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Instrument Business Outlook

Strategic Information for the Analytical & Life Science Instrument Industry

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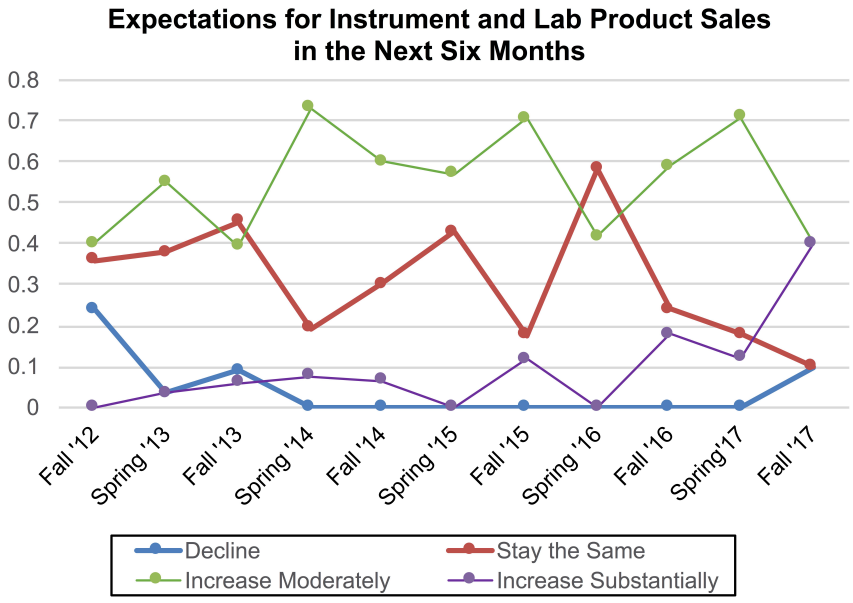
Fall 2017 Business Climate Survey: End-markets Propel Growth

The biannual ***IBO*** Business Climate Survey analyzes insight from executives at instrument and lab product companies regarding future industry and growth prospects and developments. The 2017 fall survey was conducted by email in early October and included ***IBO*** subscribers and solicited Strategic Directions International and

BioInformatics, LLC customers.

In regards to sales expectations over the next half-year period for instruments and lab products, 40% of executives indicated that they expect sales to increase moderately or increase substantially, thus a total of 80% of executives predict sales to increase over the next six months. This is a healthy jump from the spring 2017 Business Climate Survey (see ***IBO 5/15/17***), in which 71% of respondents stated that they expected sales to increase moderately and only 12% forecast sales to increase substantially.



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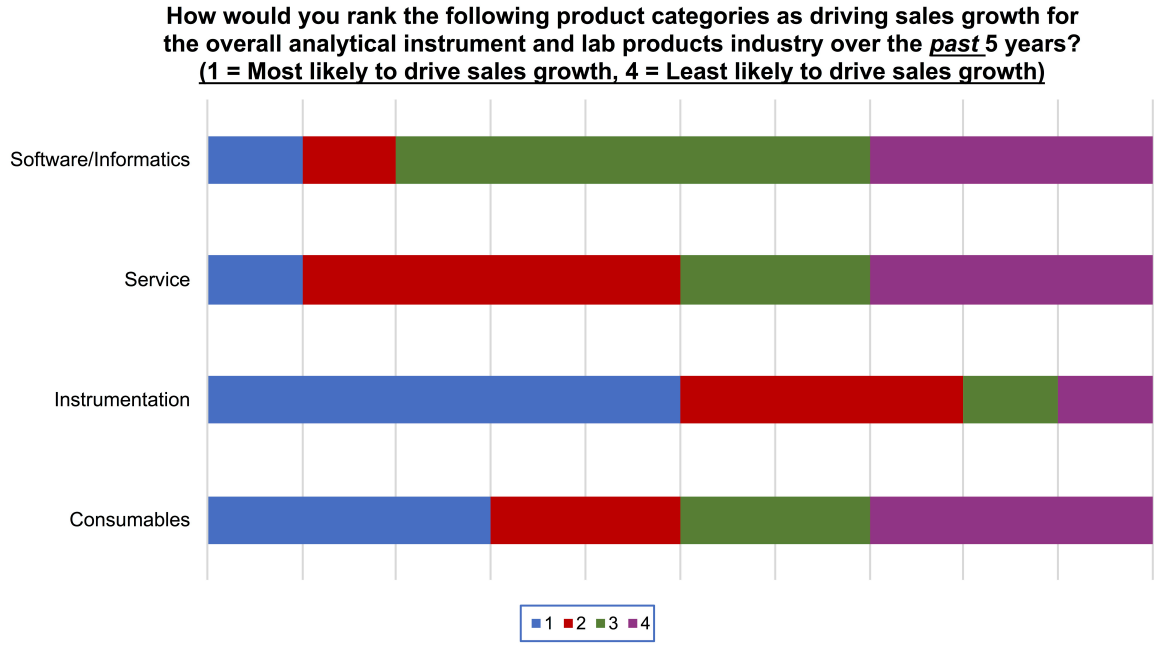
Among 4 types of product categories (see graph below), instrumentation emerged as a clear indicator of sales growth not only over the last 5 years, but it is also expected to most accelerate sales growth over the next 5 years, with 50% of respondents citing it as a major driver of sales. Thirty percent of respondents indicated consumables as most likely to have driven sales over the past 5 years.



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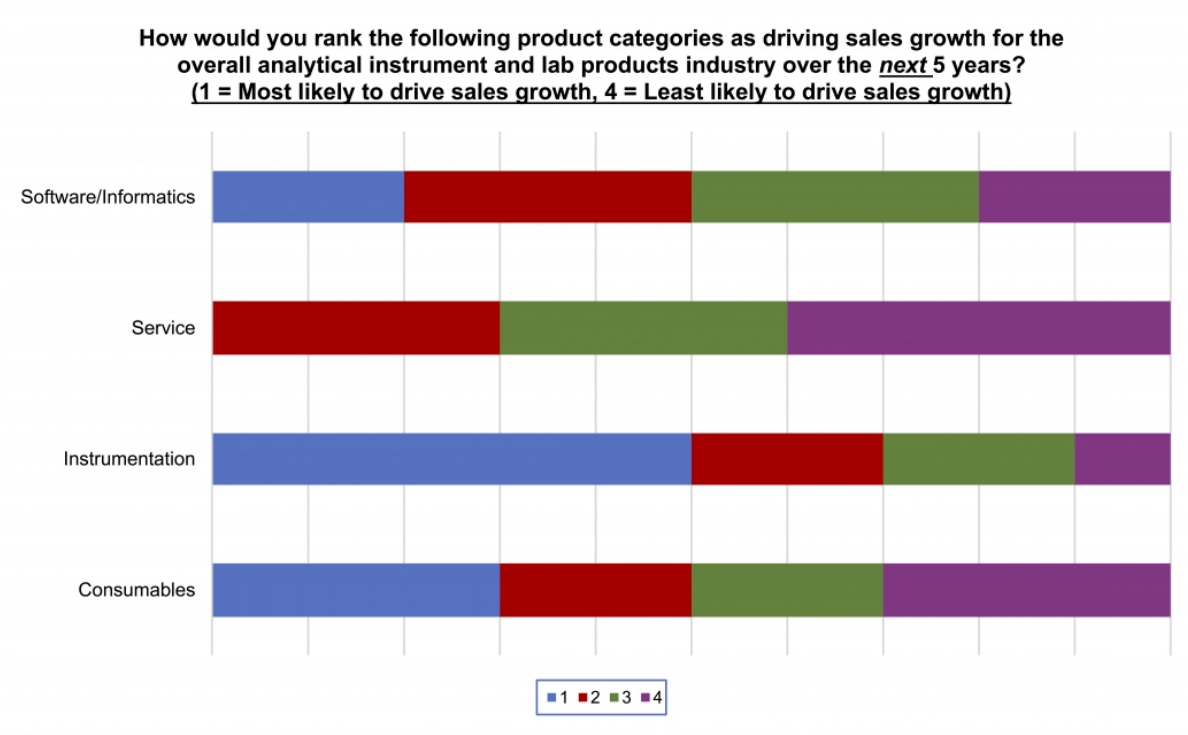
While service was acknowledged by 50% respondents as having most likely or likely to have increased sales in the past 5 years by, fewer respondents expected it to continue driving sales over the next 5-year period, as only 30% of respondents indicated it as likely to drive sales and no respondents indicated it was most likely to drive sales.

For software and informatics, however, a reverse trend emerged, with 10% of respondents indicating it as most likely to have driven sales growth in the past 5 years, and 20% of respondents expecting it to be most likely to drive sales in the next 5 years.



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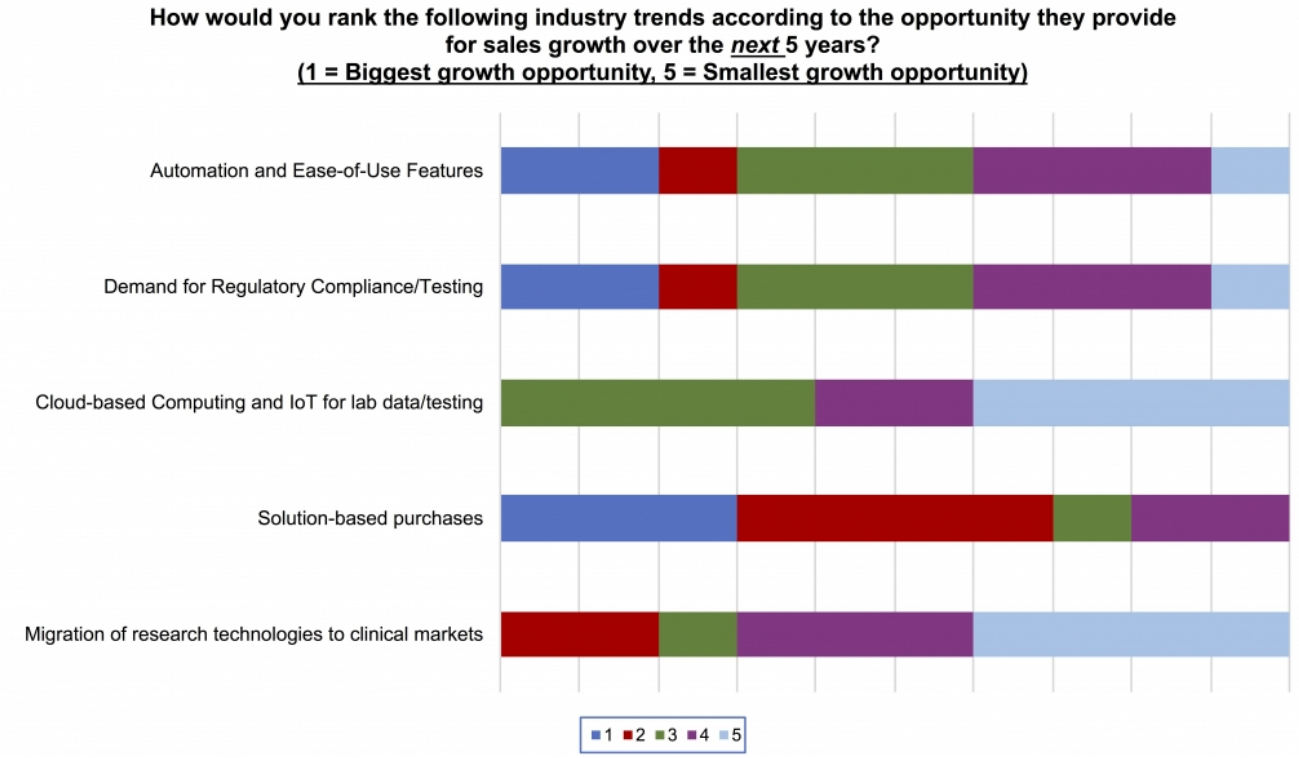
Solution-based purchases (initial sale encompassing integrated instrumentation, software, consumables and service from one vendor and its partners), automation and ease-of-use features, and a higher demand for regulatory compliance and testing emerged as the industry trends with the greatest potential to lead sales growth, with 30%, 20% and 20% of respondents, respectively, ranking them as the most lucrative developments over the next five years.

