Heat Treat 2013

Gear Market Offers Opportunities for Ingenuity and Innovation

Matthew Jaster, Senior Editor

Growth in the heat treating sector depends on many factors including product development, technology advancements, customer demand and a little luck. Successful organizations will have the right products available during strong market periods while investing in new technologies when the market slows down. Global expansion is essential as companies in the United States and Europe look to China and India for growth opportunities. In this issue, *Gear Technology* looks at various heat treat companies involved in the gear market today and the new developments leading up to the **27th ASM Heat Treating Society Conference and Exposition** that's co-located with **Gear Expo 2013** (September 17-19, Indiana Convention Center, Indianapolis). Engineers involved in this market segment see an emphasis on training, software, service/support and collaboration with their customers to remain relevant in heat treating moving forward.

Austempering with Applied Process

The Applied Process family of companies specializes in the austempering heat treatment process of steels and irons. "Austempered Ductile Iron, ADI, constitutes the majority of our work, and the remainder of our heat treating work is split between austempered steel, carbo-austempered steel, austempered gray iron, carbidic austempered ductile iron, and marquenched steel," says Justin Lefevre, regional sales engineer at Applied Process.

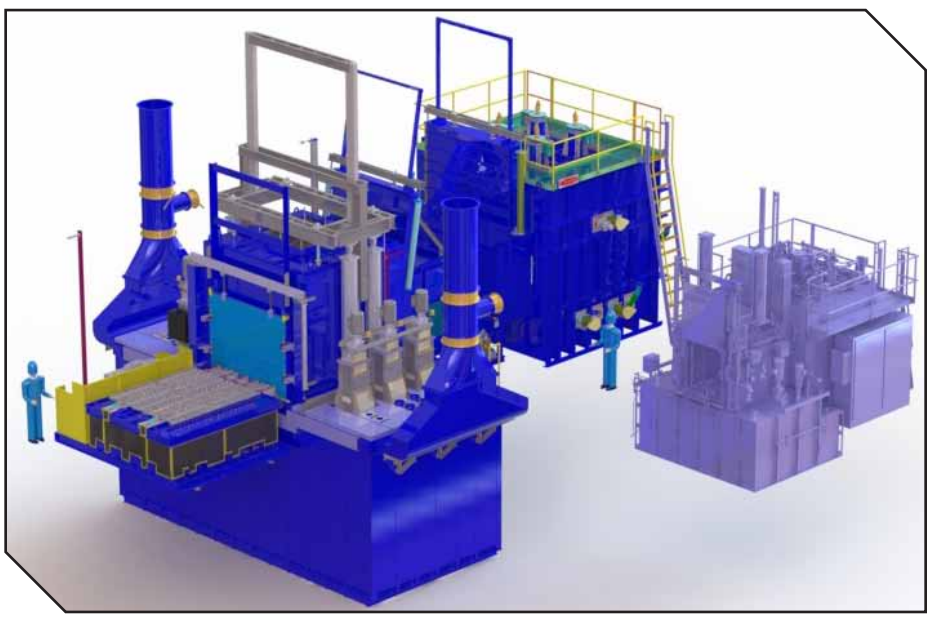
ADI offers gear manufacturers an opportunity to gain the manufacturing ease of ductile iron with properties comparable to some of the common steel gear heat treatments at a low product cost. "Austempered and carbo-austempered steel provide high performance solutions for applications where tooth breakage is an issue and redesign is no longer an option. The low levels of distortion attributed to austempering can help eliminate secondary machining processes, press quenches, and distortion issues," Lefevre says.

According to Lefevre, several of the most significant advances in heat treating today have been in the refinement of induction hardening methods and practices, shortening of the carburizing cycles, vacuum carburizing and quenching, and ion/plasma nitriding. The advances in these areas have led to lower cost and higher performing products with less waste/scrap.

