Strategic Directions International, Inc.

Instrument Business Outlook

Strategic Information for the Analytical & Life Science Instrument Industry

Volume 25, Issue 18
December 31, 2016

Health Care R&D Funding to Increase with 21st Century Cures Act

Earlier this month, the US Congress and President Obama passed the 21st Century Cures Act, a law addressing the reformation of certain health care policies, as well as the R&D and approval process for experimental medicines. Initiated by Energy and Commerce Committee Chairman Fred Upton and Representative Diana DeGette in spring 2014, the bill is the culmination of research and analysis regarding the medicinal treatment cycle of discovery, development, and delivery. Over the course of a year, the 21st Century Cures Initiative Committee conferred with health care patients, providers, regulatory agents, researchers and white papers, and conducted eight hearings and over 12 roundtables in representative districts around the nation.

The Act calls for provisions to modernize the current health care system through interoperability, which involves

various health care networks efficiently and securely exchanging information and patient data; improving clinical trials by incorporating more of the patient's feedback into the FDA's drug and device approval process; amending the drug and device approval process itself to include submissions of qualified scientific and medical developments to physicians, insurance companies and researchers to enhance patient care, which will streamline the medicine-approval process; streamlining regulatory procedures for companies developing new vaccines and treatments; and encouraging pharmaceutical companies to utilize modern manufacturing technologies in the US instead of going overseas.

Also included in the Act is $1.8 billion, distributed over the next five years, for new resources for the Cancer Moonshot initiative. In addition, approximately $3 billion has been allocated for biomedical research initiatives, such as the BRAIN (Brain Research through Advancing Innovative Neurotechnologies) and Precision Medicine programs, which received total funding of $1.6 billion and $1.4 billion, respectively, from the 10-year period of FY17 to FY26.

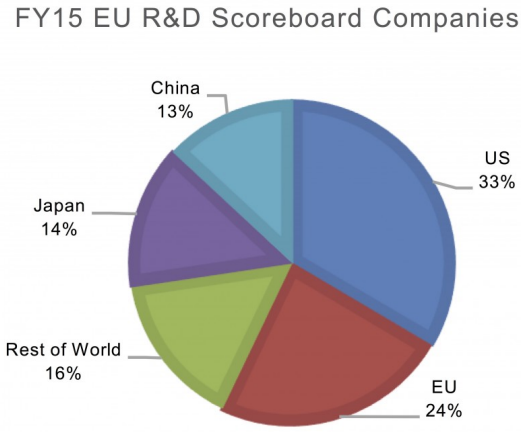
The NIH reauthorization includes $34.8 billion for FY18, $35.6 billion for FY19 and $36.5 billion for FY20. The Intramural Loan Repayment Program, which is designed to repay up to $35,000 of a researcher's education debts, was amended to now pay up to $50,000 of qualified education debts. For the R&D and treatment of neurological diseases, $5 million for each fiscal year from 2018 to 2022 was appropriated, while $15 million was allocated to health care information technology in the form of the Electronic Health Reporting program.

Additionally detailed in the law was the coordination between the NIH and FDA for awarding grants and clinical research contracts to accelerate regenerative medicine using stem cells, including autologous stem cells. The collaborative award was appropriated $30 million, to be distributed equally over the three-year period of FY18–FY20.

Selected 21st Century Cures Act Budget Figures ($M)										
	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26
NIH Innovation Account (Total)	**372**	**526**	**721**	**507**	**424**	**496**	**1,085**	**407**	**107**	**151**
Precision Medicine Initiative	0	114	23	136	78	245	580	180	30	14
BRAIN Initiative	0	124	25	135	83	251	505	227	7	137
Cancer Moonshot	372	278	663	226	263	NA	NA	NA	NA	NA
FDA Innovation Account (Total)	**NA**	**30**	**60**	**60**	**50**	**50**	**50**	**50**	**75**	**75**

EU R&D Scoreboard Indicates R&D Spending Increasing

According to the latest release of the EU's annual "R&D Scoreboard," R&D spending by 2,500 of the world's largest firms grew 6.6% in total to €696.0 billion ($773.3 billion = €0.90 = $1) in fiscal 2015/2016 (based on the company's latest available fiscal year-end report) (FY15). This is close to the previous year's 6.8% increase in R&D spending. In fact, 70% of Scoreboard companies raised R&D spending. Scoreboard companies' spending accounted for an estimated 90% of total R&D spending by businesses worldwide during the year and over 55% of total global R&D spending. Figures include the currency effects of translation of a company's financial results into euros (which depreciated against the US dollar and Japanese Yen in calendar year 2015), as well as the effects of acquisitions and divestitures.



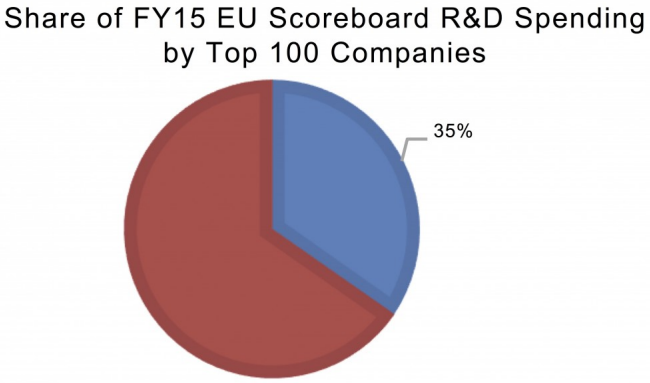
R&D spending increased in FY15 for Scoreboard companies despite a 3.6% decline in revenues to €17,686.8 billion ($19,652.0 billion), compared to a 2.2% increase the year before. Consequently, R&D intensity (R&D expenditures divided by sales) was 3.8% for the latest year. Total operating profits also declined for Scoreboard companies, falling 12.3% to €1,517.7 billion ($1,686.3 billion). Total capital expenditures also fell but were only down 0.8% to €1,127.5 billion ($1,252.8 billion).

Industrial sector	R&D 2015/16 (€M)	R&D 1-year Growth	Avg. CAGR R&D 3 Years	Sales 2015/16 (€M)	Sales 1-year Growth	Avg. CAGR Sales 3 Years	R&D Intensity	Capex 2015/16 (€M)	Capex 1-year Growth	Avg. CAGR Capex 3 Years	Capex Intensity
Alternative Energy (8 Cos.)	653.0	7.2%	38.3%	20,189.6	14.7%	15.2%	3.2%	2,886.6	41.6%	39.7%	14.3%
Automobiles & Parts (156 Cos)	107,831.3	6.7%	12.1%	2,464,931.1	7.9%	10.0%	4.4%	163,974.2	19.2%	9.9%	6.7%
Beverages (9 Cos.)	1,794.7	5.7%	11.2%	130,986.2	-1.3%	2.9%	1.4%	4,315.6	-14.1%	-4.5%	3.3%
Chemicals (126 Cos.)	23,175.2	2.3%	8.2%	1,090,507.8	30.4%	1.7%	2.1%	62,355.2	5.6%	-16.3%	5.7%
Food Producers (57 Cos.)	7,341.9	2.9%	12.0%	526,813.0	3.2%	3.4%	1.4%	17,424.5	1.7%	5.2%	3.3%
Industrial Metals & Mining (38 Cos.)	3,994.0	-0.1%	9.3%	411,943.6	-9.4%	0.5%	1.0%	22,053.6	-5.3%	-3.2%	5.4%
Oil & Gas Producers (27 Cos.)	9,351.0	-14.5%	6.1%	2,144,449.5	-29.9%	22.1%	0.4%	253,070.7	-15.5%	4.5%	11.8%
Pharmaceuticals & Biotech (361 Cos.)	131,309.0	9.9%	33.9%	837,153.0	4.8%	0.2%	15.7%	38,897.9	12.0%	61.6%	4.6%

Top 100 Spenders

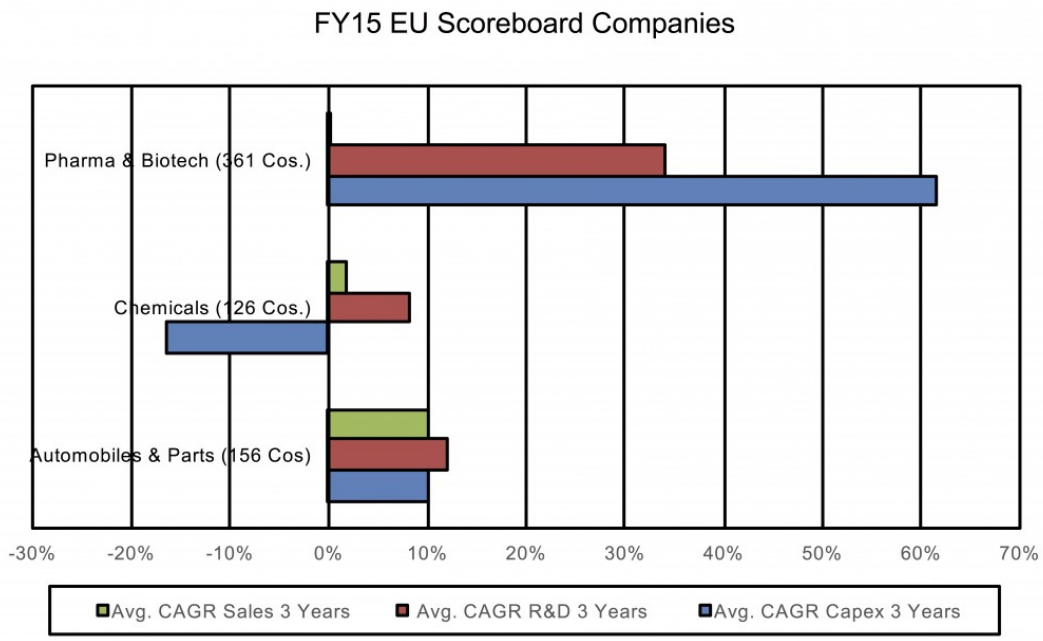
R&D spending is definitely weighted toward larger companies. The top 100 companies in the Scoreboard represented 53% of total Scoreboard R&D spending. In 2015, these firms' R&D spending rose 6.9% to €369.4 billion ($410.4 billion). Sixty-eight of the top one hundred companies increased R&D spending. R&D intensity for the top one hundred was 6.8%.

