know

Companies and organizations represented at the Alu-Motive Forum include: Acheson, Bharat, Cemafon, Compenanta/Doktas, DIFA, Dürr Ecoclean, Evolut, Fill, Frauenhofer Institut, Hegi, Hengst, Herlanco, Hidria Rotomatika, Hirschvogel Aluminium, Husky, Injecta, IPR, ISD, Italpresse, IWK-München, JL French Ansola, Knight Wendling, KS Aluminium-Technologie, Müller Wingarten, Nemak Poland, Oliver Wyman Consulting, PSA Peugeot Citroën, Robotec, RST, Senator Technology, Sir, Specma Automation, Striko Westofen, EMAG, TCG Unitech, Wiest Aktiengesellschaft, WMS Engineering, Volkswagen Poznan and LLEMI Slovakia.



>FACTS

Benefits of robotization

- Ljunghäll started with robotic production in 1987 and currently has 106 robots spread out between 80 cells that do everything from grind, screw, grease, trim, glue and assemble
- The benefits are primarily ergonomic as the company produces large unwieldy pieces that weigh up to 30 kilograms, and come out of die casting machines every third minute
- Foreman Nicklas Jaldefeldt, responsible for the robots at Ljunghäll, says that without robots, even doubling the amount of employees to 1,500 wouldn't nearly be enough to meet current production levels
- Ljunghäll's range of robots range from the small IRB 140 to the larger IRB 6650. In general, their uptime lies on average between 60 and 70 percent, although this depends on the surrounding equipment like conveyor belts and die-casting machines
- TrueView is ABB's patented Vision Guided Robotics (VGR) technology that allows robots to identify components based on size and surface area.
- TrueView can be retrofitted on any robot and does not require optimal light conditions.

Text and photos by
Alex Farnsworth

The true view of a naked robot

Making parts for the automotive and telecom industries is a robot intensive business.

> After 91 years of blacksmithing, Ljunghäll has become the leading manufacturer of technically advanced aluminum die-cast products in the Nordic region. The company, based in Södra Vi in the Swedish province of Småland, produces primarily for the automotive and telecom industries.

The company runs 106 robots, in 80 different cells, to produce inlet manifolds, oil cooler covers, and engine blocks among other products for clients such as Scania and Volvo, equipment for cell phone towers for Ericsson, and even TV pedestals for Bang & Olufsen. Their specialty: large complex castings.

Ljunghäll has been an exclusive ABB customer since it installed its first robot over 20 years ago. And Nicklas Jaldefeldt, Ljunghälls own "robot guru," or robot foreman, has been around ever since.

"We buy so-called 'naked robots' and dress them ourselves with our own in-house gripper expertise and cell technology," says Jaldefeldt. "We manufacture hundreds of different parts for different customers. It is therefore important to build a flexible system where a stop in one cell doesn't affect the work in another."

Ljunghäll's 35,000-square meter factory is basically a collection of 39 different aluminum die-casting machines. These take molten aluminum and press them into parts with predetermined nooks and crannies, the biggest of which uses pressures upwards of 3,500 metric tons per square centimeter.

Adjacent to each of these die-casting machines are robotic cells, which depending upon the piece being manufactured either, cut, grease, grind for smoothness, glue, screw, or assemble, for further dispatch on a conveyor belt to an operator, who checks quality and packs them.

"Automation is a prerequisite in our constant striving for cost efficiency," says Jaldefeldt, who credits his eight-man robot team for the smooth operations at Ljunghäll. "And human handling is our last and best quality check."

According to Jaldefeldt, there are two related reasons why the company designs and builds its own robotic cells, and doesn't use a third party integrator. One reason is that Ljunghäll was a family-owned company for many years and was used to doing everything itself.

"But another reason why we dress our robots ourselves is that we have learned what the optimal set-up needs to be next to huge die-casting machines. Handling hot aluminum requires special equipment due to the corrosive environment and our production schedule," says Jaldefeldt.

Despite its preference for homemade solutions, one particular cell at Ljunghäll uses ABB's new TrueView vision guided robotic (VGR) system. The cell consists of two robots – an IRB 6620 and an IRB 6650 – to smooth out the screw holes on a so-called bed plate, which is a 10-kilogram aluminum casing that encloses the crankshaft of an automobile.

The main advantage of TrueView is that the robot can pick up the bed plate from a palette and actually see and adjust itself according to the bed plate's position, (it could have been knocked around on its way into the cell) before picking it up and moving it to another workstation.

"TrueView is a flexible system that works in today's industrial environment where we need to quickly be able to change over to manufacturing other products. TrueView allows the robot to identify different parts on a belt and identify which one is the right one for the job."