"As the demand for lighter, more efficient power transmission systems grows, the optimization of gear material selection, processing and design will be critical. Tools to optimize gear and gearbox design will be critical in this process and could come in the form of software that optimizes gear design, new materials or advances in heat treatments," Lefevre adds.

"Quality heat treatment requires a capable system that is in control. Software, for example, plays a key role in the control of our austempering cycle development as well as the monitoring and reporting of our furnaces' settings and operating conditions. As technology and refinements of heat treating systems improve, so will the ability to integrate these system, where appropriate, in the manufacturing process. Certain types of heat treating processes lend [themselves] to integration in line with machining; i.e. induction hardening," Lefevre says.

Applied Process collaborates closely with manufacturers on many design projects, and often the most successful austempered parts arise from early engagement between the design engineers and Applied Process. "Growing the pie for austempering is our mission, and generating value through strategic



Applied Process and AFC-Holcroft joined together to produce a Monster Parts Universal Batch Quench-Austemper (UBQA) furnace (courtesy of Applied Process).

partnerships is a key part of this process. We engage in evaluation of the existing material, manufacturing methods, and application stresses of parts with designers. In doing so, often the optimum choice of material and manufacturing method is apparent, which sometimes leads to austempering business," Lefevre says.

Applied Process launched AP Monster Parts Division in 2012 in Oshkosh, Wisconsin with what is believed to be the largest universal batch quench austempering furnace in the world and added two furnaces in the Livonia, Michigan plant. In January 2013, the company hosted AP University for the first time to give customers an opportunity to learn about ductile iron design, foundry practices and austempering in general. "It was so successful that we have already planned another AP University for May of 2013. This, of course, is in addition to the 25-50 onsite presentations that we do for multiple customers every year."

As for overall business, it softened during the last quarter of 2012 but Lefevre expects 2013-2014 to show improvement especially in the larger gears for their new furnace. "We already have several projects underway that involve conversions to austempered ductile iron gears in the heavy industrial market; we cannot say much more than that about the projects. Our efforts in the near future in relation to gears are to focus on conversion opportunities in agriculture, mill gears, and automotive applications," Lefevre says.

Factors that will determine the future success of Applied Process include governmental policies and regulations that impede the growth of the economy, the company's ability to get austempering, specifically ADI (austempered ductile iron), as an accepted heat treatment/material in the gear-making/using community and the ability to produce property data that end users of gears require in order to specify austempering/ADI as a suitable material.

"Natural gas and raw mineral prices impact our cost model; however continuous improvements to our equipment help to mitigate these effects. The long term outlook for natural gas, electricity, and alloy costs are all positive for the heat treating industry. In other words, lower or stable prices will lead to stable prices for our customers," Lefevre adds.

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Aerospace Advantages with Solar

Low-pressure vacuum carburizing (LPVC) and vacuum gas nitriding (VGN) are the two main areas in which Solar serves the gear market. "The advantages include clean, bright parts with limited to no distortion," says Tim Steber, regional sales manager. The company also boasts an R&D department with metallurgist, scientists and engi-

neers on staff for consultation and oversight of work.

Solar's Souderton plant recently received a Nadcap accreditation in carburizing, allowing it to better serve the aerospace market. This accreditation joins Solar's other Nadcap approvals for heat treating, brazing and fluorescent penetrant inspection. Additionally, earlier this year the company became an approved supplier for General Electric Aviation (GEA), UTC Aerospace Systems (UTAS) and Moog Corporation.

Solar Atmospheres is comprised of more than 40 vacuum furnaces backed by NADCAP Accreditations and certified by ISO 9001/AS9100 (courtesy of Solar).

Don Jordan, vice president of R&D/corporate metallurgist, says that growth in the aerospace market has been significant for Solar, particularly with new high alloy grades developed specifically for LPVC including Ferrium C61 and C64, Pyrowear 675 and CSS-42L. "Our company collaborates with all prime rotorcraft (helicopter) aerospace companies and their suppliers," Jordan says.