In contrast to the results for all 2,500 companies, sales, operating profit and capital expenditures all increased for the top one hundred firms, rising 2.6%, 4.0% and 6.3%, respectively. The top one hundred's sales accounted for 30% of all Scoreboard companies' total revenues.



Sector Growth

Not surprisingly, of the 38 industry segments highlighted in the report, Software & Computer Services, Pharma & Biotechnology, and Technology Hardware & Equipment Parts showed the fastest increase in annual R&D spending in FY15, rising 12.3%, 9.8% and 7.6%, respectively. By dollar amount, Pharma & Biotech accounted for 19% of total Scoreboard R&D spending, followed by Automobile & Parts at 16%, and Technology Hardware & Equipment at 14%.



Pharma & Biotechnology

Among Pharma & Biotechnology companies in the Scoreboard, biotech companies showed much faster R&D expenditure growth at 23.8%, compared to 7.2% for pharmaceutical firms.

Out of the 361 Pharma & Biotechnology firms in the table (lab product companies were removed from the Scoreboard's original list), 64% showed double- or triple-digit increases in FY15 R&D spending, while 19% reported declines. But, of the companies with declines in R&D spending, only 30% reported a drop in sales.

Forty of the 361 Pharma & Biotechnologies companies reported a decline in their three-year compound annual growth rates (CAGR) for R&D spending, including Abbott Laboratories (-31.8%), Merck US (-5.6%), Eli Lilly (-5.0%) and Glaxo Smith Kline (-4.3%). The five companies with the fastest three-year CAGR for R&D spending were Atara Biotherapeutics (456.9%), Retrophin (323.8%), Kite Pharma (219.6%), La Jolla Pharmaceutical (174.7%) and Seres Therapeutics (163.7%).

For the Scoreboard's 26 Chinese Pharma & Biotechnologies companies, R&D spending and FY15 sales grew a robust 30.4% and 14.8% to €1,358.9 million ($1,509.9 million) and €50,400.3 million ($56,000.3 million), respectively. But FY15 capital expenditures dipped 7.5% to FY15 sales to 2,554.2 ($2838.0 million). Three-year CAGR for R&D spending was also strong for these firms at 32.7%, ahead of the three-year CAGR of 16.5% for sales and 10.3% for capital expenditures.

Chemicals

Moving to a very different industry, for the 126 Chemical companies in the Scoreboard, 36% recorded double- or triple-digit growth for R&D spending in FY15. However, 38% reported declines. Of these firms, 85% also showed a decline in sales.

As for the three-year CAGR for R&D spending among Chemical firms, 25% recorded a decline. Among these firms

were Akzo Nobel (-5.2%), DuPont (-2.8%) and Dow Chemical (-2.2%). The five companies with the fastest three-year CAGR for R&D were Shandong Kingenta Ecological Engineering (91.4%), Sinochem International (89.9%), Rongsheng Petro Chemical (55.4%), National Industrialization (49.3%) and Sound Environmental Resources (42.1%).

For the 11 Chinese Chemical companies in the Scoreboard, FY15 R&D spending grew 28.0% to €403.5 million ($448.3 million) and three-year CAGR rose 45.6%. Both figures outpaced sales and capital expenditures growth during the same periods. FY15 sales and capital expenditures for the firms rose 4.7% to €19,738.4 million ($21,931.6 million) and declined 7.7% to €1,690.0 million ($1,877.8 million), respectively. The three-year CAGR for sales was 11.6%, while three-year CAGR for capital expenditures rose 6.3%.

Agilent Invests in Molecular Diagnostics

Santa Clara, CA and Niel, Belgium 12/20/16—Agilent Technologies, a leader in life sciences, diagnostics and applied chemical markets, has announced a definitive agreement to purchase Belgium-based Multiplicom for €68 million ($71 million = €0.96 = $1) in cash. Multiplicom provides genetic testing technology and products. "Multiplicom's products and technology help expand our target-enrichment portfolio and enhance our next-generation sequencing workflow capabilities—providing immediate scale in adjacent markets," stated Herman Verrelst, vice president and general manager of Agilent's Genomics Division. The acquisition is expected to close in mid-January 2017.

Multiplicom has 90 employees. The company offers NGS-based assays, in the form of kits for oncology, genetic and cardio disorders, and prenatal testing, including CE-IVD marked assays. The products that are designed for target amplification are based on proprietary multiplex PCR and Multiplex Amplification of Specific Targets for Resequencing (MASTR) technologies. A spokesperson for Agilent told ***IBO****, "This acquisition expands Agilent's target enrichment portfolio offering, enhances NGS workflow capabilities and provides immediate scale in adjacent markets." Regarding the technology's advantages, she said "MASTR assays offer an innovative combination of premixed PCR primers in a ready-to-use kit, enabling enhanced target amplification for DNA-based diagnostics. This proprietary combination allows for performance that is fit for CE-IVD use."*

Rubicon Genomics Acquired

*Mountain View, CA and Ann Arbor, MI 12/15/*16—Biotechnology R&D firm and life science reagent supplier Takara Bio has acquired Rubicon Genomics for $75 million. Rubicon develops NGS library preparation kits. "This acquisition builds on Takara Bio Group's commitment to develop a differentiated NGS portfolio and provide our customers with a broader offering of genetic analysis solutions, particularly in the area of library preparation," stated Carol Lou, president of Takara Bio USA. "Rubicon's technologies and products complement our current expertise and offerings such as our portfolio of cDNA synthesis, low-input and single-cell RNA-seq products based on our proprietary SMART technology." Takara also stated that the purchase adds clinical products, particularly for IVF, and complements its planned acquisition of WaferGen Bio-systems (see ***IBO*** 5/15/16).

James Koziarz, CEO of Rubicon, told **IBO** *that the company's products "are differentiated by their ability to prepare DNA libraries using very small input amounts of DNA. We're especially strong in the areas of single cells (used in IVF) and cell-free DNA in a patient's circulation." The company has 40 employees, according to him. The acquisition extends Takara Bio's NGS library preparation produce line. Rubicon's products, such as ThruPlex and PicoPlex, offer a single tube, three-step protocol. Sales of Rubicon's DNA Library Preparation Kits rose 43% in first half of 2016 and grew 40% in 2015.*

Fujifilm Invests in Wako Pure Chemicals

Tokyo, Japan 12/15/16; Osaka, Japan 12/15/16—Takeda Pharmaceutical has agreed to sell its stake in Wako Pure Chemicals to Fujifilm for ¥154.7 billion ($1.4 billion = ¥115.21 = $1) (see ***IBO*** 11/15/16). Wako Pure Chemicals consists of three divisions: Laboratory Chemicals, Specialty Chemicals and Clinical Diagnostic Reagents. Wako's fiscal 2016 sales ending March 31 increased 2.3% to ¥79.4 billion ($66.1 million = ¥120.08 = $1). Fujifilm already holds a 10% share in the company. The remaining 2% is controlled by employees. Fujifilm highlighted expected synergies with its regenerative medicine, IVD, pharmaceutical contract development and manufacturing, and materials businesses. Fujifilm's regenerative medicine business consists of Cellular Dynamics, which develops and manufactures iPSCs, and Japan Tissues Engineering, a regenerative medicine product company. Wako develops and manufactures cell culture mediums.

In connection with the offer, Wako will buyback 30% of its own shares in the company, according to the Nikkei Asian Review. Laboratory Chemicals revenue accounts for 46% of Wako sales. The business provides a wide range of laboratory chemicals and consumables, as well as life science reagents.

Repligen Buys TangenX

Waltham, MA 12/15/16; Lyon, France 12/15/16—Bioprocessing technology firm Repligen has acquired TangenX Technology from Novasep for $39 million in cash. TangenX provides the single-use Sius line of tangential flow filtration (TFF) cassettes and hardware for downstream biopharmaceutical processing. Repligen expects the company to grow double digits and to add $7.0–$7.5 million to 2017 revenues. "This strategic acquisition strengthens our position as a leader in single-use bioprocessing technologies and extends our reach into downstream processes, where disposables are increasingly being adopted by biopharmaceutical manufacturers for the convenience, flexibility and cost advantages that they offer," commented Repligen President and CEO Tony J. Hunt.

Repligen's other downstream products include Protein A ligands for chromatography media and chromatography columns. The company currently offers the XCell ATF (Alternating Tangential Flow) for upstream processing. Other single-use TFF offerings include Pall's Cadence TFF modules and Parker Dominick Hunter's PROPOR hollow fiber filters.

Bruker Expands ESR Product Line

Billerica, MA 12/16/16—Scientific research instrument firm Bruker has purchased Active Spectrum for an undisclosed amount. Active Spectrum's benchtop micro-ESR (Electron Spin Resonance) spectroscopy systems are used for chemistry, teaching, research, applied and industrial applications for discrete sample and online testing. Bruker currently offers high-end ESR systems. " Active Spectrum's unique, performance-leading micro-ESR systems offer an outstanding platform to develop tailored solutions for the industrial and applied markets using very compact magnetic resonance technology," commented Dr. Iris Mangelschots, president of Bruker BioSpin's Applied, Industrial & Clinical Division.

The product line is a natural fit for Bruker's portfolio due to Bruker's technology offerings and end-markets. Industrial applications of the micro-ESM include online oil conditioning monitoring and oxidative stability measurements to enhance food products' shelf life.