Cloud-based computing was not seen as the biggest growth opportunity, with 40% of respondents ranking it at a 3, indicating that it is a stable growth opportunity. In contrast, the migration of research technologies to clinical markets is seen as the industry trend least likely to provide the most sales growth, with 40% of respondents ranking it a 5.



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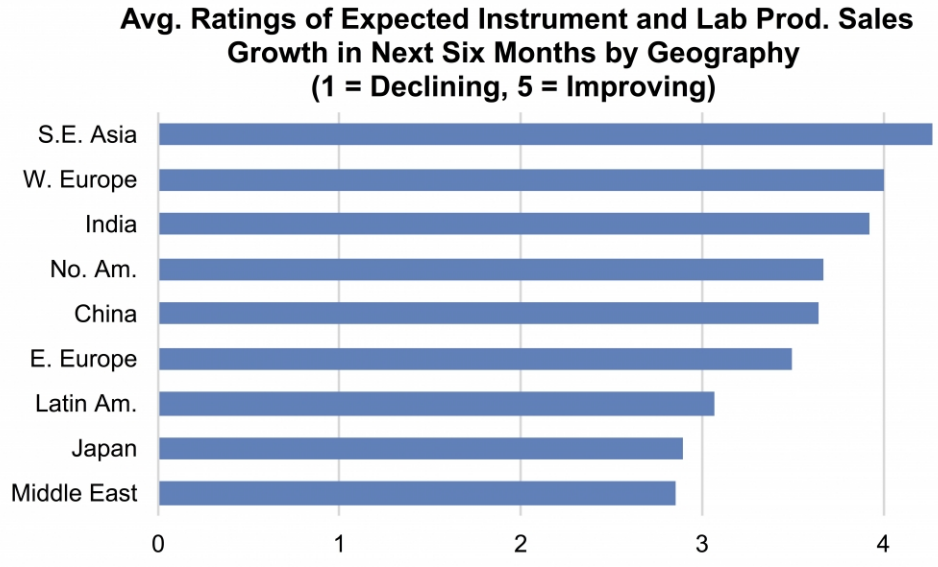
These trends are expected to carry over to the next decade as well, with respondents indicating that solution-based purchases would provide the biggest growth opportunity over the next 10-year period, followed by demand for regulatory compliance and testing.

Respondents were also asked to forecast their companies' sales growth rates for the next 6 months in 8 geographic regions (see graph below) on a scale of 1 to 5, with 1 representing a declining growth rate, 3 representing a stable growth rate and 5 representing an improving growth rate. Southeast Asia emerged as a clear leader in expectations of improving sales growth with a combined average of 4.3. The only regions to receive a combined average score of less than 3 were Japan and the Middle East, both at 2.9, indicating those regions could potentially have declining sales over the next 6 months.



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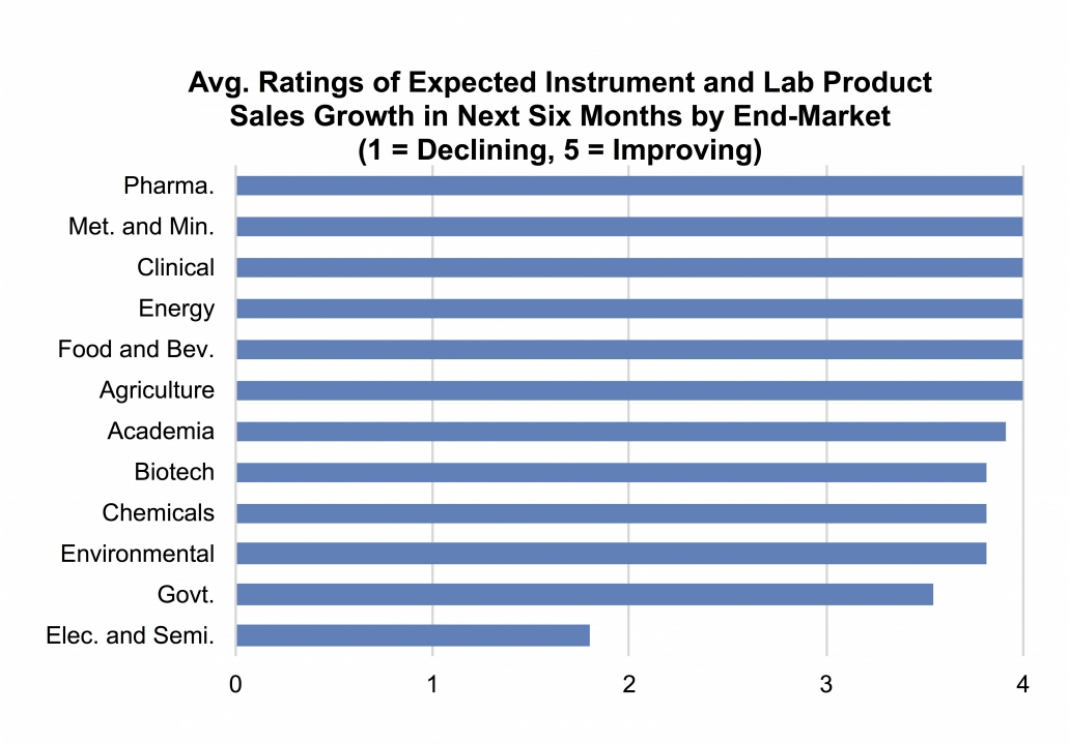
The same rating system was used to determine the respondents' views on sales growth in 12 end-markets (see graph below). Pharmaceuticals was indicated as the prospective end-market with the highest improving sales growth rate, with a combined average of 4.4. Metals and minerals, clinical, energy, food and beverage and agriculture all had combined averages of over 4.0, while biotechnology, the highest ranked end-market in the Spring 2017 survey, fell to a combined average rating of 3.8.



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Academia, chemicals and environmental hovered around a combined average of 3.8, indicating a forecast of stable sales in those end-markets. Electronics and semiconductors was the outlier of the group, receiving a combined average of 1.8, signifying that sales are not expected to improve in this market.

Next Generation Lithium Ion Batteries: Analytical Techniques Pave the Way

Lithium ion batteries (LIBs) are the most popular battery technology in the world today due to their use in consumer electronic devices, electronic vehicles (EVs), and energy-storage systems. Although new types of batteries under development, such as flow cell and solid state technologies, promise greater benefits, Li-ion batteries are expected to remain the dominant battery technology in the near future due to EV demand, falling prices, as well as investments in R&D and manufacturing capacity by major suppliers. Goldman Sachs estimates a 21.5% growth rate for the rechargeable lithium battery market this year.

Selected Recent Battery Investment Announcements			
Announcement	**Investment Amount**	**Location**	**Data Announced**
Talks to form a public-private European battery consortium	$2.6 billion	EU	October 2017
Plans for new LG Chem EV battery factory	$1.63 billion	Poland	October 2017
Plans for new Daimler-BAIC battery plant	$740 million	China	July 2017
Plans for new BASF plant for cathode materials	$440 million	Europe	June 2017
New Investments by Johnson Matthey in battery-material technology starting in 2018	$200 million	NA	September 2017

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The EV market, in particular, is driving demand. Bloomberg New Energy Research (BNER) forecasts EVs to account for 40% of LIB GwH demand by 2020, rising to 58% by 2024. EV demand for LIBs has increased from 19 GwH in 2010 to 123 GwH in 2015 and will hit 408 GwH by 2025. Also growing is demand for LIB use for stationary storage, including the wage by electrical power grid. This market is estimated at 1 GwH installed currently and forecast to reach 81 GwH in 2024, according to BNER.

Continual improvements are required for LIB technology to more effectively meet market demand as well as specific application requirements. Primary issues with the current LIBs include cost, energy density, recharging times, life cycle and safety.

At the heart of LIB R&D is materials characterization, primarily the characterization of electrode materials. New electrode materials are critical to increasing energy density and life cycle, while ensuring safety and lower costs. For cathode materials, advancements have been made via new composite materials based on new formulation and combination of metals such as cobalt, nickel, manganese and iron. The crystal structure of such materials determine the amount of lithium a battery can store and thus its **energy capacity.** Next generation cathode materials under development include nanomaterials and 3D metal oxides, promising the storage of more energy in less space. Advances in anode materials include the addition of graphite. Silicon composites are expected to play a major role in anode materials going forward.

A wide range of analytical techniques are employed to characterize the material structural and chemical composition and changes during battery charging and discharging. Examples include the investigation of particle morphology, composite formation and material defects.

Spectrometry, spectroscopy and microscopy techniques are each used for LIB material characterization. Atomic spectroscopy techniques provide structural analysis as well as determination of elemental composition. Molecular spectroscopy can be used to image structural changes as well as chemical changes. Advanced microscopy techniques provide detailed structural images.

Since LIB R&D remains active and increasingly challenging, demand for analytical instrumentation from the LIB market has been growing. Analytical techniques offered by JEOL for battery research include electron microscopy, Auger electron spectrometry, electron probe microanalysis, x-ray photoelectron spectrometry, XRF spectrometry, NMR and GC/MS.