Jordan believes that the most significant products and technologies in the future will be continued developments and advancements in LPVC and high-pressure gas quenching in vacuum heat treat processing of traditionally oil quenched alloys (e.g. 4140). Laser induction hardening will also play a significant role in multi-functional machining operations.

Trevor Jones, principal engineer at Solar says that software has an increased role in heat treating today. "Process modeling of LPVC parameters (time, temp, hydrocarbon) and the resultant hardness profiles. Process modeling of quench rates and distortion profiles as well," Jones says.

While business is good, hiring skilled workers and the rising costs of raw materials and energy remains a significant challenge. "Vacuum heat treating is not a well-known industry/science in the manufacturing world. Skilled workers have always been difficult to find and retain in our industry and remains true today," Jones says. "Raw material pricing of fixturing, electrical rates and process inert gas prices significantly affects the bottom line."

In order for future success the company will continue to develop surface treatments of materials, add furnace capacity and obtain qualified personnel.

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LIGHT YEARS AHEAD

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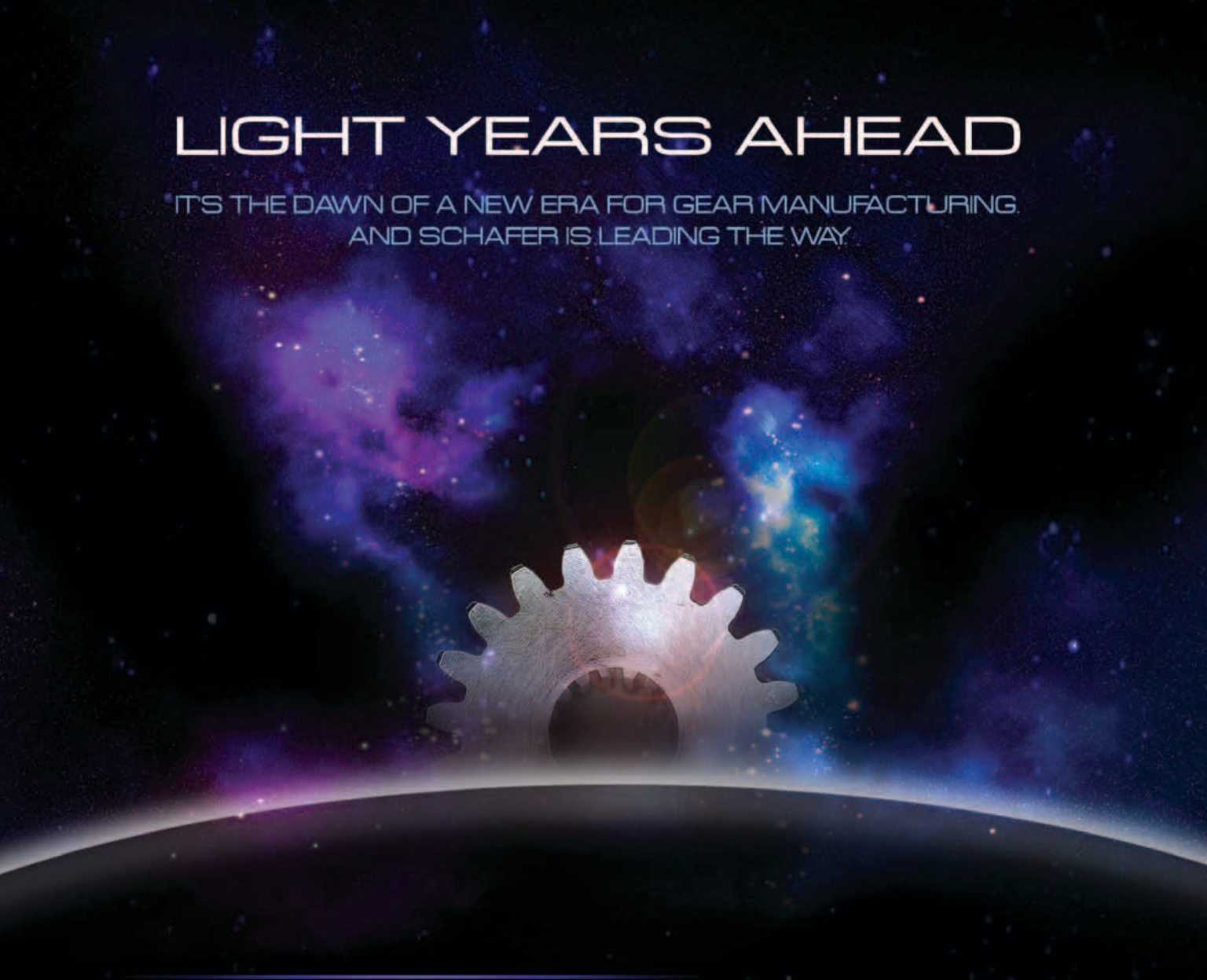