PerkinElmer Sells Medical Imaging Business

Waltham, MA 12/22/16; Palo Alto, 12/22/16—PerkinElmer has agreed to sell its Medical Imaging business to Varian Medical Systems for $276 million. The business supplies digital flat panel X-ray detectors, and has 280 employees. Varian Medical expects the purchase to add more than $140 million in revenue. "[T]he divestiture will allow PerkinElmer to focus our investments and accelerate growth in higher priority areas," stated PerkinElmer Chairman and CEO Robert Friel. The sale is scheduled to close in the first half of 2017 pending regulatory approval and other conditions.

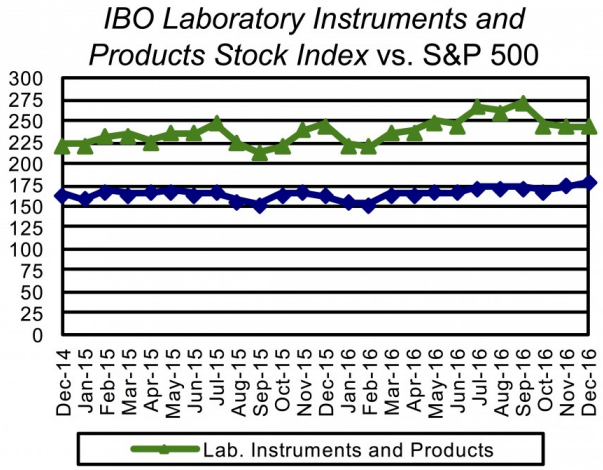
PerkinElmer has cited Medical Imaging as an underperforming business this year. Its sales declined double digits in the third quarter. The company indicated on its third quarter conference call that it was undertaking a portfolio review of it businesses.

IBO Lab Stock Index Trends Down in 2016

Major US markets experienced heightened volatility in 2016 prompted by growth concerns in China to begin the year, monetary policy changes and unexpected political events, including Brexit and Donald Trump's presidential victory. A majority of analysts predicted a market collapse with a Trump win and futures tanked roughly one thousand points on election night. However, the negative sentiment quickly shifted as the Dow Jones Industrial Average added 7.8% following the election and traded just below the 20,000 mark before the year end. Consumer confidence quickly spiked due to anticipated fiscal stimulus, reduced taxes and rolled back regulations.

As such, the Dow, S&P 500 and NASDAQ ended the year up 13.4%, 9.5% and 7.5%, respectively. Furthermore, crude oil prices jumped 43.6% and gold advanced 8.7%. The US dollar Index also increased, rising 3.5%, but could negatively impact exports. As already revealed, the US trade deficit widened towards the end of the year.

***IBO**'s Laboratory Instruments and Products Stock Index* return deviated from the major US Indexes, contracting 0.8% for the year, its first negative return since 2011. Overzealous valuations coupled with missed revenue guidance and conservative financial outlooks caused a number of companies in the *Index* to sell off during the year. In contrast, ***IBO**'s Diversified Laboratory Stock Index* nearly mirrored the S&P 500, climbing 9.6% due to share repurchases and cost cutting measures.



Laboratory Instruments and Products

The *Laboratory Instruments and Products Stock Index*, which enjoyed a four-year run of double-digit gains, posted a modest decline in 2016. Prices for a number of companies in the *Index* were negatively impacted by slower-than-projected revenue growth and reduced sales outlooks, primarily due to waning demand among academic and government markets in developed regions, as well as continued weakness from industrial customers. Furthermore, several firms experienced specific operational challenges. Valuations were also a concern given the strong price escalations for a majority of companies over the last several years, coupled with slower adjusted EPS growth. For

the *Index*, 2016 adjusted EPS growth is projected to be roughly flat, compared to double-digit gains registered in each of the previous two years.

In spite of the negative *Index* return for the year, a number of companies recorded strong price momentum due to improved profitability, new product introductions, healthy sales growth and share buybacks. Acquisitions further limited the *Index* decline as **Thermo Fisher Scientific** acquired both **Affymetrix** (see ***IBO*** 1/15/16) and **FEI** (see ***IBO*** 5/31/16) for notable premiums. The two companies recorded year-to-date price increases of 39% and 35%, respectively, prior to removal from the *Index*. Nevertheless, 11 of the remaining 20 companies in the *Index* ended in negative territory in 2016, including seven with double-digit declines.

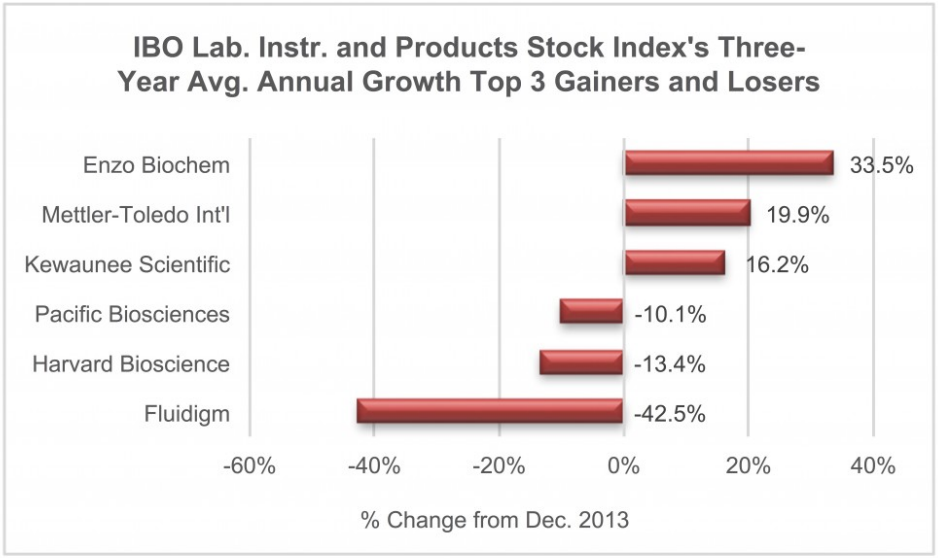
The year's biggest decliners were NGS firms **Illumina** and **Pacific Biosciences**, which slumped 33.3% and 71.1%, respectively. The two companies, which were trading at elevated prices to earnings valuations, experienced operational challenges and reduced 2016 sales outlooks. **Illumina** missed company sales expectations two out of the first three quarters of the year, as demand for high-throughput systems slowed at a stronger-than-projected pace. Furthermore, the company's bottom line was negatively impacted by increased investments in its genetic testing service venture Helix and liquid biopsy business Grail. Given the increased financial commitments to these start-ups and slower order growth for high-throughput instrumentation, the company's 2016 sales growth outlook was cut from an initial estimate of 16% to 7%, and adjusted EPS growth was trimmed from roughly 8% to flat for the year.

Despite **Illumina**'s misguided financial forecast, the company's long term growth outlook remains robust, especially within clinical applications. However, sales and earnings growth in 2017, while expected to improve, will continue to experience dilution from its joint ventures as well as potential cannibalization of its HiSeq systems by its the lower-priced NextSeq.

Pacific Biosciences experienced notable challenges as well, especially towards the end of 2016. While the company reported increased adoption of its new Sequel instrumentation, orders for the system slowed sequentially in the second and third quarters, falling below company projections. Supply issues of SMRT Cells clearly impacted demand, but competition also remains a concern for the company. Given the slower order growth, the company lowered its 2016 product and service sales growth outlook from 70% to a range of 55%–65%.

Moreover, **Pacific Biosciences** was further pressured after Roche terminated its IVD development agreement with the company (see ***IBO*** 12/15/16). While the voided agreement provides **Pacific Biosciences** unrestricted commercialization opportunity of its Sequel system into the clinical market, it remains uncertain if the company can offset projected revenue contributions from Roche or sustain its current cash burn rate. As a result of the sharp price decline, shares are currently trading 76% below its IPO price of $16 in October 2010. However, at current price levels, the company may be a viable acquisition target in 2017.

Similar to **Pacific Biosciences**, **Fluidigm** ended 2016 well below its IPO listing price in February 2011 (see ***IBO*** 2/28/11). The company, which traded at a record low and dropped 32.7% in 2016, has declined by double digits in each of the past three years. The company misguided sales projections for 2016 as a result of growing competition for single-cell genomics platforms, poor order and sales execution, in addition to timing issues. Furthermore, the company suspended its 2016 guidance due to an ongoing business review.



Several other companies, including **Bruker, Harvard Bioscience, MTS Systems** and **VWR,** also recorded double-digit declines for the year due to missed sales projections. **VWR**, which fell 11.6% in 2016, was perhaps unjustly rebuked after the company reported slightly lower-than-projected third quarter sales, primarily due to macroeconomic challenges in Europe. Despite slower projected earnings growth compared to the previous year, adjusted EPS is estimated to climb roughly 13% in 2016. The company also reported strong operating cash flow for the first nine months of 2016.

Conversely, **Bruker**'s sell off was justified due to slower sales growth and valuation concerns. Due to the company's heavy instrument revenue mix and headwinds from European academic and industrial markets, sales expectations fell below company guidance in each the second and third quarters. The company initially forecasted 2016 sales to grow 3%, but lowered its outlook to -3% following two consecutive weak quarters. Despite the revenue shortfall, the company reported a positive earnings surprise in the third quarter due to restructuring initiatives and favorable NMR pricing. However, margin expansion will prove to be more difficult in 2017 given the company's slow revenue growth and operational challenges.

Anxieties over valuations also disrupted the strong price momentum for both **Thermo Fisher Scientific** and **Waters** in 2016. Following double-digit gains in each of the previous four years, shares for the two companies slipped 0.5% and 0.1%, respectively, in 2016. However, both firms reported mostly strong financial results, including projected 2016 adjusted EPS growth of roughly 11%, driven by strong biopharmaceutical demand, robust growth in China, cost control measures and share repurchases. Unfortunately, **Waters** reported a slight third quarter revenue miss due to lower academic and government sales. **Thermo Fisher** avoided this negative trend but, like **Waters**, noted weakness in industrial markets.