Ljunghäll in brief

- Founded 1917 by blacksmiths Evin and Hilda Ljungkvist to become a leading manufacturer of die-cast aluminum products
- 750 employees
- 37,000 square meter facilities in Södra Vi, in southern Sweden
- Annual production is 15,600 tons of aluminum, of which 100 percent comes from recycled aluminum
- Turnover is SEK 1.14 billion
- In 2002, the CapMan Group, one of the leading private equity investors in the Nordic region, acquired Ljunghäll

A new system for milling using a 6-axis rigid robot takes the prize in the Netherlands.

When rigid is better

By Bob Emmerson
Photos Ruben Keestra

> In 2004, the Netherlands-based robotic specialist WWA spotted a way to improve foundry production that others may have overlooked. Rather than using a traditional and expensive CNC (computer numerical control) system for milling, it could optimize the process by using 6-axis robots instead. Four years later, the company has changed to a system that has not only improved production, but actually received awards: When demonstrated at the Techni-Show in Utrecht, The Netherlands, the system garnered two prestigious awards: It won the silver from the "Innovation" jury, while the attendees gave WWA the first prize.

WWA is located in Best, a relatively small town in the Netherlands that is near Eindhoven. It was at the Eindhoven University of Technology that the company recruited 21 students in order to develop specialist software that would translate (parse) the commands of any CAD/CAM system to those of ABB's robots – an open systems model. It's open because the regular proprietary model is based on the use of a particular CAD/CAM system, which therefore places constraints on the manufacturing process.

>FACTS

WWA highlights

- There are three principals – Jean Jacques van Broekhoven, Dennis Meijer and Marc Robben
- Current staffing is 19, to increase in 2009
- Extensive know-how in automated production processes
- Delivers cost-effective turnkey projects in short timeframes
- Has worked closely with ABB to test the IRB 6660

WWA's model allows customers to choose the optimum system for every manufacturing process and it has been remarkably successful. Marketing started in March 2008 and four solutions, known as flexible production centers, were sold in a few weeks and the order book is filling up.

WWA was formed in January 2000 and the initial focus was on the automotive industry, but that market became highly competitive, hence the decision to stop and develop and market flexible production centers. However, the experience and knowledge gained by working in that area allowed the company to develop automated production lines and to market turnkey solutions. Moreover, these solutions have been developed in short time spans, typically a few months, and at very competitive prices.

Milling machines are robust and precise but expensive. They have a maximum of five axes, so the reach is limited and this has an impact on the production of complex products. Robots can have six axes so complexity is not an issue and often it is possible to work with one fixture.

In addition, a 7th axis can be added and this extends the reach on one side to more than 20 meters. Most robots are not good milling machines because they lack the requisite rigidity, which means that they are less accurate. ABB therefore developed the new IRB 6660 to match the rigidity and accuracy requirements of the milling process.

Robots also have another limitation: they can overshoot when changing from straight-line milling to a curve. This means that the output of the CAD/CAM system has to be fine-tuned manually, e.g. the speed has to be reduced in advance. This facility has been built into WWA's software.

Optimization comes from the fact that WWA has created a "best of both worlds" solution. For example, the robot can change tools or have more spindles and it can pick up the part to be milled and remove it; the robot can also invert the part. This eliminates the need to have an expensive CNC system, so there is a significant cost saving. The company's flexible production centers (FPCs) are also ideal for applications where long parts have to be milled or where other or additional manufacturing processes are required. For example, FPCs work equally well with a grinding process as well as for water-jet or laser-jet cutting.

Around 25,000 hours went into the development of the FPC software. Twenty-one students participated in the initial phase. The objective was the realization of a groundbreaking manufacturing concept – one that has significant cost and flexibility benefits. There is no comparable system on the market, which means that WWA can market FPC systems worldwide. The company will therefore move into much bigger premises in Q3 2009, the new location being close to Eindhoven's International Airport.

Solution highlights

- Works with long production lines, e.g. 20 meters or more
- Flexible, spindle/tool changer
- Robot code is generated by the FPC from the CAM file
- Milling by 5 axes simultaneously
- No manual programming is required – this means no need for developing specialist software or employing expensive specialist staff
- Faster ROI because of lower price of robot systems compared with 5-axis CNC machines.
- Robots can be used for loading/unloading cell
- Correction of the dynamic behavior of the robot for more accuracy

One strategic move to victory.

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ABB robots have always been a key piece in winning foundry automation strategies. From the beginnings of automation to today's agile, advanced operations, our experts have helped topple some of foundry's biggest challenges, from upstream to downstream applications.

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