A progressive gear manufacturer understands it needs to go above and beyond traditional expectations. Today's customers demand – and deserve – the latest technology, a wide range of capabilities and an unrelenting commitment to prompt and effective customer service. When it comes to exceeding expectations, Schafer Gear is truly light years ahead. Our investment in the latest production equipment assures that we can provide gears for many industrial applications including transportation, medical, mining, gas and energy, agricultural equipment and many specialty applications. And every gear we make comes with one thing standard – the willingness to go to the ends of the earth to serve our customers well.

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Stack Focuses on Quality and Process Requirements

Stack Metallurgical Services began with a couple of atmosphere furnaces and has evolved into a versatile provider of heat treating services. "Vacuum carburizing provides improved case depth uniformity over the tooth profile," says Nels Plough, president and general manager at Stack Metallurgical Services, Inc. "Root to flank ratios is as much as 90 percent versus 65 percent for conventional gas carburizing. Intergranular oxidation is also eliminated in vacuum carburizing. Fixture and furnace designs offer reduced distortion by providing uniform heat removal from the part."

Much like other heat treat companies, software is becoming a key element to industry requirements. "Computerized control of every aspect of the furnace is critical. Precise, repeatable processing is vital to give our customers the high quality parts their industry requires. In addition, a charting program records all of the important parameters of a run for verification. While the physics of heat treating haven't changed, our ability to precisely and repetitively control the process has been greatly enhanced by software advances," Plough says.

Stack has key customers in the gear industry, according to Plough. "When we work in close contact with them, our ability to meet their specifications is greatly improved. The more each of us know about the requirements and limitations of the products, the more improvements can be made."

Both energy costs and labor are two significant challenges at Stack. "As the economy continues to improve, the energy resources will become more expensive and have a large effect on profitability. Energy costs must be controlled. Renewable energy initiatives are going to drive these costs higher," Plough adds.

Despite these challenges, business continues to grow. "The strength of this business is dependent on the overall economy, but also on our ability to grow and adapt to the increasing quality & processing requirements," Plough says.

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Brad Foote Gearing: In-House Heat Treat

Brad Foote Gearing boasts one of the largest captive heat treatment facilities in North America with a state-of-the-art facility that covers 50,000 square feet and features a computer control room to monitor heat levels, carbon potential and the cycle time of each heat treat load.

"We have added nine pit furnaces with the largest being 88" by 150" deep," says Richard Baker, plant manager at Brad Foote Gear Works. "Along with the furnaces we also added a 35,000 gal oil quench tank, 2-10 ton overhead cranes, a control center with all new SSI furnace controllers for each individual furnace and individual monitors. All of the nine furnaces were completely rebuilt and new recuperating burners were installed in each."

Brad Foote began primarily as an in-house heat treating facility but expanded to commercial work because of the company's well-known capabilities and capacity. "We helped a competitor on a very large part that they couldn't handle in their plant. Because of our quick turnaround, pricing, in-house testing lab and quality, they sent us more work," Baker says.