There were a number of strong performers in the *Laboratory Instruments and Products Stock Index* as well. Two smaller companies, **Enzo Biochem** and **NanoString Technologies**, recorded the highest returns for the year, climbing 54.2% and 51.6%, respectively. **Enzo Biochem** benefited from a $35 million patent infringement case against Life Technologies (see ***IBO*** 5/31/16) as well as growing demand for its high margin diagnostic services.

Shares of **NanoString** advanced following strong second and third quarter sales results due to greater adoption of its nCounter SPRINT Profiler system, especially by new customers. In addition, the company posted strong demand from academic and biopharmaceutical markets, and expanded its companion diagnostic partnerships.

Another small company, **Kewaunee Scientific**, recorded robust momentum in 2016, as shares jumped 37.4% following strong earnings results and a new international laboratory project award valued at roughly $18.5 million.

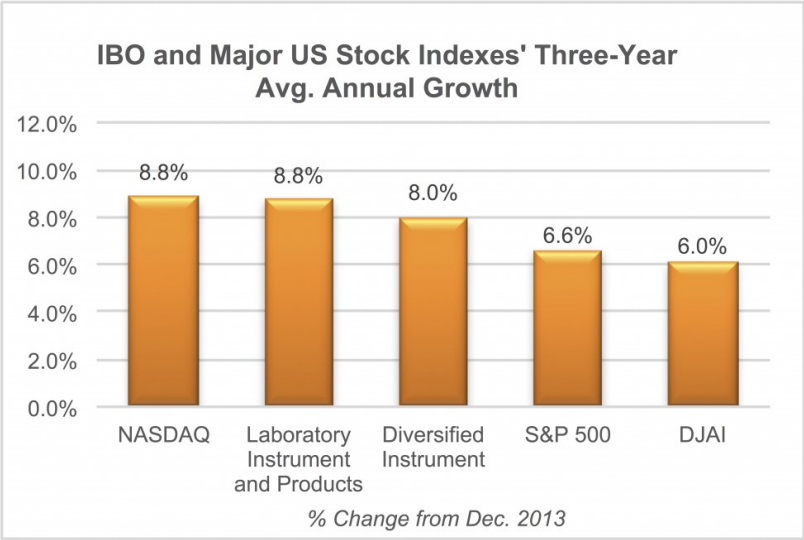
A number of larger firms, such as **Agilent Technologies**, **Becton Dickinson**, **Bio-Rad Technologies** and **Mettler-Toledo,** similarly recorded healthy price gains in 2016. **Mettler-Toledo** recorded its fifth consecutive year of double-digit returns, as shares climbed 23.4% in 2016.

Bio-Rad experienced a steady climb in 2016, rising 31.5%. Despite missed adjusted EPS results in the first and

second quarters, sales remained strong for its Digital PCR and process chromatography products. The company also continued to benefit from significant holdings in **Sartorius**.

Both **Agilent Technologies** and **Becton, Dickson**, which advanced 9.0% and 7.4% for the year, respectively, delivered fiscal earnings ahead of analysts' consensus. **Agilent** exceeded analysts' adjusted EPS expectations in each of its fiscal four quarters due to various cost saving and efficiency measures. The company further outsourced noncore manufacturing to lower cost regions, reduced its operational facilities and benefited from the discontinuation of its unprofitable NMR business. Sales were also strong for the fiscal year, led by biopharmaceutical, food and diagnostics markets.

Becton, Dickinson continued to execute significant margin expansion due to cost synergies and acquisitions. Earnings also benefited from improved tax rates and healthy sales growth. The company projected stronger sales growth for fiscal 2017, driven by new products in its core medical business, increased presence in informatics, as well as strong demand in certain life science businesses, including molecular diagnostics, cell analysis and sample preparation for NGS.



International

Major international equity markets traded mostly higher in 2016. Within the Asia Pacific markets, the strongest gains were recorded in smaller economies, as the Thailand SET, Indonesia Jakarta and Taiwan TAIEX Indexes climbed 19.8%, 15.3% and 11.0%, respectively. In addition, India's Sensex 30 advanced 1.9%, while both Japan's Nikkei 225 and Hong Kong's Hang Seng improved 0.4%. In contrast, China's Shanghai Composite declined 12.3% for the year, as the yuan valuation decelerated against the US dollar and the country limited leveraged stock purchases by insurance companies.

Despite a favorable export environment for Japanese equities due to the deprecation of the yen against the dollar, more than half of the Pacific Rim companies in the ***IBO*** Stock Table traded lower in 2016. **JEOL** recorded the sharpest decline, falling 35.4%, while **Hitachi High-Technologies** jumped 43.3%.

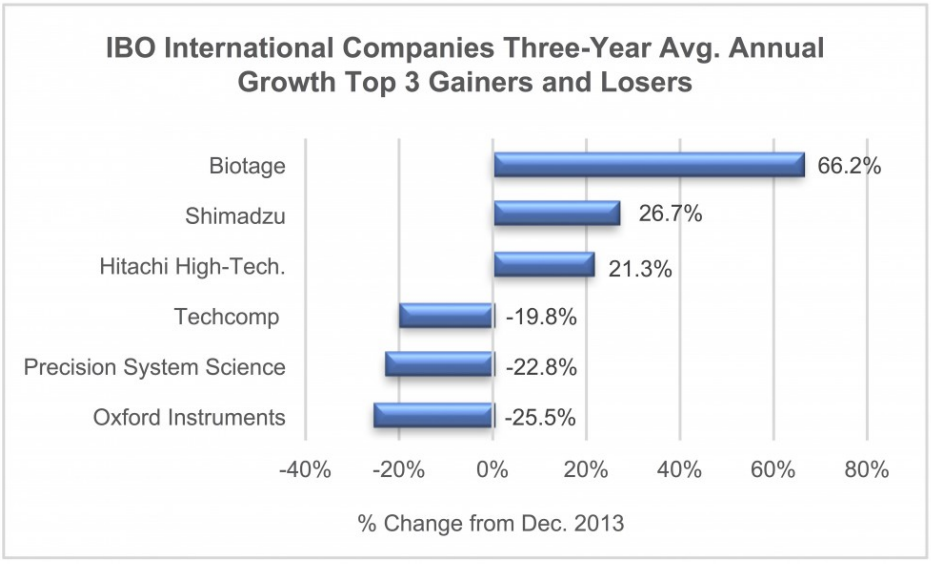
European equity markets were mostly mixed in 2016. The UK's FTSE and Germany's DAX gained 14.4% and 6.9%, respectively, despite Brexit concerns and terrorist attacks. However, Italy's MIB and Switzerland's SMI contracted 10.2% and 6.8%, respectively.

Most UK-based companies in the ***IBO*** Stock Table advanced in 2016, with the exception of **Oxford Instruments**, which fell 4.6%. **Scientific Digital Imaging** and **Spectris** recorded the strong gains, climbing 60.9% and 28.4%, respectively.

Prices for the other European companies in the ***IBO*** Stock Table were mixed in 2016 as **Biotage** soared 86.6% due to strong demand in China. Meanwhile, **Sartorius** declined 7.3% as the company reported slower growth in the Americas and Asia Pacific.

December

US equity markets posted healthy return in December, as the Dow, S&P 500 and NASDAQ improved 3.3%, 1.8% and 1.1%, respectively.



Laboratory Instruments and Products

In December, the *Index* slipped 0.3 % despite a majority of companies trading higher. **Pacific Biosciences** weighed on the *Index*, falling 50.1% following the Roche announcement.

Both **Bruker** and **VWR** also posted notable price declines for the month, contracting 6.6% and 8.0%, respectively. Conversely, **Harvard Bioscience** and **Fluidigm** advanced 24.5% and 13.2%, respectively.

On December 6, **Kewaunee Scientific** reported that GAAP EPS for the fiscal second quarter 2017 more than doubled to $0.54 due to strong International sales growth, which included the completion of several multiyear laboratory projects in India and Kuwait. However, shares were marginally lower for the month.

Enzo Biochem, which improved 1.8% for the month, reported on December 8 fiscal 2017 first quarter sales slightly ahead of analysts' expectations and a narrower-than-projected adjusted EPS loss, driven by strong demand for diagnostic services.

There were several analysts' rating revisions this month. On December 10, Morgan Stanley lowered its price target on **Illumina** from $115 to $100 per share. On December 14, JPMorgan Chase downgraded **Bruker** from "Overweight" to "Neutral," and set a price target of $20 per share.

Diversified Instrumentation

The *Index* improved 0.1% in December, with half the companies in positive territory and the other half trading lower. **AMETEK** recorded the strongest gain, climbing 2.6%, while **Xylem** fell 4.0%.

International

Asia Pacific equity indexes traded mostly higher in December, as Japan's Nikkei 225 and Australia's All Ordinaries improved 4.4% and 3.9%, respectively. Meanwhile, China's Shanghai Composite and Hong Kong's Hang Seng sank 4.5% and 3.5%, respectively.

Prices for most of the Pacific Region companies in the ***IBO*** Stock Table improved this month, led by **JEOL**, which jumped 13.1%. Conversely, **Precision System Science** and **Techcomp** slipped 0.2% and 0.8% in December, respectively.

European equity markets all traded higher in December, including a 13.6% and 7.9% gain in Italy's FTSE MIB and

Germany's DAX, respectively. London's FTSE 100 returned a gain of 5.3%.

Most UK-based companies in the ***IBO*** Stock Table traded higher, led by **Horizon Discovery**, which scaled 26.9%. **Abcam** and **Halm** recorded the only declines, subsiding 7.4% and 4.8%, respectively. **Halma** was upgraded by HSBC from "Hold" to "Buy" on December 5, and by Numis Securities from "Add" to "Buy" on December 6.

Prices for the other European companies in the ***IBO*** Stock Table also varied. **Merck KGaA** advanced 4.9%, while **Biotage** eased 1.7%.