> ***"The market is driven by the need to develop and improve Li battery electrodes and other materials for faster charging, longer battery life and higher energy-storage density, as well as to understand why batteries fail and what is the chemistry involved."***

As Michael Frey, PhD, Analytical Instruments Product Manager at JEOL, and Natasha Erdman, PhD, Product Manager, told ***IBO***, "We have seen an upward trend in this market space, likely due to increased needs for high-resolution imaging and characterization as drivers for improvements in electrode material developments and manufacturing." Such research addresses the fundamental shortcomings of today's battery materials. "The market is driven by the need to develop and improve Li battery electrodes and other materials for faster charging, longer battery life and higher energy-storage density, as well as to understand why batteries fail and what is the chemistry involved."

Dr. Frey discussed the use of SEM in LIB research. JEOL's SEM offerings include the JSM-7800F FE-SEM with resolution of 0.8 nm at 15 kV and 1.2 nm at 1kV. "From the SEM and sample preparation perspective, we provide the tools that assist in morphological (surface) and compositional characterization of the battery materials without any air exposure." An example is sample transfer devices. "JEOL offers special holders and specimen loading devices that allow seamless transition between a sample preparation device, such as cross-section polisher and an imaging platform (SEM)," he explained. Exposure to the air can create deposits on the sample surface.

Specific features for JEOL's SEMs address the requirements working with LIB materials. As Dr. Frey said, "We offer a specialized specimen preparation device (cross-section polisher) that can prepare air isolated specimens, which is critical for Li battery industry (air exposure alters battery surface via oxidation); JEOL also offers a way to transfer this sample directly into the SEM for observation without any additional air exposure."

Ultra low voltage SEM enables higher-resolution surface imaging and increased contrast, enabling greater examination of pore structure and size. One example of next generation cathode materials are sulfur/carbon composites, whose beneficial features center on porosity, pore volume and surface area. "Ultra-low voltage Electron Microscopy, combined with signal filtering, allows direct imaging and analysis of cathode materials at ultra-high resolution," noted Dr. Frey. "Ultra-low voltage imaging combined with signal filtering in the SEM allows direct imaging and analysis of battery constituents (anode and cathode) with nanometer resolution." Both cathodes and anodes suffer cracking, affecting safety as well as life cycle.

SEM is often used on combination with other techniques to provide elemental composition as well as structure. One example is energy dispersive spectroscopy (EDS). "As a result of JEOL's unique combination of sub-nm resolution SEM for imaging and high probe current for analytical work, we are a leader in low-voltage imaging and simultaneous EDS analysis," explained Dr. Frey. "This allows us to unambiguously pinpoint the location of various constituents within the battery materials, including fluorine." Fluorine containing compounds are among the next-generation polyanionic materials being studied for cathodes.

Likewise JEOL's NNR systems are used in LIB research. NMR provides chemical characterization with high resolution. "NMR is used to understand the changes at a molecular chemistry level that occur during battery charging and discharging cycling and to understand the bulk chemistry of the battery materials," said Dr. Erdman. "NMR has been increasingly used because it is able to reveal the chemistry at the electrode interfaces and in the bulk materials with a level of detail that has been unavailable in the past."

Like JEOL, HORIBA offers multiple techniques for both LIB R&D and manufacturing. "HORIBA has a number of groups and products that are used for lithium ion battery technology. Particle analysis is used to determine size distribution due to the effect of size on charge transfer, and reaction rates. Also, the behavior of the slurries used for the binders is in part determined by the size of the particles in the slurries," explained Dr. Jeff Bodycomb, product manager.

> ***"Since there is a rapid growth in the use of new materials, as well as increased sales of existing materials; it is certainly an area for growth in sales. This is especially true for our particle characterization technologies."***

Examining structural properties and changes also includes in-depth analysis of particles, including particle size distribution. "Since there is a rapid growth in the use of new materials, as well as increased sales of existing materials; it is certainly an area for growth in sales. This is especially true for our particle characterization technologies."

For electrode material chemical and structural characterization, HORIBA offers a wide range of techniques. Among the applications are the examination of material degradation and changes. "Our spectroscopy tools are also used to

probe the battery materials. Raman spectroscopy can be used to monitor changes in crystal structure in both cathode and anode materials." In addition, the company provides atomic spectroscopy techniques. "XRF and ED-XRF are excellent tools for foreign material and impurity analysis. Optical emission spectroscopy can be used to determine composition such as the oxygen deficiency in the cathode."

Use of the techniques extend beyond LIB R&D. "As with most markets, our technologies are used throughout the entire supply chain," noted Dr. Bodycomb. "For the battery electrode materials, as an example, all the way from removing the minerals from the ground to the actual preparation of the electrodes, QA must be performed on the materials."

Many of the same techniques are used throughout the process. "There is still a large amount of research going into battery materials. As each new material is developed, it must be characterized completely prior to being considered as a replacement for existing components," noted Dr. Bodcomb. "For example, with electrode materials, the particle size distribution, surface area, porosimetry and other techniques will come into play. Even as these materials move into actual production, these techniques must be used to perform QA on the production samples."

Like HORIBA, Thermo Fisher Scientific's analytical instrument offerings are also positioned to offer a range of characterization techniques for LIB materials characterization in both R&D and manufacturing. Investigation of materials requires a thorough understanding of physical, chemical and structural behavior and interactions.

Fitz DeSmet, vice president of Marketing, Materials and Structural Analysis, at Thermo Fisher Scientific told ***IBO***, "As lithium ion batteries power more and more items of our everyday life, it is increasingly important to improve their performance by accurately identifying microscopic defects in the final product and thereby improving the manufacturing process." Discussing an example of the use of atomic and imaging techniques, he commented that EDS "complements SEM and TEM analysis by adding elemental and phase mapping to microscopic samples. As lighter elements and energy sensitive samples in materials become critical components, the ability to understand materials with fewer and fewer x-ray events becomes critical."

Analytical imaging techniques meet specific challenges of material investigation, particularly as it relates to charge transport. "We currently see two main use cases for imaging and analysis with our EM solutions. The first is generating improved 3D reconstructions of the battery to better understand the flow of lithium and charge carriers," noted Mr. DeSmet. "This is a combination of micro-CT-based visualization, revealing the internal porosity and other defects of the entire structure of interest, and Plasma FiB-SEM imaging, allowing researchers to generate a field of view in 3D and at nanometer resolution that is representative of the entire sample's transport properties." As with other techniques, these techniques also can detect cracks in the cathode structure. "The second use case is imaging the crystal structure of the cathode active material with the TEM."

Molecular spectroscopy techniques also provide structural information about particle and crystal analysis at a molecular level in addition to the atomic level view of imaging and EM surface analysis. "IR (e.g., Raman and FTIR) spectroscopy is used to characterize the effect on the structure of cathode materials in the process of lithium-ion insertion/extraction, enabling the improvement of the performance of lithium-ion batteries," said Mr. DeSmet.

He added, "Additionally, it is also used for evaluation of crystallinity and morphology of materials, which affects performance. Understanding the SEI [Solid Electrolyte Interphase] layer is an area of significant interest, so that it can be controlled and therefore improve cell performance." Analysis of deeper layers of the material is also provided by XPS. "XPS depth profiling offers a way of chemically characterizing the complex mix that makes up the interphase layer, allowing an identification of the chemistries that comprise the SEI."

> ***"The energy storage market is experiencing high growth, with lithium ion batteries outpacing other technologies. The typical customer used to be academic institutes working in close collaboration with industrial customers but more recently we see an increasing number of industrial customers adapting EM technology in their own R&D labs."***

According to Mr. DeSmet, demand is robust. "The energy storage market is experiencing high growth, with lithium ion batteries outpacing other technologies. The typical customer used to be academic institutes working in close collaboration with industrial customers but more recently we see an increasing number of industrial customers adapting EM technology in their own R&D labs."

Although challenged by new battery technologies, R&D remains a central focus for LIB R&D as a number of hurdles remain. Mr. DeSmet listed these hurdles. “Some of the key challenges developers and manufacturers in the industry face are: (1) minimizing degradation processes to extend battery life; (2) designing methods to achieve longer discharge, extending range of electric vehicles on a single charge; (3) rapid charging of the battery in minutes, and (4) reaction dynamics during normal operation.”

And while many types of analytical techniques are required, automated integration of results is increasingly being realized. As Mr. DeSmet put it, “Our focus going forward is to make it easier for customers to link the data sets from the different tools and length scales together in their labs so that they can ultimately get a better understanding of their sample and make timely decisions about improvements in their manufacturing process.”

Bioprocessing Conference Shows Push for Greater Productivity

The BioProcessing International conference (BPI), held September 4–7 and part of Biotech Week in Boston, Massachusetts, hosted approximately 4,500 attendees, up 50% from last year, as well as 200 exhibitors eager to introduce their products to the attendees working in the production of biotherapeutics. These BPI conferences are held twice a year, on the West Coast in the spring and on the East Coast in the fall. These bioprocess-specific conferences provide an opportunity for attendees to learn new technologies, network and talk to vendors about emerging technologies used in their biomanufacturing environments. This year, exhibitors focused their efforts on three ongoing trends affecting the industry: the emergence of continuous processing, the move towards single-use technologies and the focus on improved process productivity.

Several significant obstacles still exist to implement commercial continuous processing, including the conservative nature of the pharmaceutical industry, and the development of other enabling devices that allow for real-time monitoring and control of the process. Pall has been leading the industry in this regard, and its presence at BPI this year was no different. At the show, Pall introduced the Cadence BioSMB platform, which employs a unique single-use eight column system architecture, enabling a highly flexible flow configuration through the use of a novel single-use valve cassette. There are two flow-range variants available targeted to perfusion for bioreactor-based processes, the Cadence BioSMB Process 80 system, and for batch operations, the Cadence BioSMB Process 350 system.

On these new systems, Pall claims a less than 30 minute manifold installation time and easier infrastructure management using the smaller pre-packed columns. Perhaps one of the most overlooked time saving inventions on the system is the use of a compact disposable valve cassette specially designed and patented as a single-use component. This valve system eliminates the need for a difficult cleaning validation process often seen on competitive systems.

Other vendors demonstrated technologies at BPI supporting the continuous process movement, including at-line or in-line sensors used to monitor the process. Mettler-Toledo, for example, demonstrated an in-line liquid phase dCO^2 sensor, the InPro 5000i, capable of real-time measurements critical for enabling continuous upstream processing. The company also showed the at-line bioburden detector, 7000 RMS, used to control for potential contamination of process waters.

