Worldwide competence

Creation of innovative products makes Mahle's Brazilian technology center stand out

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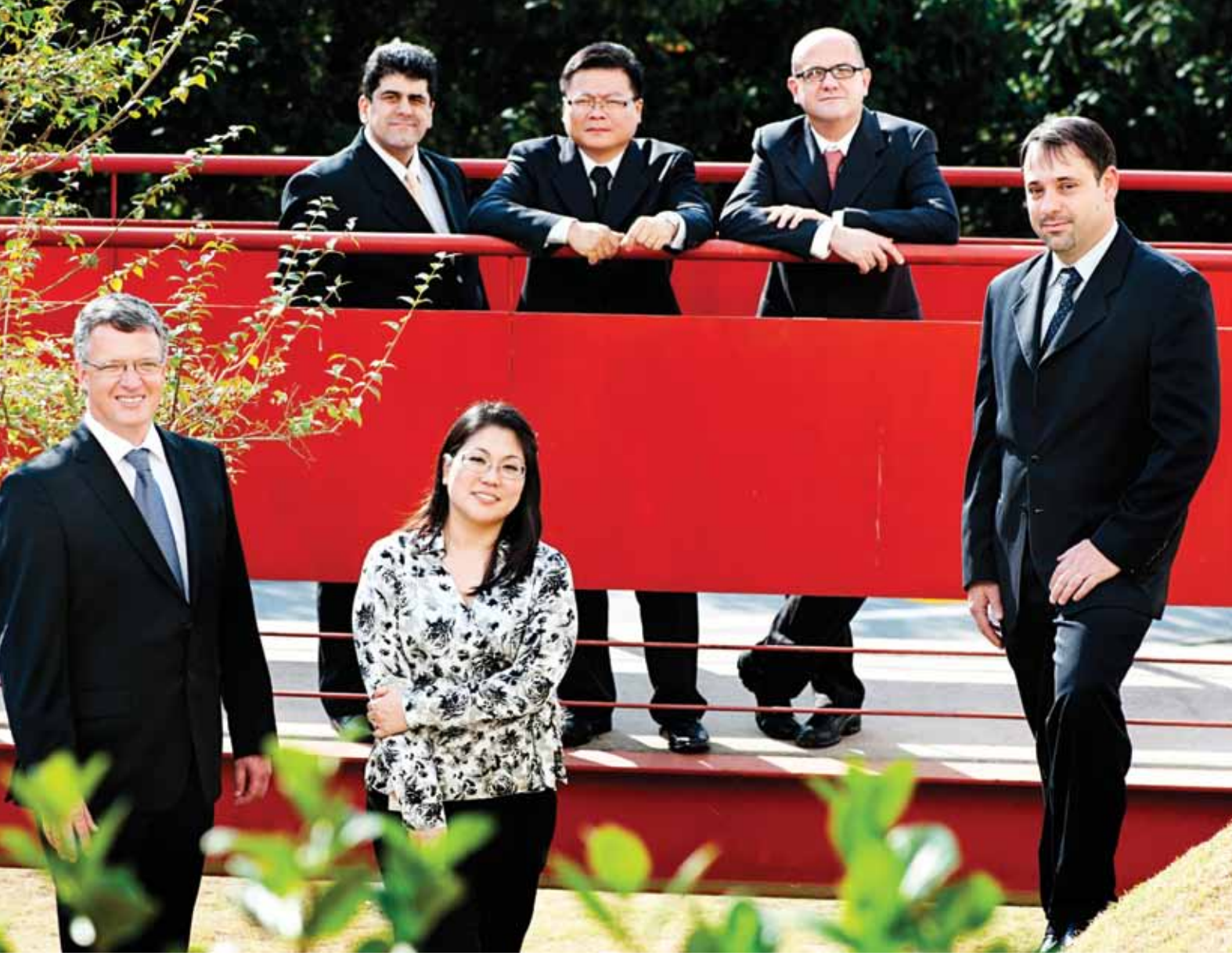
From top left, researchers Andrew Ferrarese, Fernando Yoshino, Eduardo Tomanik. From bottom left, Carlos Roberto Camargo, Samantha Uehara, and Paulo Mordente

The Mahle Metal Leve technology center is located in an environmental protection area in the Japi Mountains in the city of Jundiaí, 60 kilometers from the capital of São Paulo. In this facility, engine components such as pistons, rings, sleeves, bearings, air filters and fuel filters are developed and tested in large rooms with glass panels so that visitors and customers can tour the facilities without disturbing the testing and research routines. The center consists of three independent buildings that follow the precepts of sustainable architecture, including a reflecting pool on the roof that serves as thermal insulation, large skylights that allow natural light in and a design that preserves the natural slope of the land. Approximately 300 people work at the site, including technicians, engineers and interns, and more than 200 of these employees are directly involved in research.