Commercial work has really taken off, according to Baker, in the last part of 2012 and so far in 2013. "It has been steadily growing because of our capacity we can offer competitive pricing and delivery which has helped us for repeat business and helped out customers by getting them their parts back quickly— depending on the case depth sometimes back within a week or less."

The company specializes in AGMA Grade 3 carburizing of large and small gearing, thru-hardening, normalizing and stress relieving. While Baker won't divulge any secrets to the company's success in this market, he does have an idea why many captive heat treaters fail when they attempt to get commercial work. "The trick is to stay within your capabilities and not overpromise anything. We know gearing and have been carburizing gearing for many years. Our workforce experience averages more than 20 years of heat treat experience."

Brad Foote's captive heat treat facility in Pittsburgh, Pennsylvania is one of the largest in North America (courtesy of Brad Foote Gear Works).

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ALD-Holcroft: In-Line and In-Synch

ALD offers furnace systems for low pressure carburizing (LPC) with high pressure gas quenching (HPGQ) or oil quench. The company offers LPC heat treat services for those gear manufacturers that do not want to heat treat in-house. The biggest advantages of ALD's products and services include, "distortion control, excellent carburizing homogeneity even for components with complex shapes, avoiding intergranular oxidation (IGO) and surface oxidation, shorter cycle times compared to atmospheric carburizing, integrating heat treatment into the production line, no conditioning necessary, clean surfaces of parts after heat treatment and it's an environmentally friendly process that utilizes a small consumption of resources (no disposal of oil, salt bath residues or detergent residues).

Dr. Volker Heuer, ALD-Vacuum Technologies GmbH, believes that better distortion control and the integration of heat treatment into the manufacturing line are two of the most significant developments in heat treating. Additionally, the role of software has increased. "All new processes are developed with help of simulation software," Heuer says. "Process monitoring software is integrated into modern furnaces (quick alerts if quality is in danger) and software will have a key role if fully synchronized manufacturing lines are established (collection of all quality data on one computer)."

The company's introduction of its SynchroTherm is evidence that ALD-Holcroft believes that the in-line, in-synch approach will have significant market appeal. "Our unique approach to high volume processing has become the mainstay in the automotive gear market. The extremely high up-time of our systems in conjunction with an outstanding service network has ultimately been a winning combination," Heuer adds.

The company is having great success in Europe, Mexico, Russia and South Korea and continuing to focus on China, India, Southeast Asia and the United States for the future.

ALD has found its fair share of challenges when it comes to energy pricing and raw materials. "Prices of raw materials have a direct effect on our equipment pricing. Further, our customer base has

All new processes are developed with the help of simulation software according to Dr. Volker Heuer (courtesy of ALD-Vacuum Technologies).

reluctance to improve alloying factors (because of cost) in materials in order to take advantage of higher temperature processing. The math proves the process is worth the extra cost, but quite often legacy parts and processes dictate," Heuer adds.

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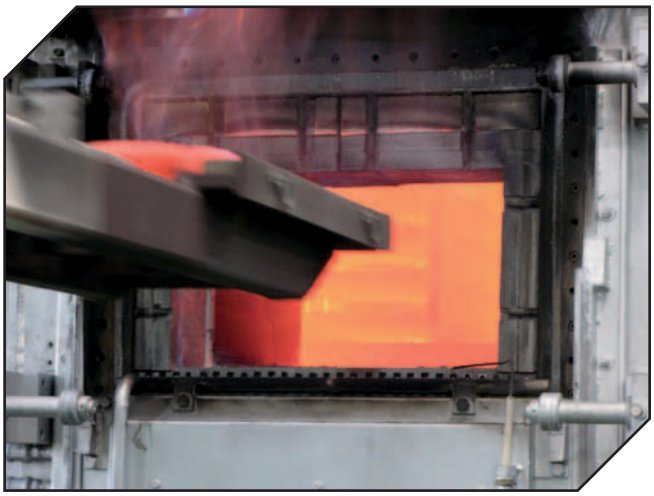
Ipsen: Improving the Customer Experience

Ipsen is known in the industry for its wide range of equipment, advanced technology and strong service and support in Asia, North America and Europe. The company's atmosphere equipment includes pusher, batch and rotary hearth furnaces while its vacuum technology includes single chamber with AvaC + high pressure gas quench to 15 bar, 2 chamber furnace oil quench.