At the show, Thermo Fisher Scientific spoke with customers about the benefit of their February acquisition of Finesse Solutions (see ***IBO*** 2/15/17), and the ability of the system to control bioreactor and mixer systems, collect data and optimize processes. The acquisition allows Thermo Fisher to provide an integrated Smart Factory solution to customers—critical to enabling continuous processing.

Thermo Fisher also continued to introduce customers to their improved scale-up capability in upstream processing, allowing a 5:1 scale up of processes (rather than the traditional 2:1), allowing customers to scale up to a 1,000 L vessel in only three steps. The improved development path allows customers to save on capital expenditures and improves operating efficiency.

Other notable products or processes introduced at the show to improve process productivity included GE

Healthcare's MabSelect PrismaA Protein A column, which is capable of a 40% improvement in mAb purification capacity; MilliporeSigma's Eshmuno P anti-A and anti-B affinity resins used in the purification of Immunoglobulin products; and an update to Sartorius Stedim Biotech's BIOSTAT STR bioreactor product line, to allow for more rapid direct linear scale-up of fermentation processes. Beckman Coulter demonstrated an end-to-end solution for cell line development leveraging their automation in conjunction with Molecular Devices' and Pall's detection technologies.

September 15 Issue: 3M Food Safety and IntegenX

In the September 15, 2017, issue of ***IBO*** (3M Food Safety Invests in Allergen Testing), the technology that 3M Food Safety uses for nucleic amplification was incorrectly identified. The technology is based on LAMP (Loop-Mediated isothermal Amplification), not PCR.

In the same issue (Rapid DNA Testing: New Law, New Users), a quote from Robert Schueren, president and CEO of IntegenX, should have read, "We have thousands of samples in CODIS," instead of "We have hundreds of thousands of samples in CODIS." ***IBO*** regrets the errors.

Brooks Acquires PCR Consumables Firm

Chelmsford, MA 10/5/17—Automation and cryogenic solutions supplier Brooks Automation has purchased 4titude for $65 million in cash. UK-based 4titude manufactures consumables for biological sample materials used in genomics and DNA analytical applications, including PCR plates, and sealing and sequencing tubes. The company recorded $14 million in revenues over the last 12 months, with 20% growth per year over the last two years. 4titude supplies PCR plates to over 1,200 customers. "4titude is a natural addition to Brooks Life Science offerings," stated Brooks Life Sciences President Dusty Tenney. "As our services have expanded into supporting the genomic analysis process for many of our storage customers, we now have a premier consumables offering that gives our customers the sample quality and integrity they require in this high-growth application space." Brooks Automation expects the acquisition to be accretive to its non-GAAP earnings within a quarter of closing. In connection with the acquisition, Brooks announced a loan agreement that immediately adds $200 million to the company's balance sheet.

Adding PCR products will be a new product line for Brooks Automation. Mr. Tenney told **IBO**, *"Brooks provides a full range of biological sample tubes, primarily used for storage and related sample management automation. 4titude is widely recognized for its innovative range of PCR plates, seals and related benchtop instrumentation." Discussing the product integration, he said, "The integration of sample storage consumables for biobanking applications and PCR has synergies beyond the obvious advantages of maximizing space in mechanical storage units, optimally protecting sample from the outside environment and facilitating automation friendly sample management.*

Mr. Tenney added, "The potential for complete integration into the analytical paths for qPCR, dPCR, microarray and NGS creates a complete sample chain of custody through sample preparation, analytical processes, genomic analysis, scientific services and related storage solutions that is unique in the markets we serve."

4titude has 85 employees, according to Mr. Tenney. Regarding 4titude's current management and brand, he stated, "The current management team has transitioned to Brooks in senior leadership positions; Brooks will continue to use the 4titude brand given its unique market relevance."

NanoString to Miss Third Quarter Forecast

Seattle, WA 10/11/17—NanoString Technologies, which provides translational research and molecular diagnostic products, has announced preliminary revenues for the third quarter. Total revenues are now forecast to be

$25.9–$26.9 million. The company expects $16.9 million in product and service revenue, compared to its previous guidance of $19.5–$21.5 million. “We are in the process of transforming our business, by strengthening our commercial channel to drive growth on an increasing scale, while setting the stage for the launch of multiple innovative products currently in development,” commented NanoString President and CEO Brad Gray. “While we are disappointed that softness in our instrument and consumable sales drove a shortfall in our product and service revenue in the third quarter, we believe that initiatives underway will strengthen the value proposition of our products and enhance the growth of the business over time.” Final quarterly results will be released on November 2.

Based on third quarter figures from a year ago, the new guidance would indicate an 8.4%–12.6% increase in total revenues. Compared to product and service sales of $19.2 million in the same period a year ago, the revised guidance would indicate a decline in such sales, suggesting strength in collaboration revenue.

Meridian Bioscience Names New CEO

Cincinnati, OH 10/10/17—Meridian Bioscience, a provider of life science products, has named John (Jack) P. Kenney as CEO and a Board member, effective October 9. Most recently, he held the position of senior vice president/general manager, North America, at Siemens Healthcare. Mr. Kenney replaces Chairman and CEO John (Jack) A. Kraeutler, who will become executive chairman. “The Company’s reputation in the marketplace is strong. Meridian has a strong product portfolio, a solid infrastructure, a sound financial position and an exceptional team of employees,” commented Mr. Kenney. “I see opportunities to develop the business based upon both current and new products.”

*Mr. Kraeutler’s retirement as CEO was announced in May (see **IBO** 5/15/17). He had served as CEO since 2008. Publicly held Meridian Bioscience provides research and diagnostic kits, reagents, biologics and components. For the nine-month period ending June 30, company revenues rose 1.3% to $151.1 million. Diagnostics (molecular tests that operate on the illumigene platform and non-molecular tests for multiple platforms) and Life Science (molecular and immunoassay components) sales represented 71% and 29%, of revenues, respectively.*

LGC to Divest Forensics Testing Business

Teddington, UK 10/12/17; Luxembourg 10/12/17—Life science and laboratory supplier LGC has agreed to sell its Forensics and Security division to lab testing firm Eurofins for an undisclosed amount. With €45 million ($49 million at €0.91 = $1) in revenue and 650 employees, the division provides forensic science services. “We are proud to have played a crucial role in the UK forensics landscape in the last two decades. During that time, LGC has invested significantly in improving the efficiency and effectiveness of delivering forensic evidence, with a very strong focus on quality and innovation,” said LGC CEO Tim Robinson. “I am confident that the business is set for a successful and exciting future under the global reach and scientific expertise of Eurofins.” The transaction is expected to close within the next few weeks.

LGC has invested in building its lab standards and genomics testing products portfolio in recent years with a series of acquisitions. This disposal may indicate a further shift toward lab products versus services. The company’s current divisions are Health & Pharma Solutions, Health Science and Innovation; Genomics; and LGC Standards.

Second Quarter Results: Abcam, Bio-Rad, Biotage, HORIBA and Tecan

CY Q2 2017 Results								
	Revenues			Rev. Growth Summary			Adj. Operating Profit	
Company	Rev. ($M)	% of Co. Rev.	Growth	Curr.	Acq./Div.	Org. Growth	($M)	% Growth
Abcam	£217.1	100%	26.5%	0%	0%	9.9%	£64.5	20.3%
Bio-Rad Laboratories (Life Science)	$179.4	36%	-0.3%	-0.6%	0%	0.3%	-$23.0	NM
Biotage	SEK 196.3	100%	20.5%	0%	0%	16%	SEK 37.2	53.7%
HORIBA (P&E, SI)	¥9,552.0	23%	0.7%	-1%	0%	2%	-¥232.0	NM
Tecan (Life Sciences)	CHF 253.3	100%	7.7%	3%	1%	3.4%	CHF 29.6	6.5%

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Fiscal Year Revenues Soar for Abcam

Abcam revenues for the fiscal year ending June 30 amounted to £217.1 million ($287.0 million at £0.76 = $1), advancing 26.5% on a reported basis and 9.9% on a currency neutral basis. Full-year currency neutral revenue growth matched expectations, meeting the company's projected guidance of 9%–11%. Operating profit grew 14.3% to £51.9 million ($68.6 million), while its operating margin fell 2.6 percentage points to 23.9%.

Abcam FY17			
	Rev. (M)	% Rev. Growth	% of Rev.
Catalogue Revenue	£202.4	27.4%	93%
Custom Product & Licensing	£14.7	15.2%	7%

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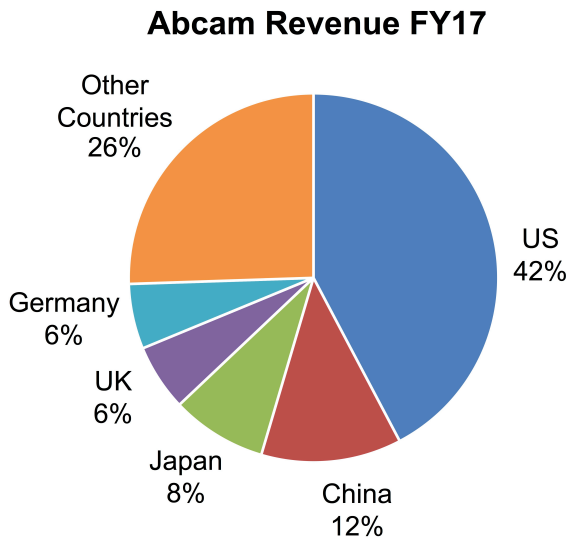
The company's catalogue revenue increased 27.4%, 10.8% on a currency neutral basis, to £202.5 million ($267.7 million), accounting for 93% of total company revenues. Additionally, both primary and non-primary antibodies experienced double-digit revenue growth, advancing 25.9% to £159.8 million ($212.4 million) and 33.0% to £42.7 million ($56.7 million), respectively. On a currency neutral basis, their sales gained 25.2% and 15.6%, respectively.



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Core primary antibody sales increased 20.7% to £118.3 million ($157.2 million), accounting for 74% of total primary antibody revenue. RabMAb primary antibody sales amounted to £41.5 million ($54.9 million), increasing 43.9% and accounted for 26% of total primary antibody revenue. RabMAb primary antibody revenue growth matched company expectations, even with the upgraded guidance of 23%–27% growth from March this year. Non-primary antibody revenue also grew at the expected rate, between 15% and 20%, led by strong sales from the company's kits and assays. In particular, the SimpleStep ELISAs provided robust sales. Overall, kits and assays represented around 60% of total non-primary antibody sales.