"This is the second largest Mahle technology center in the world," says mechanical engineer Ricardo Simões de Abreu, 56, an alumnus of the University of Mogi das Cruzes (UMC) and global vice president of research and development (R&D) of the company established more than 90 years ago in Germany to manufacture alloy engine pistons. The technology center model was established by Abreu in 2005 after he took over



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global responsibility for the group's development of metallic components. Each of the seven centers, including four with worldwide competence, has a general manager, product experts and engineers who are responsible for the technologies. "I established a model in which all centers can work with all engine components, but one of them leads the process," says Abreu, who taught for several years at the Mauá Institute of Technology, the Ignatian Educational Foundation (FEI) and UMC before joining Mahle, where he has remained for 17 years.

The main technology center is in Stuttgart, Germany, and is responsible for pistons, pins, camshafts and other components. The Brazilian center is responsible for rings and sleeves for engine cylinders and is being a world reference in flex fuel engines. The Northampton, England center is responsible for engineering services, while the Detroit center is responsible for connecting rods. The two centers in Japan and China serve customers in their respective countries. Approximately 48,000 people work in 100 plants around the world and in the seven R&D centers. In 2012, the Mahle Group had worldwide revenues (net sales) of approximately R$19.7 billion, and its investments in R&D totaled approximately R$930 million (4.7% of net revenue). Mahle Metal Leve had revenues of R$2.2 billion last year and invested R$67 million (3.02% of net sales) in R&D.

The innovations developed by the Brazilian research center include items ranging from a new generation of filters for use in flex fuel engines to the use of chromium carbonitride (a chemical compound composed of carbon and chromium) as a nanoscale coating for piston rings that results in reduced friction and thus greater part durability, as well as a reduction in fuel burned and carbon dioxide emissions. This innovation will replace the galvanized material currently used for this purpose. "Carbon in the form of graphite has no mechanical resistance, but it has a very important function, which is to reduce friction," says mechanical engineer Paulo Mordente, 37, who has been at the company for 14 years. He is a materials science researcher and project coordinator. The reduction in friction – which is between 10% and 20%, according to the researcher – is obtained by distributing islands of graphite on the order of 5 to 10 nanometers in size throughout the ceramic coating of piston rings. As a result, cars fitted with piston rings with this coating will use 1% less fuel.

The nanotechnology project origi-

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Investments in R&D in Brazil reached R$ 67 million in 2012

nated in 2004 within a European consortium formed by companies interested in surface protection coatings and universities such as one in Basel, Switzerland, with government support. "After three and a half years, the consortium was terminated, but Mahle decided to continue the research, which resulted in three patent filings and a product expected to enter the market in 2017," says Mordente, who graduated from the Federal University of Uberlândia (UFU) in Minas Gerais and holds a master's degree from the Polytechnic School of the University of São Paulo (Poli/USP). The new product will initially be applied to engines of European cars.

"The demand for engines is greater in Europe and the United States, but that does not mean that innovative components are developed there," says mechanical engineer André Ferrarese, 35, coordinator of the innovation department. He has been with the company since 1999, when he started as an intern. "Today, 70% of diesel engines for passenger cars supplied by Mahle to Europe use a piston ring that was developed here." It is an oil control ring called X-taper and is able to reduce force and therefore friction without losing the power to seal and scrape. "Thus there is a gain in fuel consumption," says Ferrarese, who graduated and obtained a master's from Poli/USP.