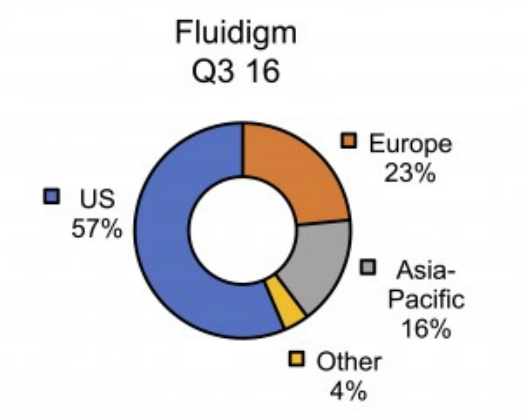
Company: Exchange	Market Value (US $000s)	52 Week Low	52 Week High	Price 12/30/16	Change 1 Month	Change YTD	P/E (ttm)	EPS (ttm)	EPS (FY)	Price/ Sales (ttm)	Price/ CF (ttm)	ROE % (ttm)
Laboratory Instruments and Products												
Agilent Technologies: n	$14,943,680	34.15	48.63	$45.56	3.6%	9.0%	33	1.40	1.40	3.6	13.6	11.0
Becton, Dickinson and Company: n	$36,075,994	129.50	181.76	$165.55	-2.1%	7.4%	37	4.49	4.49	2.9	14.1	12.9
Bio-Rad Laboratories: n	$5,408,430	122.03	184.89	$182.28	5.1%	31.5%	55	3.33	3.85	2.6	27.8	3.8
Bio-Techne: o	$3,853,349	79.95	117.42	$102.83	-2.4%	14.3%	39	2.62	2.80	7.5	34.4	11.3
Bruker: o	$3,420,570	19.59	29.85	$21.18	-6.6%	-12.7%	24	0.88	0.60	2.1	31.1	20.4
Enzo Biochem: n	$321,128	4.00	7.51	$6.94	1.8%	54.2%	8	0.84	0.97	3.1	8.1	59.2
Fluidigm: o	$211,622	4.31	11.05	$7.28	13.2%	-32.7%	NM	-2.46	-1.86	1.9	NM	-72.6
Harvard Bioscience: o	$104,697	2.25	3.90	$3.05	24.5%	-12.1%	NM	-0.60	-0.57	1.0	19.3	-25.0
Illumina: o	$18,937,244	119.37	188.25	$128.04	-3.8%	-33.3%	43	2.98	3.10	8.0	29.2	21.3
Kewaunee Scientific: o	$66,724	15.82	27.60	$24.45	-0.2%	37.4%	13	1.83	1.42	0.5	8.8	12.9
Luminex: o	$872,641	17.29	23.75	$20.23	-0.6%	-5.4%	23	0.87	0.86	3.4	18.3	10.0
Mettler-Toledo International: n	$11,254,580	291.33	434.50	$418.56	1.6%	23.4%	31	13.49	12.48	4.6	26.3	68.4
MTS Systems: o	$887,922	41.53	62.60	$56.70	5.3%	-10.6%	28	2.06	3.00	1.5	12.0	11.0
NanoString Technologies: o	$442,967	11.30	23.45	$22.30	1.4%	51.6%	NM	-2.24	-2.40	5.3	NM	-264.6
Pacific Biosciences: o	$350,018	3.76	13.98	$3.80	-50.1%	-71.1%	NM	-0.64	-0.42	3.5	NM	-69.1
PerkinElmer: n	$5,740,568	39.50	57.28	$52.15	2.8%	-2.7%	24	2.14	1.87	2.5	34.7	11.4
QIAGEN: o	$6,678,371	19.94	28.84	$28.02	2.6%	1.3%	56	0.50	0.54	5.1	20.3	4.5
Thermo Fisher Scientific: n	$56,073,140	119.75	160.68	$141.10	0.7%	-0.5%	28	5.00	4.92	3.1	17.6	11.1
VWR: o	$3,301,457	21.56	31.75	$25.03	-8.0%	-11.6%	19	1.33	1.17	0.7	13.0	12.5
Waters: n	$10,937,733	112.00	162.53	$134.39	-0.1%	-0.1%	22	6.09	5.65	5.1	17.9	23.6
Diversified Laboratory												
AMETEK: n	$11,310,241	42.82	52.93	$48.60	2.6%	-9.3%	21	2.30	2.45	2.9	16.0	16.3
Corning:	$26,745,540	16.13	25.35	$24.27	1.0%	32.8%	12	1.99	1.00	2.9	13.0	12.4
Danaher: n	$54,589,192	61.60	82.64	$77.84	-0.4%	-16.2%	22	3.58	4.74	2.4	13.3	10.4
Honeywell	$88,292,148	93.71	120.02	$115.85	1.7%	11.9%	18	6.39	6.04	2.2	16.5	33.4
Illinois Tool Works: n	$43,534,530	79.15	127.99	$122.46	-2.2%	32.1%	22	5.48	5.13	3.2	18.6	39.1
Roper Technologies: n	$18,769,728	155.79	189.44	$183.08	1.1%	-3.5%	27	6.70	6.85	5.0	19.5	12.6
Teledyne Technologies: n	$4,378,800	73.66	129.36	$123.00	-1.5%	38.7%	23	5.46	5.44	2.0	14.0	13.4
Xylem: n	$8,928,456	31.67	54.99	$49.52	-4.0%	35.7%	28	1.80	1.87	2.4	18.7	15.2
Laboratory Instruments and Products Stock Index				**243.11**	**-0.3%**	**-0.8%**	**31**			**3.2**		
Diversified Laboratory Stock Index				**205.53**	**0.1%**	**9.6%**	**22**			**2.6**		
Dow Jones Industrial Average				19,762.60	3.3%	13.4%						
S&P 500				2,238.83	1.8%	9.5%						
NASDAQ Composite				5,383.12	1.1%	7.5%						
Region Company	Market Value (US $000s)	Market Value (Local 000s)		Price 12/30/16 (Local)	Change 1 Month	Change YTD	P/E (ttm)	EPS (ttm)	EPS (FY)	Price/ Sales (ttm)	Price/ CF (ttm)	ROE % (ttm)
Pacific Shares												
GL Sciences: t	$84,802	¥9,903,150		¥885	2.0%	42.7%	9	¥95.75	¥75.42	0.5	7.4	6.2
Hitachi High-Technologies: t	$5,561,210	¥649,438,112		¥4,715	4.5%	43.3%	16	¥290.44	¥261.68	1.0	35.0	12.6
HORIBA: t	$1,970,390	¥230,102,188		¥5,410	6.3%	15.2%	20	¥270.99	¥304.36	1.4	21.6	9.3
JEOL: t	$431,473	¥50,387,435		¥510	13.1%	-35.4%	222	¥2.30	¥42.32	0.5	6.2	0.7
Precision System Science: os	$72,342	¥8,448,058		¥407	-0.2%	-29.1%	NM	-¥10.61	-¥11.79	2.0	117.1	-45.6
Shimadzu: t	$4,720,695	¥551,282,763		¥1,862	6.8%	-8.9%	23	¥81.08	¥81.05	1.6	17.9	11.5
Techcomp: hk	$45,971	HKD 356,459		HKD 1.29	-0.8%	-23.2%	17	$0.01	$0.01	0.3	NM	3.1
European Shares (London)												
Abcam: l	$1,910,434	£1,549,362		£7.67	-7.4%	15.3%	41	£0.19	£0.19	9.0	32.7	15.3
Halma: l	$4,188,434	£3,396,820		£8.98	-4.8%	3.8%	31	£0.29	£0.29	3.9	21.5	16.6
Horizon Discovery: l	$167,122	£135,536		£1.44	26.9%	7.5%	NM	-£0.10	-£0.11	6.2	NM	-11.7
Oxford Instruments: l	$516,281	£418,704		£7.32	17.5%	-4.6%	75	£0.10	£0.16	1.1	10.3	4.3
Scientific Digital Imaging: l	$14,649	£11,881		£0.19	5.7%	60.9%	16	£0.01	£0.01	1.4	9.4	10.8
Spectris: l	$34,025	£2,759,409		£23.13	13.2%	28.4%	24	£0.95	£0.95	2.3	18.0	12.3
European Shares (Other)												
Biotage: st	$327,190	SEK 2,970,393		SEK 45.9	-1.7%	86.6%	31	SEK 1.48	SEK 1.13	4.5	22.8	18.0
Datacolor: s	$105,969	CHF 107,665		CHF 650.0	2.8%	14.0%	18	CHF 36.36	CHF 36.36	1.5	9.7	16.6
Merck KGaA: g	$13,531,541	€ 12,814,369		€ 99.15	4.9%	10.7%	29	€ 3.42	€ 2.56	1.0	4.4	11.4
Sartorius: g	$5,756,351	€ 5,451,264		€ 72.80	4.0%	-7.3%	56	€ 1.29	€ 1.66	4.4	37.5	15.6
Tecan: s	$1,761,319	CHF 1,789,500		CHF 158.9	-1.1%	-2.5%	34	CHF 4.73	CHF 4.96	3.8	13.9	12.4

Third Quarter Financial Results

Fluidigm Continues Descent

Fluidigm reported another disappointing quarter, as third quarter sales slumped 22.5% to $22.2 million due to increased competition and weak operational execution. The company missed revenue guidance on all three of its projected growth drivers, including single-cell biology, new products and applied market consumables. Instrument sales were particularly weak, especially for genomics systems. However, demand remained sturdy in China, and Service revenue climbed 19.1%.

Total Product sales tumbled 28.3% to account for 81% of revenues. Sales to research and applied customers contracted 23% and 36% to account for 66% and 34% of Product sales, respectively. Instrument sales fell 39.1% as demand for Helios and BioMark systems diminished dramatically.



The sharply lower-than- projected demand for Helios systems was attributed to rising competition, as well as longer sales cycles from applied customers and timing of shipments. Faced with similar timing and competitive challenges, as well as specific systems' inactivity, consumables sales underperformed expectations, falling 12.2%. Demand for integrated fluidic circuits for genomics preparatory systems were particularly weak. On the positive side, proteomic reagent sales increased, and consumables sales for the mass cytometry business expanded 30%.