Geographically, all regions recorded double digit-growth in revenues, with Japanese sales vaulting 47.4% to £18.1 million ($23.9 million). Sales in China, the company's second largest market, also increased considerably, growing 41.6% to £26.7 million ($35.5 million). US sales advanced 19.5% to £91.8 million ($121.4 million) and accounted for the largest portion of company revenues at 42%. Revenues for the UK and Germany were nearly identical, with the former increasing 12.9% to £12.6 million ($16.7 million) and the latter leaping 33.4% to £12.4 million ($16.4 million). As for the rest of the world, sales grew 28.3% to £55.4 million ($73.2 million).

For fiscal 2018, the company is targeting 20%–25% growth each for its recombinant antibody and immunoassay revenues. The company expects revenue growth for fiscal 2018 to be similar to that of fiscal 2017.

Bio-Rad Revenues Slip for Second Quarter

Second quarter revenue for Bio-Rad Laboratories' Life Science segment (LS) decreased slightly by 0.3% to $179.4 million. On a currency neutral basis, revenue instead increased 0.3%, driven by strong sales of Droplet Digital PCR. Acquisitions further added to sales as recently acquired RainDance Technologies (see ***IBO*** 1/31/17) provided solid growth. However, segment sales were slightly offset by a decline in process chromatography media sales of approximately $8 million, along with unfavorable customer ordering patterns. The segment's gross margin decreased 1.9 percentage points, driven down by lower cell biology, food science and gene expression margins. Overall, Life Science segment revenue accounted for 36% of company sales.

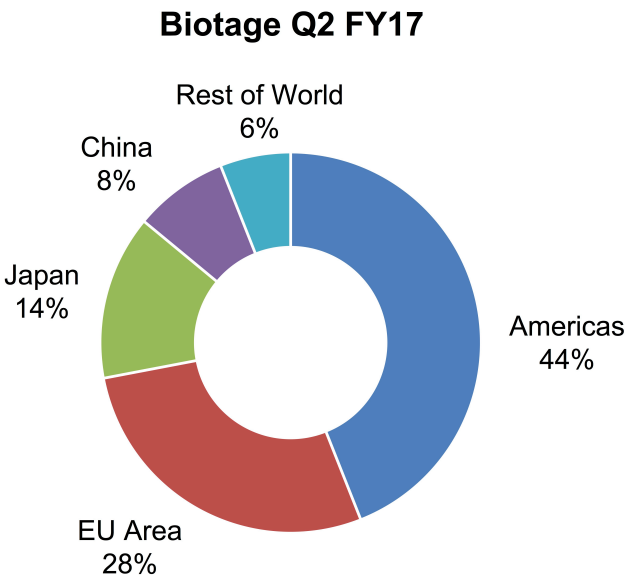
Geographically, only LS sales in North America and the Asia Pacific region, excluding Japan, increased, with China experiencing particularly strong sales growth. Conversely, in both Europe and Latin America, sales declined. ERP deployment in Europe primarily drove sales down for the region, negatively impacting sales by $3–$4 million.

For the full year, Bio-Rad reaffirmed its currency neutral sales growth of 4%. The company believes RainDance could also add up to 1% to sales. However, the company lowered its operating profit growth target to 6%–6.5% from 7%, due to lower-than-expected operating profit in the first half.

Biotage Produces Strong Second Quarter Revenues

Second quarter sales for Biotage advanced 20.5% to SEK 196.3 million ($24.3 million at SEK 8.07 = $1). On a currency neutral basis, sales rose 15.9%, while gross profit increased 7.3% to SEK 121.0 million ($15.0 million). Gross margin for the quarter advanced 4.5 percentage points to 61.7%, and also grew sequentially by 80 basis points. The strong growth in gross margin was largely driven by increased sales volume, along with higher production efficiency. Operating profit increased 53.7% to SEK 37.2 million ($4.6 million), as operating margin grew 4.1 percentage points to 18.95%. Overall, system and aftermarket product sales accounted for 49% and 51% of company revenues, compared to 45% and 55% in the previous year, respectively.

For the quarter, all product areas experienced healthy sales growth. Sales of peptide synthesis, evaporation systems and industrial products were especially strong. System sales for organic synthesis continued to show strength, while industrial products, including systems and consumables, also experienced healthy sales growth.



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Geographically, all regions experienced double-digit sales growth. Asia performed the best, driven by strong sales in South Korea, China and Japan. China's solid sales growth for the quarter was largely driven by systems sales. Direct sales contributed much to South Korea and China's sales growth.

Overall, the Americas accounted for 44% of total company revenues, up 1 percentage point, to become the company's largest market segment. The European region amounted to 28% of company sales, falling 2 percentage points, to account for the company's second largest market segment. Conversely, Japan advanced 2 percentage points to 14% of company sales. China fell 1 percentage point to 8%, while South Korea rose 1 percentage point to 3%.

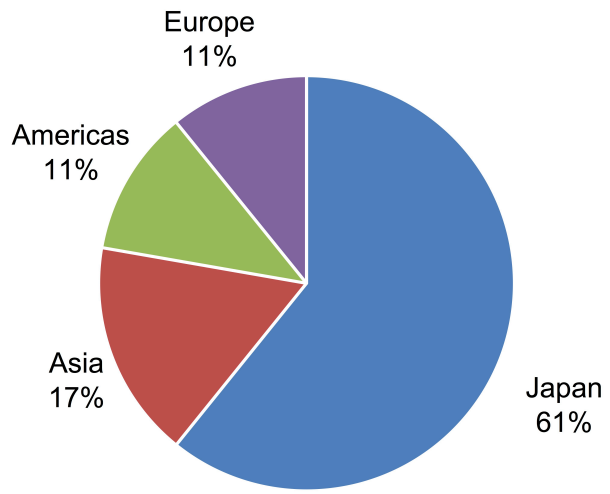
Second Quarter Sales Flat for HORIBA

Second quarter revenue for HORIBA's Process & Environmental Instruments & Systems (P&E) segment grew 6.7% to ¥3,884.0 million ($34.5 million at ¥112.4 = $1), accounting for 9% of total company revenues. The segment's operating income totaled ¥147.0 million ($1.3 million), decreasing 26.5%. As for the first half, segment revenues grew 3.6% to ¥8,079.0 million ($72.2 million), led by increased demand for the company's stack gas analyzers along with increased VOC-regulation related sales in China.

HORIBA Q2 FY17			
	Rev. (M)	% Rev. Growth	% of Rev.
Process & Environmental Instruments & Systems	¥3,884.0	6.7%	9%
Scientific Instruments & Systems	¥5,668.0	-3.0%	14%

Click to enlarge

For HORIBA's P&E segment, Japan accounted for the segment's largest market at 61%. Japanese sales rose 9.6% for the first half, reaching ¥4,910.0 million ($43.9 million). As for the rest of Asia, sales jumped 41.9% to ¥1,370.0 million ($12.2 million), led by China's strong performance. Sales in the Americas, however, fell 37.2% to ¥923.0 million ($8.21 million), accounting for 11% of total segment revenues. European sales decreased slightly by 1.0% to ¥874.0 million ($7.8 million), also accounting for 11% of segment sales.



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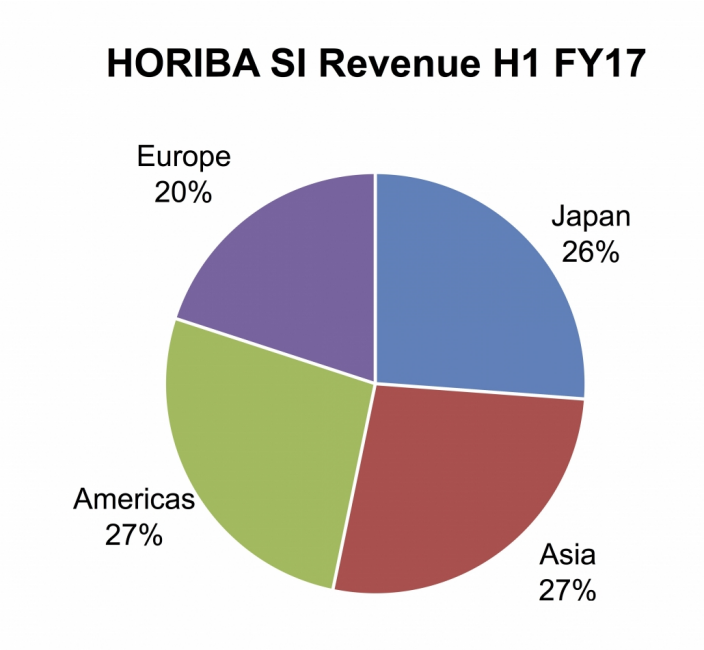
HORIBA's Scientific Instruments & Systems (SI) revenue fell 3.0% to ¥5,668.0 ($50.7 million), amounting to 14% of total company sales. The segment's operating income fell into negative territory, from last year's profit of ¥57.0 million ($0.5 million), to -¥379.0 million (-$3.4 million). First-half results followed the same trend, as segment revenue fell 6.9% to ¥11,513.0 million ($102.9 million), along with operating profit, which declined to -¥440.0 million (-$3.9 million). The segment's sluggish performance was primarily due to poor sales to universities in Japan, US and Europe.

As for HORIBA's SI segment, Americas and Asia were the two largest markets for the first half, each accounting for 27% of segment sales. However, sales growth between the two regions differed, as sales rose 4.3% and 1.2%, respectively. Each managed to reach sales of approximately ¥3.1 billion ($27.6 million). Japanese sales came in at ¥3.0 billion ($26.7 million).



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For the full year, HORIBA projects P&E sales to be ¥18.0 billion ($160.1 million), unchanged from the previous guidance. Similarly, the SI sales forecast remained unchanged with an expected total of ¥25.0 billion ($222.4 million). The same follows for P&E and SI operating profit, for which projections remain unchanged at ¥1.1 billion ($9.8 million) and ¥0.5 billion ($4.5 million), respectively.