In 2012 alone, the company filed 28 original patents in Brazil, meaning that all of the innovations were generated in Brazil. This figure is nearly double the 16 patents that were filed in 2011. "We have targets for the number of patents filed, designs turned into products on the market, and scientific articles published," reports mechatronic engineer Fernando Yoshino, 38, who graduated from Poli/USP and is responsible for filtration systems product engineering. In just the first half of this year, his team, which is composed of 11 people, filed nine patents in Brazil. The innovations developed by his group are already on the market and include a system to remove water from diesel fuel tank filters because the accumulation of water in the reservoir is a serious problem for injection systems. His team also creates innovations related to flex fuel engines such as a new-generation fuel filter that has a greater capacity for removing impurities and durability that will result in an extension of the service interval.

NAMES OF INSTITUTIONS FROM WHICH MAHLE RESEARCHERS GRADUATED

Fernando Yoshino, mechatronic engineer, responsible for filtration system product engineering	USP – undergraduate degree
Paulo Mordente, mechanical engineer, materials science researcher	Federal University of Uberlândia – undergraduate degree USP – master's degree
Eduardo Tomanik, mechanical engineer, R&D technical consultant in the product technology department	USP – undergraduate, master's, and PhD degrees
Carlos Roberto Camargo, mechanical engineer, manager of experimental test engineering	FEI – undergraduate degree USP – MBA
Ricardo Simões de Abreu, mechanical engineer, global vice president of R&D	University of Mogi das Cruzes – undergraduate degree
André Ferrarese, mechanical engineer, coordinator of the innovation department	USP – undergraduate and master's degrees

DIVERSIFIED PORTFOLIO

Mahle began its activities in Brazil in 1975 by manufacturing pistons for the automotive industry and, over time, has purchased other companies, including a competitor, Metal Leve, which also manufactured bearings. Together with Magneti Marelli, it bought Cofap, a company that makes shock absorbers and piston rings. "With these acquisitions, Mahle diversified its portfolio, adding more parts to its development capability," says Ferrarese. "It started as a manufacturer of pistons and trans-

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1 Architecture of the technology center integrated into the Japi mountain range in Jundiaí

2 Monitoring of tests conducted in the engine laboratory

3 Equipment for measuring piston rings

4 Components laboratory: piston testing

formed itself into an engine component producer." In June 2008, the technology center in Jundiaí continued the research that was initiated in Santo Amaro, a neighborhood in the southern part of the city of São Paulo, and added new activities and research groups. Examples of these groups include the automotive component laboratories located on the second floor and the engine laboratory that occupies the third floor of the building. The 52-member group was assembled by mechanical engineer and manager of experimental test engineering, Carlos Roberto Camargo, age 48. "When I came here, there were only technicians, I was the first engineer in the group," says Camargo, an alumnus of FEI. He recruited the experimental engineering team and reorganized the laboratories.

Different types of projects are part of the researchers' daily routines. They are divided into the following areas: product portfolios, where there is a commitment to quickly placing a part on the market at a competitive cost; systems, where the demand is for a systemic solution based on existing products; basic tools, where methods are developed for analysis, simulation, and testing that result in new components; and incubation technology, which handles ideas that are not associated with a specific product at first due to their degree of innovation. "Some concepts or ideas become part of the company's portfolio only after we are certain about their technical performance and production capacity," says Ferrarese. The innovation department is responsible for four processes: idea management, intellectual property, image (the technological and technical promotion of a new product), and competitive intelligence.

The Brazilian Mahle currently has more than 100 projects under development, of which 70 have some type of government support. One of the projects funded by FAPESP through the Partnership for Technological Innovation (Pite) involves a consortium of companies and universities focusing on biofuel engines (see *Pesquisa FAPESP* Issue No.196). Volkswagen, Fiat, Renault, Mahle, Petrobras, and Fundição Tupy are participating in the study, as are USP, the Federal University of the ABC (UFABC) and the University of Campinas (Unicamp).

"The idea of studying the problems related to the use of ethanol in engines emerged during discussions in a tribology group at Poli, to which I belong," says mechanical engineer Eduardo Tomanik, 55, an R&D technical consultant in the Mahle product technology department and company employee for almost 30 years. Tribology involves the study of phenomena related to friction, wear, and lubrication. Throughout his career, Tomanik has worked on different projects including piston rings that are coated using a technique called PVD (physical vapor deposition), which results in a product with lower friction. In 2004, PVD rings began to be produced in Portugal for the European market and are now being manufactured in Brazil. ■