Europe was largely impacted by the lower demand for C1 systems, as sales for the region faltered 48.3%. US and Other sales declined 8.1% and 40.4%, respectively. Conversely, sales in Asia-Pacific advanced 2.6%, as strength in China offset weakness in Japan and other Asian regions.

Adjusted Product gross margin contracted 197 basis points to 70.2% due to product mix and lower production volume. Adjusted operating loss widened 79.2% to $14.1 million.

While 2016 sales will certainly fall below the company's previous outlook of $124–$128 million, Fluidigm did not provide updated guidance. The company is in the process of an internal business analysis as well as operational modifications.

Fluidigm Q3 FY16			
	Rev. ($M)	% Rev. Growth	% of Rev.
Instruments	$9.2	-39.1%	41%
Consumables	$8.8	-12.2%	40%
Service	$4.2	19.1%	19%
License and Grant	$0.0	-14.5%	0%

NanoString Delivers Strong Growth

Third quarter sales for NanoString Technologies jumped 52.5% to $23.9 million. Collaboration revenue advanced 167% to make up 20% of sales. Product and Service revenue rose 39% excluding currency to account for 80%, led by record instrument placements and strong demand for life science consumables. By end-market, academic sales climbed roughly 30%, including approximately 50% revenue growth for instrumentation. Biopharmaceutical sales growth was even more robust with strength in both instrumentation and consumables.

Instrument sales jumped 62.1% as a result of broader adoption of the nCounter SPRINT Profiler system, but included a partial benefit from missed orders in the first quarter. The company placed more than 20 SPRINT systems during the quarter, of which 80% were to new customers, primarily academic researchers. However, as expected, the lower pricing for the SPRINT Profiler, which accounted for roughly half of all instruments sold, partially offset revenue growth. On a cumulative basis, the company's total installed base expanded nearly 40% to more than 450 systems, including approximately 55 SPRINT systems.

NanoString Technologies Q3 FY16			
	Rev. ($M)	% Rev. Growth	% of Rev.
Instruments	$6.9	62.1%	29%
Consumables	$10.3	23.4%	43%
In vitro diagnostic kits	$1.1	73.3%	5%
Service	$0.8	28.0%	3%
Collaboration	$4.8	167.3%	20%

Life science consumables sales advanced 23%, including roughly 35% and 15% sales growth to biopharmaceutical and academic customers, respectively. Accounting for nearly half of life science consumables revenues, sales of Panel products jumped 45%.

While still relatively only a small part of sales, Prosigna IVD kit revenue advanced 73% due to expanded reimbursement coverage.

Overall, sales in the Americas climbed 53.6% to account for 70% of revenues. Including currency, sales in Europe/Middle East and Asia Pacific expanded 45.1% and 62.4% to make up 21% and 9% of revenues, respectively. The company highlighted particular strength for instrumentation in Europe. In addition, sales in China remained robust, as the country accounts for the second largest installed base of nCounter systems behind the US.

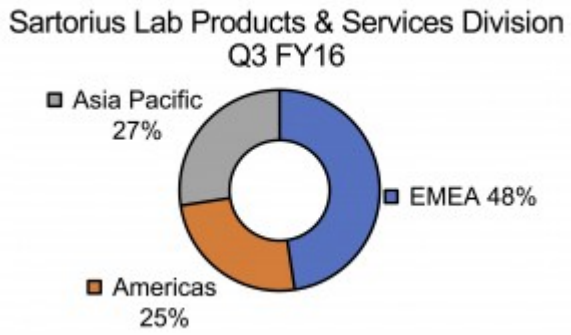
Operating loss was roughly unchanged at $8.5 million. The company maintained its 2016 sales outlook of $89–$93 million, including Collaboration revenue of $18 million.

Sartorius Reports Steady Growth

Third quarter sales for Sartorius' Lab Products & Services Division (LPS) grew 9.5%, roughly 4% organically, to €82.7 million ($91.9 million = €0.90 = $1) to account for 24% of revenues.

Acquisitions contributed approximately 6% to segment revenue growth, while currency headwinds lowered growth by 1%.

Including acquisitions, LPS sales in the Americas, Asia Pacific and Europe expanded 27.6%, 7.5% and 4.5%, respectively. Segment orders grew 11.3% in local currency including acquisitions. Similarly benefiting from the acquisitions, LPS adjusted EBITDA margin improved 68 basis points to 16.2%. The company maintained its 2016 LPS sales growth outlook of 6%–9%, including 3% growth from acquisitions.



Chip-based CE

Capillary Electrophoresis (CE) utilizes the same principles as gel electrophoresis for the qualitative and quantitative analysis of charged biological species. Using this technology, biological substances such as proteins, carbohydrates, nucleic acids and inorganic compounds are separated based on the electrical properties of the analytes and their mobility through a substrate. Several types of detection methods are employed for CE, including UV-Vis spectrophotometry, laser-induced fluorescence and MS, which is becoming an increasingly popular detection technique for CE.

Microfluidics-based CE technology in particular has become mainstream in recent years and thereby constitutes a significant segment in the CE market. Instead of employing fused silica tubing, microfluidics-based CE systems carry out the electrophoretic separation on a glass chip embedded with micro-channels. In most cases, small amounts of fluids are injected into a separation channel by using a plug injection that allows specific control of the liquid flow. Similar to traditional systems, substances are separated based on their electrophoretic mobility, which is proportional to their charge-to-size ratio.

Microfluidic-based CE offers several advantages over benchtop CE systems including the use of much smaller sample volumes. The separation channels are only a few centimeters in length allowing for significantly faster analysis times. While these systems are not as sensitive as benchtop CE systems, microfluidics-based CE enables high-throughput routine analysis, and has become a vital tool for QC of biological samples for NGS, microarray analysis and PCR workflows.

Genomic and proteomic laboratories largely utilize chip-based CE devices as a routine analytical tool. Hence, the biotechnology industry forms the largest market for these systems followed closely by the pharmaceutical industry, thanks to its applications in drug discovery and research. Academia forms another significant market, as researchers are migrating towards microfluidic chip–based CE systems due to the benefits offered by the need for extremely low sample volumes.

The global market for microfluidic chip-based CE systems was close to $65 million in 2015. The market for such chip-based CE systems is growing fast, with a forecasted growth rate of about 5% over the next five years. This market is primarily driven by an increasing adoption in functions such as methods development and forensics, continuous innovation in terms of features and modularity of the system, and a high number of applications in NGS and MS.

PerkinElmer currently leads the chip-based CE market with its LabChip GX product offerings, of which half enable high-throughput analysis. Agilent Technologies represents 30% of this market with its 2100 Electrophoresis Bioanalyzer system, while Bio-Rad Laboratories ranks third with its microfluidic-based Experion Automated Electrophoresis Station. Furthermore, the rapid innovation in the chip-based CE market coupled with the growing popularity of genetic testing is responsible for many smaller companies entering this market with unique system features that cater to niche applications.

Chip-based Capillary Electrophoresis at a glance:

Leading Vendors:

- PerkinElmer
- Agilent Technologies
- Bio-Rad Laboratories

Largest Markets:

- Biotechnology
- Academia
- Pharmaceuticals

Instrument Cost:

- $20,000–$135,000

Energy

Earlier this month, the EPA released a report detailing the link between fracking and drinking water, entitled "Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States." The EPA's research concluded that there is evidence of the impact hydraulic fracturing has on drinking water in certain situations, such as in areas of minimal water resources; fracking spills that contaminate groundwater; and groundwater resources and wells that have been injected with fracking fluids. The report was unable to measure the severity of the impacts on drinking water due to "data gaps and uncertainties."

The report indicated that public water systems are required to undergo routine monitoring and testing as per the National Primary Drinking Water Standards, whereas non-public water systems do not have these requirements, which can make them more vulnerable to contaminations. Approximately 58% of public water supply is sourced from surface water, while the remaining 42% is represented from groundwater.

The EPA's research found that during the chemical mixing stage to make hydraulic fracturing fluid, there have been reports of chemical spills and fluids reaching soil and water receptors, yet there is a lack of post-spill testing and sampling to document the effects, which is needed in order to adequately address and remedy the issue. Testing is required to determine the mechanical integrity of wells, and also to monitor pre- and post-fracking water quality so as to detect the movement of fracking fluids in drinking water to prevent and mitigate the harsh effects that contaminated drinking water may pose. There is also a lack of field compaction testing that needs to be addressed, as well as pressure testing of fracking casings to ensure the casing is not problematic.

The report calls for the need for "assessment, sampling, analytical testing, and reporting of water quality associated with oil and gas well stimulation activities." This includes area-specific monitoring, which includes groundwater monitoring for all fracking projects that began after July 2015, as well as reported information from well officers regarding any human or natural features that could impact the groundwater, well construction and fracking fluid. A regional monitoring program is also recommended, in which groundwater monitoring data would be submitted to a state-maintained database for further reference and investigation on the impacts of fracking on drinking water.

Source: *EPA Office of Research and Development*

Pharmaceuticals

Deloitte's Center for Health Solutions released its seventh annual report on pharmaceutical innovation earlier this month, which analyzes the R&D investment and sales figures of 12 leading pharmaceutical companies. Since 2010, return on investments have been on a steady decline, totaling 3.7% in 2016. There have been trends of large R&D costs, but forecast peak sales per asset have been declining by 11.4% on a year-on-year basis since 2010. Average peak sales dropped to $394 million in 2016.

In 2016, R&D expenditure was $1.54 billion, a 2% decrease, while forecast sales were down 5% to $394 million. Within the last 7 years, the 12 surveyed companies have released 233 products and progressed 376 assets into late-stage pipelines. Although the number of assets in pipeline stages of development have been consistent for the past seven years, not as many assets have translated into "blockbuster status," or assets with forecast sales of over $1 billion. The decline in overall performance is largely attributed to instability of pipelines and new R&D costs due to M&A. Although the cost for asset R&D-to-launch had dropped 2.3%, in 2016, costs were still skyhigh at approximately $1.5 billion, 30% more than 2010 costs.