Life Science Division Lift Tecan Second Quarter Sales

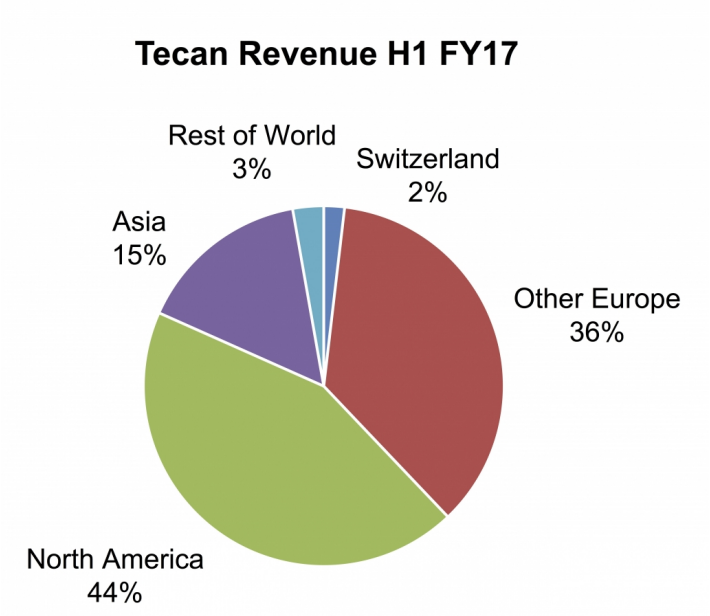
For the first half of 2017, revenues for Tecan increased 7.7%, 3.4% organically, to CHF 253.3 million ($259.74 at CHF 0.98 = $1). Order entries also grew notably, jumping 16.2%, 12.5% organically, to reach CHF 291.2 million ($299 million), exceeding sales. The company's operating profit grew 6.6% to CHF 29.6 million ($30.4 million), lowering operating margin by 13 basis points to 11.7%.

Life Science sales advanced 17.4% to CHF 138.2 million ($141.9 million) for the first half. Organically, segment sales increased 9.5%, primarily driven by strong instrument platform and consumables sales. The segment's operating profit vaulted 46.5% to CHF 17.8 million ($18.3 million) mainly from the large sales increase, along with higher efficiency gains. Operating margin improved to 12.4%, a 2.5 percentage point increase.

Tecan H1 FY17			
	Rev. (M)	% Rev. Growth	% of Rev.
Life Science	CHF 138.2	17.4%	55%
Partnering	CHF 115.1	-2.1%	45%

Click to enlarge

Tecan's Partnering segment sales, however, fell 2.1% to CHF 115.1 million ($118.2 million) due to phased-out instrument platforms, which benefited last year's first-half sales. Acquired precision-pump company Pulssar Technologies added a minimal contribution to segment revenue. Organically, revenue fell 2.6%, while operating profit also declined, sliding 9.1% to CHF 19.0 million ($19.5 million). Similarly, the segment's operating margin dipped 1.3 percentage points to 16.4%, driven down by lower sales volume.



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Recurring sales of services and consumables advanced 25.5% to CHF 113.2 million ($116.2 million), driven by strong organic growth and SPEware consumables. For the first-half, recurring sales accounted for 45% of total company sales, a 6 percentage point increase, the company's all-time high. Service sales, which included spare parts, amounted to 23% of total company sales. As for consumables, sales accounted for around 22% of company

sales.

Lab-scale Continous Chromatography Systems

Continuous chromatography, also referred to as Simulated Moving Bed (SMB), Multi-column Continuous Chromatography (MCC) and Periodic Counter Current (PCC) chromatography, is an automated or semi-automated process chromatography technique that involves using multiple (two or more) columns for implementing chromatographic separation and purification in a continuous manner. In contrast to conventional batch chromatography methods, a continuous chromatography approach provides increased productivity in terms of quantity of product purified as well as media requirements, and a higher yield of recovery and purity of the product.

Continuous chromatography systems function on the same fundamental principles of conventional batch chromatography, but differ in terms of design, operation and applications. Hence, SMB instruments are unable implement a separation or purification cycle that cannot be performed using simple column purification, but they can implement it with a higher degree of performance and cost effectiveness. Such systems generally operate at a higher flow rate (100–300 mL/min) and pressure (50–300 bar), and employ large column ID's (Internal Diameter) (20–50 mm).

A typical continuous chromatography system is designed using multiple columns and operated similar to a "carousel" manner, where the columns move against the direction of feed flow, thereby lengthening the stationary phase. Due to the periodic nature of this column movement, it is also dubbed PCC.

The configuration of a system can vary based on the separation requirements and design, and primarily differs in terms of the number of columns utilized. Currently available multi-column chromatography systems employ anywhere between 2 to 16 columns. Generally, 2 loading columns are considered sufficient to achieve an effective continuous chromatography cycle. However, the addition of extra columns marginally improves the chromatography media–capacity utilization, while increasing the complexity of the system configuration in terms of pump requirements, valve arrangements and maintenance.

The unique design of a moving bed usually implemented in such systems provides several advantages, such as reducing the requirements of the amount of separation media, solvent and energy utilized. Consequently, such configurations increase the productivity (grams of product purified per liter of resin per hour) by several fold, reduce operating cost by about 40%–60%, enhance flexibility and standardization for production, allow easy scalability, and lower the equipment footprint. However, it also makes the design more complex and expensive, along with adding higher maintenance requirements.

Due to its productivity attributes, continuous chromatography is popular in the pharmaceutical and biotechnology industries for a wide range of applications. It is most prominently used for the purification and production of recombinant protein products, biologics and mAbs.

The market deman for laboratory-scale continuous chromatography is estimated to grow at a rate of 6.5% over the next five years. This market growth is mainly driven by the increasing popularity of single-use, multi-column purification systems in process development laboratories and high-throughput downstream processing applications in the biotech and pharmaceutical industries. The food and agricultural biotech industries have also been recently adopting continuous chromatography techniques for their separation and purification needs.

GE Healthcare leads the market with its ÄKTA pcc 75 chromatography system, which offers a three column configuration. Pall is another large manufacturer in the continuous processing market thanks to its Cadence series of BioSMB multi-column, benchtop chromatography systems. Among its several system and configuration offerings, the Cadence Acoustic Separator and the Cadence BioSMB PD systems are the most popular. Knauer, LEWA, Novasep and Semba Biosciences are some other significant manufacturers in this market.

Continuous Chromatography at a Glance

Leading Vendors:

- GE Healthcare
- Pall (Danaher)
- Novasep

Largest Markets:

- Pharmaceutical
- Biotech
- Clinical

Instrument Cost:

- $25,000–$65,000

Pharmaceuticals

Last week, the NIH announced the establishment of the Partnership for Accelerating Cancer Therapies (PACT), a public-private partnership with 11 pharmaceutical companies as part of the cancer moonshot program. PACT is a five-year initiative focused on identifying, developing and validating cancer biomarkers to help advance immunotherapy treatments. By creating a database of biomarkers, a standard can be established, allowing companies to be able to compare drugs.

The companies participating in PACT are AbbVie, Amgen, Boehringer Ingelheim, Bristol-Myers Squibb, Celgene Corporation, Genentech, Gilead, GlaxoSmithKline, Janssen/Johnson & Johnson, Novartis and Pfizer. Each company will provide $1 million over the five-year period totaling $55 million, and the NIH will contribute $160 million in funding over the timespan.

Source: *STAT*

Energy

Although US oil output may exceed the 1970 record of an average of 9.6 million barrels per day, US oil drilling has started to slow down in general, especially with a rise in companies facing technological, logistical and financial issues. Drilling expenses are increasing due to higher costs for labor and services. Investors are worried that US growth in oil output may peak sooner than later. Recently, the growing production of shale served as a substitute for a dearth of oil supply in the world, but leaders in the oil industry predict that its success is not as limitless as expected.

In September, the US Energy Information Administration (EIA) cut its forecast for US oil production 1.3% to 9.69 million barrels per day, but some oil companies believe that figure is still inflated. The EIA has defended its forecast, citing the Permian basin, an area in Texas and New Mexico, as the “hottest drilling spot in the world,” thus justifying the recent prediction. Although oil prices rose to more than $50 per barrel in September, executives from prominent US oil companies stated that even if prices rise to $60 per barrel, they do not have plans to spend more on drilling.

Source: *The Wall Street Journal*

Food

With the rise of whole genome sequencing over the past five years, higher resolution and more accurate data have been obtained for examining foodborne pathogens and the evolution of a set of isolates, which help health officials in identifying the source of a disease outbreak. In 2012, the GenomeTrakr project was established by the FDA, comprised of state and federal public health labs across the country, for the purposes of uploading the data obtained from sequencing microbial foodborne pathogens in real time. Over the years, the accumulation of data has included information on factors such as the geographic region, source and dates from food, environmental and clinical isolates. The data from GenomeTrakr can also be used to monitor antibiotic resistance genes.

As of August, Salmonella enterica, Listeria monocytogenes, Escherichia coli/Shigella, Campylobacter jejuni, and Vibrio parahaemolyticus are the five foodborne pathogens under surveillance on GenomeTrakr. The Salmonella database is the largest at more than 80,000 sequences; the Vibrio parahaemolyticus collection is the latest collection and contains approximately 1,000 sequences. The FDA uses this data to examine whether a sequence from an isolate that was obtained during a routine FDA inspection and uploaded to GenomeTrakr matches a set of clinical isolate sequences. If so, the Agency begins an inquiry, involving further collections of the original sample to determine whether there is a relationship between illness and processing facilities. If a link is found, the FDA implements regulatory action.

Source: *R&D Magazine*

France

In a draft proposal for the 2018 budget, the budget for the French ministry of higher education, research and innovation increased by over 6% to €8.4 billion ($9.9 billion). Moreover, an additional €2.4 billion ($2.8 billion), part of an economic recovery plan, will be allotted for R&D over the next five years.

As per the draft proposal, the budget for the French National Research Agency will rise 5% to €706 million ($836.7 million). However, as grant funding is extremely competitive at the Agency, this increase may not address the 12% grant application success rate. Basic research agency CNRS and biomedical agency INSERM are both expected to receive a 1% increase to their budgets to €5.94 billion ($7.0 billion), with portions of the budget going towards attracting international climate scientists to France as part of President Emmanual Macron's Make Our Planet Great Again campaign.

Source: *Nature*

Puerto Rico

Hurricane Maria has devastated Puerto Rico, and the fate of the region's robust pharmaceutical manufacturing industry is up in the air. Pharmaceutical manufacturing was the territory's largest export last year, representing 72% of its total exports. Over $57 billion in pharmaceuticals were sold internationally by the US in 2016, with Puerto Rico serving as the chief exporter, comprising over a quarter of that figure. More than 50 pharmaceutical facilities that manufacture many of the top-selling drugs in the world are registered in Puerto Rico.

Due to the damage caused by Hurricane Maria, it is unclear if and when the region's pharmaceutical manufacturing will resume operations. The major concern for the industry is less the lack of power supply on the island, and more the devastation that the people who work at the facilities are facing. The residents are focused on basic needs, such as acquiring food and water for themselves and their families, and it is unknown when they will be able to re-staff the drug facilities. In the meantime, pharmaceutical companies such as Pfizer, AbbVie and Johnson & Johnson have supplies of finished products, and do not predict any patient impact in the near future.