Ipsen's mission is to be a dependable, long-term partner, recognized for the quality of its products and reliability of its commitments. "This means collaborating with our customers to find out what they need and want out of their thermal processing equipment, allowing us to provide the best equipment, which in turn allows them to be successful," says Geoffrey Somary, president and CEO of Ipsen USA.

Aftermarket Support and Service is one of the most important aspects of Ipsen's business. "When you buy heat treat equipment from Ipsen you buy equipment backed by 65-year experience, and we don't stop at delivering new equipment. We are here to help you maintain and care for your equipment in order to help you minimize downtown and keep your equipment running for years to come. Our Engineered Components group helps your equipment stay up-to-date with retrofits and upgrades. We have some furnaces out there that have been running for 60+ years, so it's important to keep these furnaces working for our customers, including new hot zones, upgraded controls, adding capabilities and much more," Somary says.

Today, the company is focusing on improving the customer experience. "With our Titan line of furnaces, we already offer what we call 'The Titan Experience.' This prepares our customers for the arrival of their new furnace as well as guidance and advice throughout the life of the furnace, helping our customers maintain their furnaces better and minimizing downtown. Our goal is to extend that same process and thinking to our full line of furnaces," Somary says.



Machine tools rapidly handle single-piece flow, whereas traditional heat treatment has always been done in batches. This disconnect in the production flow will be driven toward unity over the coming years.

"The challenge, of course, with heat treating is the long cycle times, so the real innovation will come from both process and electro-mechanical improvements. While some solutions exist to heat treat single trays of parts in-line, the process speed has not been sufficiently improved. Ipsen has been working on this very topic in its research and development center for the past two years and we are approaching a unique solution that we expect to bring to market over the next years," Somary adds.

As a worldwide heat treater, Ipsen has seen the various markets fluctuate through the years. "After a period of flatness in Asia, we have seen a decent recovery in the past 3-6 months that looks to be holding and increasing in momentum. The Americas have been going very strong for several years now, driven by low energy costs, aerospace industry growth and a nicely rebounding automotive sector. Europe has been steady with more fluctuation than the other regions, but trending strong over the first half of 2013. We are focusing as a company, not so much on regions and industries, but, instead, on working tirelessly to provide the exact product that fits our customers' needs at a competitive price. This approach wins in all markets," Somary says.

While many in heat treating are challenged to find skilled help, Ipsen has taken a proactive role in recent years. "We know that if we simply stand still and do things the way we've always done them, we will get run over. So in 2012, we decided to start the Ipsen Corporate Academy. This offering helps us to find, attract, train and retain the best talent available. In this three-month program, new recruits participate in a rotational training program that helps them take the knowledge they've learned in school/previous jobs and turn it into experience – what we call books to business. It is our hope that this will allow them to build a strong foundation for success. The Ipsen Corporate Academy benefits not only the new hires, but also the company as a whole. We make better use of everyone's time and resources through this streamlined approach, making this a smart investment. We reinforce our corporate culture by creating an inclusive, welcoming climate all while creating a more cohesive, productive and collaborative team of employees," Somary says.

The future health of the organization will bring growth, challenge and opportunity, according to Somary. "We are committed to what we call *evolutionary* innovation, as well as *revolutionary* innovation. The idea is that we must contribute to the success of our customers in order to achieve success as a company by bridging the gap between our customers' dreams and the technology available to make those dreams reality. This is the concept behind our, 'You dream it, we build it,' philosophy. Our mission also reinforces this idea – Be a dependable, long-term partner, recognized for the quality of our products and reliability of our commitments."

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