Source: *Deloitte*

Government

In FY16, the federal budget authority for R&D increased an estimated 7.5%, or $10.5 billion, in current dollars to $149.0 billion. The increase is significant, especially within the last three years, as the budget authority grew 1.8% in FY15 and 2.8% in FY14. For FY17, the president's proposed budget allocates $153.9 billion for R&D and R&D plant funding, an increase of 3.3%, or $4.9 billion.

In FY16, expenditure for R&D plant was $2.6 billion. R&D Plant is defined as R&D facilities and fixed equipment (i.e., reactors, particle accelerators), and "includes acquisitions of, construction of, major repairs to, or alterations in structures works, equipment, facilities, or land for use in R&D activities at federal or non-federal installations," excluding office furniture/equipment and expendable or movable equipment (i.e., microscopes, spectrometers). Historically, the majority of R&D Plant funding goes towards general science and basic research, including investments in new or renovated facilities, as well as large-scale equipment.

In FY16, the budget authority for Health R&D (including R&D Plant) was $32.4 billion, or 22% of the total budget, a 6.1% increase. In the past, the NIH has received the largest portion of this budget authority, obtaining $28.8 billion in FY15, and $30.6 billion in FY16. Of the NIH funding, the National Cancer Institute, and the National Institutes of Allergy and Infectious Diseases typically received the largest share. Also included in the NIH funding are various DHHS R&D programs (i.e., FDA, CDC, Agency for Healthcare Research and Quality), the Consumer Product Safety Commission, and the Department of Labor's Occupational Safety Health Administration.

General Science and Basic Research had a budget authority of $11.4 billion in FY15, or 8% of total R&D funding, a 3.0% increase. This section includes the NSF and the DoE's Office of Science. In FY15 and FY16, NSF programs made up $6.0 billion and $6.1 billion, respectively, or half of the section's total budget.

The budget authority for Energy increased 8.9% to $3.5 billion in FY16. Agriculture budget authority increased 9.6% in FY16 to $2.4 billion. This section is comprised of the Department of Agriculture's R&D programs.

Source: *NSF National Center for Science and Engineering Statistics*

New Zealand

Last month, the New Zealand government released the first "Science and Innovation System Performance Report," an annual analysis of the strengths and weaknesses of New Zealand's science industry. Compared to other Small

Advanced Economies such as Denmark, Ireland, Finland, Israel and Australia, New Zealand has the lowest proportion of GDP to R&D, spending 1.17% in 2014. However, New Zealand publishes 15.6 research papers per million dollars spent, indicating that the science and innovation industry is small but industrious.

By sector, the country's R&D focuses largely on agricultural and biological sciences, as well as health professions. In 2014, NZD 179 million ($117.9 million) was spent on health R&D by the higher education sector, 22% of the total NZD 817 million ($538.3 million) the sector spent on R&D. Also in 2014, 30,000 researchers worked as full-time equivalent staff. The majority of researchers were in higher education, but the data include students doing research as a part of their studies; excluding that data, the private sector employs the greatest number of researchers, which jumped from approximately 7,000 in 2012 to 10,000 in 2014. By 2020, government R&D expenditure is forecast to reach NZD 1.6 billion ($1.1 billion), a 23% increase from 2016, due to new budgets allocated for science as per the Innovative New Zealand initiative introduced in 2016's federal budget.

Source: *New Zealand Ministry of Business, Innovation and Employment*

Switzerland

Earlier this month, Switzerland approved an Association Agreement with Horizon 2020, indicating that, in January 2017, Switzerland will be fully associated with Horizon 2020 and Swiss researchers will be eligible for receiving funding for their projects, a major status change from the "partial association" in effect between September 2014 and December 2016. With this new status, Switzerland can send observers to participate in any meetings regarding the implementation of Horizon 2020, as well as participate in meetings with the Board of Governors of the European Commission's Joint Research Center and the European Research Area. For these rights as a fully associated Horizon 2020 country, Switzerland is required to pay a monetary fee to the EU budget, based on a ratio between the country's GDP and the total number of the Member States of Union GDP, as based on the Agreement.

All research projects that began before the Agreement will be unaffected and treated as projects from a non-associated country. As the Agreement does not come into effect until January 1, 2017, Switzerland will still be considered a non-associated country, except in regards to: the Excellent Science pillar, which includes the European Research Council, Future and Emerging Technologies and Research Infrastructures; an exclusive objective of "spreading excellence and widening participation"; the Euratom Program; and any activities implemented by the European Joint Undertaking for the ITER project, as well as the Development of Fusion for Energy for 2014–2020.

Source: *European Commission*

Japan

Earlier this month, the Statistics Bureau, part of the Ministry of Internal Affairs and Communications, released the results of 2016's "Survey of Research and Development" in Japan. The largest data sets regarding R&D personnel, capital, sales and R&D expenditure was collected for the fiscal year ending March 31, 2016. The survey covers business enterprises; nonprofit institutions and public organizations, including corporations and research institutions; and universities and colleges, including university and facility faculties, junior college organizations, technical colleges, university-associated research institutions, inter-university research institutes, corporations and the National Institute of Technology. The FY16 survey covered approximately 13,500 business enterprises, 1,100 nonprofit institutions and public organizations, and 3,700 universities and colleges, for an approximate total of 18,300 respondents. An estimated 82% of business enterprises, 99% of nonprofit institutions and public organizations, and 100% of universities and colleges submitted responses.

For the first time in three years, in FY15, Japanese total R&D expenditures decreased 0.2% to JPY 18.94 trillion ($160.9 billion = JPY = 117.69 = $1). As a percentage of GDP, R&D spending declined 10 percentage points to 3.6%. The total number of research personnel decreased 2.3% to 847,100.

For business enterprises, R&D expenditure increased 0.7% to JPY 13,686 billion ($116.3 million), the only sector to

show an increase. R&D spending for universities and colleges decreased 1.4% to JPY 3,644 billion ($31.0 million), while expenditures for nonprofit institutions and public organizations decreased the most to JPY 1,609 billion ($13.7 million), a 4.7% drop.

By industries in the business enterprises sector, transportation equipment had the largest increase of 3.8% to JPY 2.95 trillion ($25.1 billion) and made up 22% of all business enterprises industries' spending. Medicines represented 11% of business enterprises' R&D expenditure, while scientific development and research institutes, and chemical and allied products both made up 6%.

Data regarding the technology balance of payments by business enterprises indicated that technology exports increased 6.4% to JPY 3.35 trillion ($28.5 billion), its highest figure ever, with receipts from technology imports increasing 7.9% to JPY 3.95 trillion ($33.6 billion) and payments from technology imports rising 17.5% to JPY 603 billion ($5.1 billion).

Source: *Statistics Japan*

Broad-based Companies

Company Announcements

For the fiscal half year ending October 1, **Halma Environmental & Analysis** revenue grew 13.2%, 4% organically, to £98.7 million ($110.9 million = €0.89 = $1) to account for 22% of sales (see ***IBO*** 11/30/16). Organic growth was primarily driven by higher sales in each of the Environmental, Water and Food Safety businesses. Geographically, currency-neutral sales improved in Asia Pacific and the US, but declined in both the UK and Europe. Segment adjusted operating profit margin slipped 71 basis points to 16.2%.

For the year ending September 30, revenues for molecular genetics firm **Oxford Gene Technologies** grew 15.2% to £19.7 million ($28.1 million). Product sales increased 28.6% to £18.4 million ($26.3 million).

In November, **Agilent Technologies** named Peter Robinson, MD, MSC, as a recipient its Agilent Thought Leader Award in recognition of his contributions to clinical genomics and computational biology. The funding will be used to extend his research to identify non-coding regions of the genome involved in gene regulation and disease.

In December, **Agilent Technologies** announced that Dr. Rohit Bhargava received an Agilent Thought Leader Award in recognition of his work in the development of IR spectroscopic imaging and its application to life sciences research. He is a founding professor of bioengineering at the **University of Illinois Cancer Center**, and is founder and director of the **Cancer Community at Illinois** program. The Award will fund research for facilitating IR analysis of histological samples, in particular utilizing Agilent's Laser Direct Infrared Imaging technology.

Illumina announced in November in an **SEC** filing that Tristan Orpin, executive vice president, Clinical Genomics, will leave the company in January 2017.

In December, **Illumina** announced that Sam A. Samad was named senior vice president and CFO, effective January 6, 2017. Most recently, he served as senior vice president and corporate treasurer for **Cardinal Health**.

Illumina named Jonathan Seaton as senior vice president for Corporate & Business Development, effective January 3, 2017. He previously served as vice president and head of Strategy and Business Development for **Becton, Dickinson's Life Sciences segment**.

In December, **Danaher** promoted Rainer Blair, president of **Pall** and a Danaher vice president, executive vice president, effective January 1, 2017. He will have responsibility for the company's **Life Sciences** platform.

AMETEK named Bruce P. Wilson as senior vice president, **Ultra Precision Technologies**, in December. He previously served as vice president and general mananger. Ultra Precision Technologies businesses include **Taylor Hobson** and **Reichert**.

Peter Chambré stepped down from the **Spectris** board, effective December 2, and Chairman Dr. John Hughes

announced he intends to resign.

Bruker announced in December SEC filing that René Lenggenhager, **Bruker BioSpin** president, will be leaving the company effective February 24, 2017, to become CEO of **COMET-Group**.

In December, **Waters** named Sherry Buck as named senior vice president and CFO, effective January 9, 2017. She will replace Eugene G. Cassis, who will serve as a senior advisory. She previously served as vice president and CFO of **Libbey**.

Thermo Fisher Scientific announced in December its Center of Excellence in Immunotherapy Program designed to build strategic collaborations, and accelerate research and clinical trials in immune-oncology. The first partner is **Washington University School of Medicine**. The University's **Center for Human Immunology and Immunotherapy Programs**, led by Dr. Robert Schreiber, will utilize a Thermo Fisher technology–led workflow, including transcriptomic profiling of clinical trial samples, deep immune profiling with immuno-assays, antigen discovery using MS, and RNA-ISH technologies to explore novel targets through in situ analysis of tumor microenvironments.