Source: *Chemistry World*

China

Investments in Chinese biotech firms listed on global markets are on the upswing. Zai Lab and WuXi Biologics have raised $172 million and $586 million last week and since June, respectively, leading to Zai Lab increasing 54% on the Nasdaq and WuXi Biologics jumping 84% in Hong Kong. The latest Chinese companies planning to go public include Xynomic Pharmaceuticals and Ascentage Pharma Group, both companies specializing in cancer therapeutics. The growth of investments in Chinese biotech firms can be largely attributed to the lack of US biotech IPOs over the past few years.

Although clinical-stage biotech companies do not have actual product revenues, the rise in investments points to the steep valuation of biotech firms and the confidence of investors in the potential of these companies. For example, Zai Lab has no sales, yet it has a $1.4 billion market capitalization. Similarly, WuXi Biologics had revenues of $181 million in 2016, yet trades at 114 times its 2017 predicted earnings. In the third quarter of 2017, only four biotech IPOs have been priced, with Zai Lab being the largest.

Source: *Bloomberg*

Sequencing

Company Announcements

In September, **Thermo Fisher Scientific** signed an agreement with the **Institute of Pathology Heidelberg** to establish the **Center of Molecular Pathology at Heidelberg University Hospital** as the newest member of its Next Generation Sequencing Companion Dx Center of Excellence Program (see ***IBO*** 8/31/17).

Paragon Genomics, the provider of CleanPlex NGS library preparation technology, closed an oversubscribed Series A funding round in September. The round was led by **Cowin Venture Capital** and **Fosun Industrial**.

Fabric Genomics partnered with **Genome Medical**, a genomics medical practice, in September with the goal of bringing expert medical interpretation and counseling around genomic data directly to physicians and patients.

In September, **Advanced Analytical Technologies** partnered with **Illumina** to support collaborations and co-marketing activities for quality assessment of nucleic acids in Illumina's NGS workflows.

SOPHiA GENETICS closed a $30 million Series D funding round, led by **Balderton Capital**, in September. The company's SOPHiA Artificial Intelligence platform analyzes and detects all types of genomic variants. SOPHiA is used daily by 334 hospitals.

Edico Genome announced in September the commercial deployment of its DRAGEN-Bio-IT Platform on **Amazon** Web Services Marketplace.

Also in September, **Edico Genome** announced the availability of the DRAGEN-Bio-IT Platform on **Illumina**'s BaseSpace Sequence Hub. It will launch several additional pipelines on Hub later this year.

In September, **PerkinElmer** announced a collaboration with **In-Depth Genomics** (IDG) to support IDG's Whole Genome Sequencing Diagnostic Program for neurology patients by providing sequencing, interpretation services and diagnostic report generation. The Program will be offered to US physicians at no cost to the patient. The plan is to sequence one hundred thousand genomes of patients who suffer from rare and undiagnosed conditions.

1CellBiO signed a reseller and license agreement with **Hangzhou Chengyuan Genomics** in September. 1CellBiO sells the inDrop instrument for high-resolution single-cell RNA sequencing, as well as kits and consumables.

In October, **Swift Biosciences** announced the opening of a new office in the San Francisco Bay Area. The company

also opened a new, expanded headquarters in Michigan, which doubles its R&D and manufacturing space.

QIAGEN announced in October a collaboration and comarketing agreement with **CENTOGENE**, which provides genetic diagnostics for rare diseases. The companies will integrate their respective bioinformatics offerings and CentoMD rare disease variant database. QIAGEN will exclusively distribute the database.

In October, **Pacific Biosciences** announced the integration of its de novo assembly pipeline on to the **Bluebee** genomics analysis platform, providing fully automated, end-to-end data analysis solution.

Oxford Nanopore announced in October plans to open an office in Shanghai, China, this year. The company's current presence in the country includes customers such as **GrandOmics**, **CookGene** and **Simcere Diagnostics**.

Product Introductions

Dolomite Bio introduced in September the DroNc-Seq[1] chip for high-throughput single-nucleus RNA-Seq using droplet microfluidics. It is compatible with the company's Single Cell RNA-Seq System.

In September, **PerkinElmer** expanded its Whole Genome Sequencing (WGS) services to families that preserve their cord blood and cord tissue with **ViaCord**. The WGS test examines disease-related genes and provides diagnostic findings contributing to pediatric onset diseases, as well as reporting pharmacogenetic variants used to optimize certain drug selections.

BC Platforms released in September the BC|Request platform for browsing and analytics of genomic and clinical data that has been aggregated across biobanks. The platform streamlines collaboration between biobanks and the pharmaceutical industry. Data is indexed and accessed through the **Microsoft** Azure cloud platform. **BC|Request** will be used by members of the **Open Biobank Research Enhancement Alliance**, formed by BC Platforms.

PierianDx announced in September that its Clinical Genomicist Workspace now supports clinical microarray technology.

In September, **Horizon Discovery** released the OncoSpan novel cell line–derived multiplex DNA Reference Standard, which supports the validation of NGS assays. It features 386 variants across 152 key cancer genes. The company is also offering an online companion NGS QC solution, OncoMatic, developed in partnership with **Euformatics**.

Lexogen introduced in September the SLAMseq (thiol (SH)-Linked Alkylation for the Metabolic Sequencing of RNA) product family for high-throughput metabolic sequencing of RNA. SLAMseq can differentiate between nascent RNA and existing RNA, allowing for parallel quantification of total and newly synthesized RNA levels without the need for biochemical isolation. Sampling at different time points reveals the complete in vivo and transcriptome-wide kinetics of RNA synthesis and degradation.

In October, **NuGEN Technologies** debuted a new line of indexing solutions designed to take full advantage of **Illumina**'s new NovaSeq system. The three enhancements include 96 unique dual index pairs to address index hopping, the incorporation of molecular tags to accurately measure PCR duplication levels and a new Metaplex Module designed to scale multiplexing to thousands of samples per flow cell.

Illumina launched in October Nextera DNA Flex for whole-genome sequencing library preparation. Using On-Bead Tagmentation, the workflow eliminates the need for mechanical fragmentation of DNA, as well as quantification and normalization, with a total library preparation turnaround time of less than three hours. The technique enables direct input of blood and saliva samples, and supports 1–500 ng input from multiple types of genomes.

In October, **DNAnexus** unveiled the DNAnexus CloudSeq solution, designed to support the informatics infrastructure needs of the **Illumina** NovaSeq Series of Sequencing Systems. It features a fixed pricing model.

In October, **iGenomX** released the low-cost, scalable Riptide High-Throughput Rapid Library Prep solution, which enables users to create up to 960 high-quality NGS libraries faster. It is intended for use on small genomes and synthetic DNA constructs.

PierianDx introduced in October a complete technology and medical interpretation solution to support **Illumina**'s TruSight Tumor 170 (TST170).

In October, **10x Genomics** announced an automation solution for whole-genome and exome sequencing developed in collaboration with **PerkinElmer**. The workflow allows Linked-Read sequencing to be performed on saliva as well as dried blood spot. The solution includes PerkinElmer's chemagic nucleic acid extraction technology and Sciclone automation platform, and 10x's Chromium Genome and Exome Solutions.

Swift Biosciences introduced the Accel-Amplicon Custom NGS Panels, a targeted DNA sequencing product that enables clinical researchers to rapidly design highly focused panels to discover, validate and screen disease genes and their variants. The Panels require only 10 ng sample input and offer a library prep workflow time of under 2 hours. They are supported on Ion Torrent or Illumina platforms. The offering is the result of a collaboration with software firm **Genialis**.

Orders/Sales of Note

In September, **Congenica** announced a customer partnership with **Coimbra Paediatric Hospital** in Portugal for analysis of whole-exome sequencing data and the production of diagnostic reports for the **In2Genome** national project.

10x Genomics announced in September that the **Genome 10K Consortium** selected its Chromium de novo Assembly Solution and consumables reagents to sequence the next phase of the initiative at **The Vertebrate Genome Lab (VGP)** at **Rockefeller University**. The VGP aims to create reference quality genome assemblies of 260 species representing all vertebrate orders. The Consortium also plans to use 10x's Single Cell 3' Solution to study neuronal cell-type diversity.

In October, **10x Genomics** announced the use of its Chromium Exome Solution as part of the **Faroe Genome Project**, a population sequencing project of the Faroe Island Native people.

In September, **QIAGEN Biotechnology Malaysia** announced the installation of a GeneReader NGS System at digital health care solutions firm **Pathomics Health**, the first installation of the System in Malaysia.

The University of Edinburgh's Edinburgh Genomics facility in Scotland announced in September the use of **Illumina**'s NovaSeq platform. This is the first site in Scotland to deploy the NovaSeq.

In October, **Edico Genome** announced the first deployment in Africa of its first DRAGEN Bio-IT platform at the **Centre for Proteomic and Genomic Research** in South Africa.

SOPHiA GENETICS announced in October that six health care institutions in Mexico have adopted its SOPHiA DDM platform for clinical genomics analysis.

Broad-based Companies

Company Announcements

Hach announced in August the opening of a 90,000 ft^2 (27,432 m^2) expansion of its Loveland, Colorado, campus. The new building houses an advanced R&D work space for development teams, and includes multiple testing and research labs. The Loveland facility currently has 750 full-time employees, with 50 additional off-site employees who will move onto the campus upon completion of the new facility. With the new building, the campus now has more than 300,000 ft^2 (91,440 m^2) of production, office, meeting space and labs.

Scientist.com, a marketplace for outsourced scientific services, launched in August the Innovation Hub, an online repository of life science research tools and services. The collection is available exclusively to registered users of Scientist.com's marketplace. The platform uses a music-app style recommendation system.

In September, **Markes International** announced it will be establishing a new Technology Support Center in Shanghai, China, along with an online portal.

The East Midlands Business Link reported in September that lab product distributor **I&L Biosystems** plans to open an office in Leicester, UK. The company has more than 55 employees.

In September, **PerkinElmer** announced that Andy Wilson, senior vice president and CFO, will retire in August 2018.

Xylem appointed Colin Sabol as senior vice president and president of Sensus & Analytics, effective October 1. He most recently served as senior vice president and president of Xylem's Analytics and Treatment businesses. He replaces Randy Bays, who will move to an advisory role with a focus on Xylem's global manufacturing operations.

In September, **Agilent Technologies** became a platinum sponsor of **LabCentral**, an independent, shared lab space based in Cambridge, Massachusetts. Agilent will provide technology for the space as well as fund a startup biotech company via a contest.

China Daily reported in September that **Thermo Fisher Scientific** has opened a 1,969 ft^2 (600 m^2) customer center in Guangzhou, China, for precision medicine. The company's Chinese presence consists of 21 offices, 6 factories, 5 labs and a center for innovation.

In September, **Anton Paar** announced the donation of 10 instruments worth €600,000 ($659,341) to the Soft Matter Application Lab at Austria's **Technical University of Graz**.

Hitachi High-Technologies announced in September an investment in **MagArray**, a US-based cancer diagnostic testing service.

In September, Canadian firm **Valens GroWorks**, a medical cannabis company, announced a collaboration with **Thermo Fisher Scientific (Mississauga)** to develop a Centre of Excellence in Plant Based Medicine Analytics in Kelowna, Canada.

Metrohm USA opened a West Coast field office in Fountain Valley, California. It will house eight employees.

In September, **Waters** CEO Chris O'Connell inaugurated an 11,483 ft^2 (3,500 m^2) Romanian Software Development Center in Brasov. The Center employs over 160 employees.

Diploma announced in September the retirement of Bruce Thompson as CEO before the end of September 2018.

In September, at its 2017 Capital Markets Day, **Merck KGaA** provided an update on its Life Science business. It announced that around 80% of its legacy Life Sciences business portfolio has been added to Sigma-Aldrich's e-commerce platform in North America and Europe. The company also announced that 11 Life Science production sites and 6 logistic sites have been consolidated

Following its acquisition of medical device firm **C.R. Bard**, **Becton, Dickinson** named two former C.R. Bard members to newly created seats on its Board, C.R. Bard CEO Timothy M. Ring and David F. Melcher, president and CEO of the **Aerospace Industries Association**.

VWR announced in an October **SEC** filing that it does not expect its merger with **Avantor** (see ***IBO*** 5/15/17) to close until the mid- to late fourth quarter, as the European Commission is still reviewing it.

In October, **Merck KGaA** announced the opening of its new Life Science Center in Burlington, Massachusetts. With nearly one thousand employees, the 280,000 ft^2 (85,344 m^2) facility houses a customer service and call center, and an M Lab Collaboration Center. By year end, the company will open the region's first BioReliance End-to-End Biodevelopment Center for small-scale drug manufacturers who will use the lab for their early-phase clinical trials.

Shimadzu Scientific Instruments announced in October a collaboration with biopharmaceutical firm **VpH** to establish the Medical Botanical Center of Excellence, the first fully comprehensive pharmaceutical grade Medical Botanical Testing Platform in Texas. The Center will be positioned to support the **State of Texas Compassionate Use Act** and **Compassionate Use Registry of Texas**.

Product Introductions

In September, **CTC Analytics** introduced the PAL DHR Dual Head sample automation system, featuring two parallel heads that can move independently.

Materials Characterization

Company Announcements

Fluence Analytics (formerly **Advanced Polymer Monitoring**), a manufacturer of industrial and lab systems for polymer and biopharmaceutical applications, announced in May that it raised a Series A funding round, led by **Energy Innovation Capital**.

In August, **Anton Paar** announced an innovation partnership agreement with the **University of Michigan**'s Chemical Engineering Department. Dr. Michael Solomon will use the company's TwinDrive MCR 702 rheometer.

As part of its research partnership program, **Anton Paar** announced in September a collaboration with **University of Colorado Boulder** Professor Christine Hrenya, who will use the company's MCR 502 powder rheometer.

Nanoindentation firm **Nanomechanics** announced in August an exclusive distribution agreement with **Scanwel** for the UK and Ireland.

In September, **MTS Systems** announced that **John Morris Group**, its PCB sensors division, will support the company's entire portfolio of test and sensing solutions in Australia and New Zealand, including MTS Materials Testing Systems products.

Product Introductions

TA Instruments, a **Waters** company, introduced in August the Discovery HP-TGA 750, a high-pressure thermogravimetric analyzer, calling it the first and only benchtop high-pressure TGA available. It enables measurement of reactions with fast kinetics.

In October, **TA Instruments** unveiled the new ElectroForce DMA 3200, which combines fatigue and Dynamic Mechanic Analysis (DMA) technologies into a single mechanical test platform. It features a frictionless ElectroForce motor with 500 N of force, which extends the range of DMA experiments to much larger samples and higher loads.

In September, **Fluid Imaging Technologies** launched the Nano-Flow Imaging Particle Analyzer, calling it the world's only imaging nano particle analyzer. It provides digital images of particles ranging in size from 300 nm to 30 µm using oil immersion technology for enhanced optical resolution. This is the sixth model in the FlowCam product line.

Mettler-Toledo launched in September the new DMA/SDTA 1+, a Dynamic Mechanical Analyzer/Simultaneous Differential Thermal Analysis system. It features an automatic switch mode that controls the measurement and automatically changes from force controlled to displacement controlled. The maximum oscillation frequency value is 1,000 Hz.

In September, **Lloyd Instruments**, an **AMETEK** firm, launched five cost-effective universal testing machines for materials testing up to 100 kN. They are especially suited for metals testing. Features include a 17.8 in (452 mm) wide working area and a crosshead travel of 42.1 in (1,070 mm) that is extendable to 65.7 in (1,669 mm).

In October, **Halo Labs** introduced in Europe the HORIZON low-volume, high-throughput biopharmaceutical particle analysis system. Based on Background Membrane Imaging technology, the system analyzes subvisible and visible particulate matter.

Fluence Analytics unveiled in October the ARGEN protein and polymer stability monitoring product, utilizing

continuous light scattering measurements. The company calls it the only instrument on the market that allows for the simultaneous, stressor-dependent testing of 16 samples.

In October, **Spectro Scientific** launched the MiniLab EL Series oil analysis tool for nondestructive testing of high-performance engines in aircraft, racing cars and railway environments. The systems provide lab quality results in less than 5 minutes using only a 5 mL sample of oil.

Informatics

Company Announcements

ELN company **labfolder** announced its selection to participate in **Merck KGaA**'s Accelerator program. As a result, it will benefit from support, coaching and consulting. The company has 20 employees.

In September, **Kyowa Hakko Kirin** joined **Certara**'s Simcyp Consortium and licensed the Simcyp Population-based Simulator. Kyowa Hakko Kirin is the 36th biopharmaceutical company and 11th Japanese pharmaceutical company to join the Consortium.

Synthace announced in September that it raised $9.6 million in Series A funding. Its Antha language and software platform for biology is designed to make reproducible and scalable workflows that can be readily edited and shared, and easily automated on labs' existing equipment.

In October, **Elsevier** announced the donation of its Unified Data Model (UDM) XML file format to the **Pistoia Alliance**, a nonprofit organization developing standards and best practices for sharing research. The UDM will now be developed and extended under the stewardship of the Pistoia Alliance, with the ultimate aim of publishing an open and freely available format for the storage and exchange of drug discovery data. The inaugural version of the extended UDM will be published in the first quarter of 2018.

Cheminformatics firm **Optibrium** announced in October that it will join the five-year, €40 million ($44 million) **Enhancing Translational Safety Assessment through Integrative Knowledge Management (eTRANSAFE)** project, a European collaboration to improve safety assessment across the drug discovery and development process. The membership consists of 8 academic institutes, 6 small and medium-sized enterprises, and 12 pharmaceutical companies.

Product Introductions

In September, **RowAnalytics** launched Synomics Studio, a multi-SNP association platform for large-scale genome population studies. It identifies and validates sets of genomic, phenotypic and clinical factors that, in specific combinations, are strongly associated with disease risk, disease protective effects and therapy response. It is part of the precision.life product suite.

Genedata debuted in September its Early Access Program to Deep Learning for High Content Screening image analysis, a deep learning technology using convolutional neural networks to automatically analyze microscopy images in high throughput. Benefits include reduced classification time and unbiased image analysis.

In September, **Global Specimen Solutions** released the LabCODE LIMS, featuring pre-built capabilities for biobanking, pharmacokinetics, pharmacogenetics, NGS, flow cytometry, pathology and others. It is fully integrated with the company's GlobalCODE pipeline data management tool.

Benchling unveiled in September its Workflow & Release Management system, a new class of informatics software that organizes, optimizes and measures experimental progress from discovery to bioprocessing for any biologics modality.

In September, **OnRamp Bioinformatics** launched the Rosalind platform, which enables researchers performing

large-scale genomics studies across a range of fields (including drug development, precision medicine and agri-business) to rapidly and dynamically explore and interpret their own data.

Certara introduced Phoenix 8.0 pharmacokinetic, pharmacodynamics and toxicokinetic modeling and simulation software. New features include support of grid computing to reduce model run time and a distributed delay function. The software is currently used by 60,000 researchers.

Orders/Sales of Note

In September, **Genedata** announced the extension of its licensing agreement with **Axxam**, a Partner Research Organization, for its Genedata Screener platform. Axxam has used the platform since 2008.

Reported Financial Results

$US	Period	Ended	Sales	Chg.	Op. Prof.	Chg.	Net Prof.	Chg.
BioLife Solutions	Q2	30-Jun	$2.6	28.5%	($0.3)	78.6%	($0.8)	43.4%
BioLife Solutions	H1	30-Jun	$4.9	28.2%	($0.8)	73.9%	($1.6)	36.5%
Other Currencies (in Millions)								
AddLife	Q2	30-Jun	SEK 572.0	23.0%	SEK 38.0	8.6%	SEK 29.0	11.5%
AddLife	H1	30-Jun	SEK 1,148.0	25.1%	SEK 76.0	28.8%	SEK 58.0	28.9%
Gentinge	Q2	30-Jun	SEK 7,241.0	4.5%	SEK 162.0	-65.8%	SEK 7.0	-96.9%
Gentinge	H1	30-Jun	SEK 13,905.0	4.5%	SEK 702.0	-11.0%	SEK 288.0	-15.8%
Lonza (Pharma & Biotech)	H1	30-Jun	CHF 1,064.0	27.0%	CHF 273.0	71.7%	NA	NA
Precision System Science	Q4	30-Jun	¥1,014.0	-6.0%	(¥ 73.0)	76.3%	(¥ 84.0)	75.1%
Precision System Science	FYE	30-Jun	¥3,847.0	-13.7%	(¥ 440.0)	40.3%	(¥ 428.0)	47.9%
XRF Scientific	FYE	30-Jun	AUD 21.5	1.9%	AUD 1.0	-57.6%	AUD 0.8	-48.4%
XRF Scientific (Capital Equipment)	FYE	30-Jun	AUD 6.3	4.2%	AUD 0.1	-59.1%	NA	NA
XRF Scientific (Precious Metals)	FYE	30-Jun	AUD 9.0	-6.2%	(AUD 0.6)	NM	NA	NA
XRF Scientific (Consumables)	FYE	30-Jun	AUD 6.9	10.0%	AUD 1.7	-5.0%	NA	NA

NA = not available, NM = not meaningful
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