In December, **Thermo Fisher Scientific** announced in a **SEC** filing that Peter W. Wilver, executive vice president and chief administrative officer, will retire, effective March 31, 2017.

The *LimerickPost* reported in December that **Becton, Dickinson** (BD) will open an R&D center in Limerick, Ireland. The €21 million ($23 million) Centre of Excellence will initially target the company's Life Sciences business. The Centre will employ 200, including 100 new employees. At present, BD has nearly 600 employees in Ireland.

Titertek-Berthold/Berthold Detection Systems will merge with the life science business of **Berthold Technologies**, effective January 1, 2017. The new entity will be led by Titertek-Berthold President Dr. Anselm Berthold.

MS & LC/MS

Company Announcements

Shimadzu and India-based **Veeda Clinical Research** signed a memorandum of understanding in August to collaborate on clinical research using MS, including use in clinical trials.

In September, **Microsaic Systems** Chairman Colin Nicholl announced that he will retire on January 31, 2017.

Agilent Technologies announced in November a comarketing agreement with CRO **PureHoney Technologies** to develop new applications on its RapidFire 365 High-throughput Mass Spectrometry System for pharma and biopharma research, and forensic toxicology and metabolomics analysis. PureHoney was founded by the original developers of RapidFire MS instrumentation.

In November, **Protea Biosciences** named David Halverson as president. He previously served as vice president and CBO.

In November, **Advion** named **Accurate Mass Scientific** as an Australian distributor.

Product Introductions

In September, **Sage-N Research** launched the Linux-based SORCERER Storm, a cloud-based platform for precision proteomics. Key analytics are built with transparent scripts. The platform can be rented as a "virtual system," enabling payment for only the resources that are used.

In October, **CAMAG** released the CAMAG TLC-MS Interface 2, featuring a modified elution head and easily accessible, exchangeable filter, arranged in front of the valve.

PerkinElmer launched in October the QSight triple quadrupole MS, which is based on technology gained through its acquisition of **Ionics** (see ***IBO*** 9/30/16). Combined with the company's Altus UPLC system, it provides a complete solution for food, industrial and environmental applications.

In November, **Mass Spec Analytica** introduced the TEIS-3200, its new Thermal Extraction Ion Source for the SCIEX 3200 Triple Quadrupole MS and other V-Series models. It speeds up workflow times compared to GC/MS analysis.

Biognosys announced in November that its targeted proteomics portfolio now supports parallel reaction monitoring measurements.

In November, **Biognosys** released Spectronaut 10, a proteomics software tool for hyper reaction monitoring, featuring improved quantification logics and a new protein quantification algorithm.

PREMIER Biosoft introduced in December SimLipid 5.50, featuring automated data analysis for shotgun lipidomics workflows. Native files from **Waters** and **Shimadzu** are now supported.

Sequencing

Company Announcements

In October, the Chinese **FDA** approved **BGI**'s BGISEQ-500 sequencer as a medical device.

China Money Network's website reported on November 3 that regulators terminated Chinese sequencing company **BGI**'s application to list on the Chi-Next board of the **Shenzhen Stock Exchange**, citing incomplete documentation.

In December, **BGI** opened an office in Seattle Washington, forming BGI Groups USA, as part of the company's North American expansion.

Horizon Discovery entered into OEM partnerships in November with three Chinese diagnostic kit developers to provide its HDx Reference Standards for novel NGS assay development, clinical trials and, eventually, for in-kit controls.

In November, **Genalyte** announced that it raised an additional $36 million in its latest financing round.

In December, **Oxford Nanopore** completed $126 million in fundraising through a private placement of ordinary shares, led by new investor **GT Healthcare Capital Partners**. This brings the total funds raised by the company to $444 million. The same month, **Oxford University's Wellcome Trust Centre** and **Genomics plc** announced the first sequencing and analysis of multiple human genomes using Oxford Nanopore's MinION sequencer.

GenDx, a company focused on development, production and sales of innovative assays and analysis software for transplantation medicine and companion diagnostics, announced in December a reseller agreement with **Illumina** for instruments, reagents and maintenance contracts for the field of HLA sequencing in a restricted number of countries, including Benelux, Italy, UK, Germany and Finland. The products will be delivered by GenDx's local distributors.

In December, **Rubicon Genomics** signed a supply agreement with **Agilent Technologies** for its PicoPLEX WGA kits. They will be sold with Agilent's GenetiSure Pre-Screen Kit for pre-implanation genetic screening.

Product Introductions

In November, **BGI** launched the BGISEQ-50 NGS sequencer based on probe-anchor synthesis and DNA nanoballs technology. Including sample preparation, the sequencing process takes 18 hours. Sixteen NIPT tests can be completed per run. Initially launched in China, deliveries of the system will begin in early 2017.

Thermo Fisher Scientific introduced in November four additional NGS multi-biomarker targeted assays for cancer research: the Oncomine Immune Response Research Assay, the Oncomine BRCA Research Assay, the Oncomine Breast cfDNA Assay and the Oncomine Colon cfDNA assay. The Oncomine Immune Response Research Assay is a 395-gene panel, requiring 10 ng of FFPE RNA, designed to interrogate the tumor microenvironment and enable identification of predictive biomarkers for immunotherapy clinical research trials.

In November, **QIAGEN** and **CosmosID** released a metagenomics analysis plugin for the QIAGEN Microbial Genomics Pro Suite and CLC Genomics Workbench. The plugin supports shotgun metagenomics and microbiome profiling.

Oxford Gene Technology launched in December the SureSeq myPanel NGS Custom FH Panel for the study of familial hypercholesterolemia, featuring both SNV and CNV detection in a single NGS assay.

In December, **Personal Genome Diagnostics** introduced the CancerSELECT 125 test for pan-cancer tumor profiling, which incorporates assay technology and bioinformatics.

Sales/Orders of Note

BGI announced in November that it has received more than 500 orders for its BGISEQ-500 system since the end of 2015.

In November, **Parabon Nanolabs** announced the award of a two-year **US Department of Defense** contract to develop a software platform for forensic analysis of DNA evidence. The platform would allow bioinformatics data from any forensic science instrument to be analyzed via software plugins. The **Institute of Advanced Genetics at the University of North Texas Health Science Center** will assist in the project.

Life Science Instruments

Company Announcements

In November, **Nanomedical Diagnostics**, a company driving the use of biosensor assays for life science research and diagnostics, named Dr. Joe Keegan, former president and CEO of **ForteBio**, to its Board.

In October, **Luminex** named Tadd S. Lazarus, MD, as senior vice president and CMO. Previously, he served as CMO at **QIAGEN**.

Innopsys named **Applied Microarrays** as a distributor in November.

In November, **NanoString Technologies** announced a new myeloid gene expression collaboration with the **OHSU Knight Cancer Institute** to create two new myeloid-focused research panels. The company is working with Lisa Coussens, PhD, professor and chair of the Developmental & Cancer Biology Department.

Quanterix announced in November a strategic collaboration with **UmanDiagnostics**, a company specializing in early detection of brain diseases, for access to a Simoa NeuroFilament Light assay.

Synoptics, a **Scientific Digital Imaging** business, named Dr. Brian Stammers as CEO in November. Most recently, he spent five years working as an international trade adviser for **UK Trade & Investment**.

In December, **AYOXXA Biosystems** announced that Rodney Turner was named permanent CEO. He was a senior corporate development executive at **Life Technologies** and has been a member of AYOXXA's Board since 2014.

Gyros Protein Technologies appointed **Abacus** as its exclusive distributor of its immunoassay products in Australia and New Zealand.

SYGNIS entered into an agreement in December to acquire US-based **C.B.S. Scientific** for $900,000 in cash and

stock. C.B.S. provides electrophoresis equipment, and scientific instrumentation for genomics and proteomics research. Its annual revenues total over $1.5 million, and it is profitable. SYGNIS expects the acquisitions to be earnings enhancing and cash generative immediately.

Product Introductions

In November, **SCIENION** introduced the sciREADER FL2 for fluorescence detection of multiplex assays, featuring three fluorescent channels. The company stated that "it's the only reader on the market which allows for high quality imaging of 96-well plates for standard fluorescence single parameter assays and multiplexed assays."

ProZyme launched in November the Gly-Q Glycan Analysis System for high-throughput glycoanalysis, combining sample preparation and detection. The capillary electrophoresis–based system is designed for use in biotherapeutic development and glycan biomarker discovery.

NanoString Technologies announced in November that it has begun accepting applications to its Technology Access Program for its Digital Spatial Profiling technology, which allows sequential analysis of multi-target IHC slides on a single slide.

In November, **Optiscan** released the second generation View*n*Vivo miniaturized fluorescence endomicroscope platform for preclinical research.

In December, **SGI-DNA** launched the Custom Cloning Module for its BioXp 3200 System for synthesizing and cloning DNA directly into a vector of choice in an overnight run. Researchers can now add vectors for automated Gibson Assembly cloning from de novo–generated DNA fragments.

PathSensors introduced in December the new biosensor-based Bioflash MailGuard system for biothreat detection. It can detect more than 25 biological threats, including anthrax and ricin, in concentrations as low as 100 CFU in less than five minutes.

Reported Financial Results

$US	Period	Ended	Sales	Chg.	Op. Prof.	Chg.	Net Prof.	Chg.
Enzo Biochem	Q1	31-Oct	$26.3	4.4%	($1.3)	NM	$1.5	-66.8%
Enzo Biochem (Life Sci.)	Q1	31-Oct	$8.1	0.0%	$7.6	0.0%	NA	NA
Kewaunee Scientific	Q2	31-Oct	$36.3	17.1%	$2.3	102.7%	$1.5	113.8%

NA = Not Available, NM = Not Meaningful