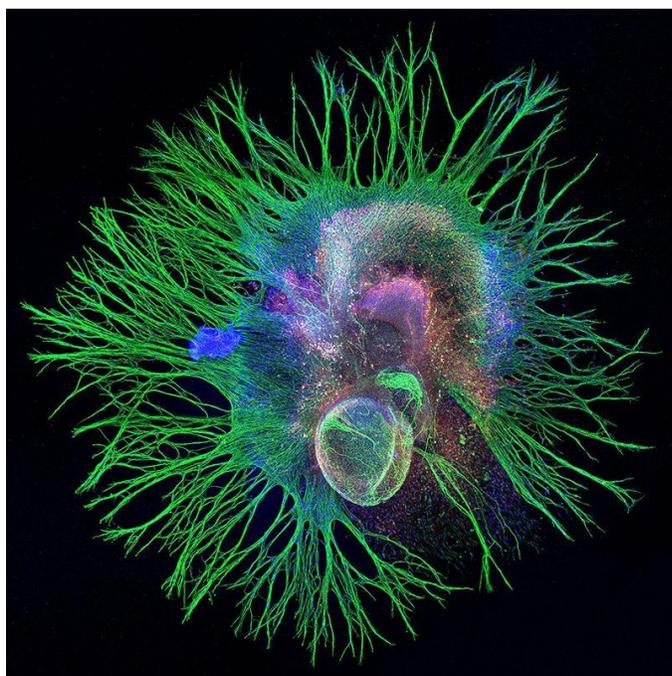


Analytical, Life Science & Diagnostics Association Industry Market Assessment - Quarterly Review

February 2019

Fourth Quarter (Q4 2018)



Mouse inner ear: Freeman and Delacroix, Liège University

Prepared by
Strategic Directions International, Inc.



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Preface

This issue of the ALDA Industry Market Assessment Quarterly (IMAQ) Review prepared by Strategic Directions International, Inc. (SDi) addresses industry results for the fourth quarter of 2018 (October to December). As in the reviews presented in previous years, 15 product categories of particular interest to ALDA are addressed, which generally align with product categories presented in ***SDi Global Assessment Report 2019***, which has just been published this month.

The ALDA Board selected SDi to provide industry growth and segmentation data on a quarterly basis as an aid to members for planning and performance measurement purposes based on current industry trends. SDi provides the IMAQ 2 months following the end of each calendar quarter. The next issue covering the first quarter results for 2019 will be published at the end of May. This year-end issue also includes a presentation with additional detail on the life science and cell analysis markets.

SDi has been providing consulting and market intelligence to industry participants for over 30 years. We are well-positioned to assess industry trends based upon our infrastructure for tracking market developments for both our consulting practice and our various publications including the ***SDi Global Assessment Report 2019—The Laboratory Analytical and Life Science Instrumentation Industry***, which covers 81 analytical and life science instrument technologies. In addition to the new 2019 version of the ***Global Assessment Report***, the publication schedule for the year will cover topics like **Laboratory Software, Purification & Filtration, Liquid Biopsy**, and the market for instruments in **Europe** and **Southeast Asia**, among other titles. SDi also stays on top of industry events with its industry leading newsletter, ***Instrument Business Outlook (IBO)***.

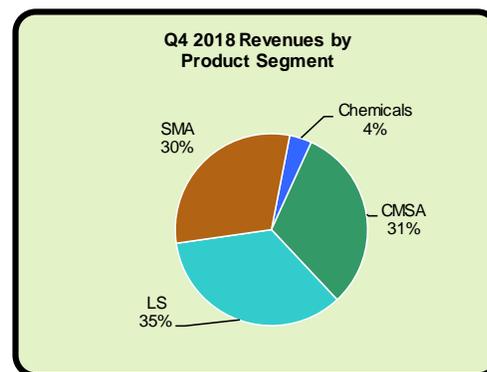
Many of our reports are published for the general industry reader, and in most cases on an annual basis. What differentiates this report is that it is specifically tailored to meet the needs of the ALDA membership. It is designed to present information on a more frequent quarterly timeframe, at a level of detail that is readily available and useful, and that focuses on the 15 technology markets most important to the membership. The aggregate market of these 15 ALDA segments represents about 75–80% of global industry revenues at end-user values. Of course, many ALDA member companies are involved in a number of technology areas, so multiple presentations are included to show the differences in market growth and regional and industrial prospects for those businesses.

PART A. FOURTH QUARTER MARKET RESULTS

Q4 Revenues by Product Segment

\$Mil	2018	2017	Growth
Chrom, Mass Spec & Automation (CMSA)	3,993	3,717	7.4%
Spectroscopy and Materials Analysis (SMA)	3,880	3,686	5.2%
Life Science (LS)	4,442	4,063	9.3%
Analytical Chemicals	480	445	7.8%
Total	12,795	11,912	7.4%

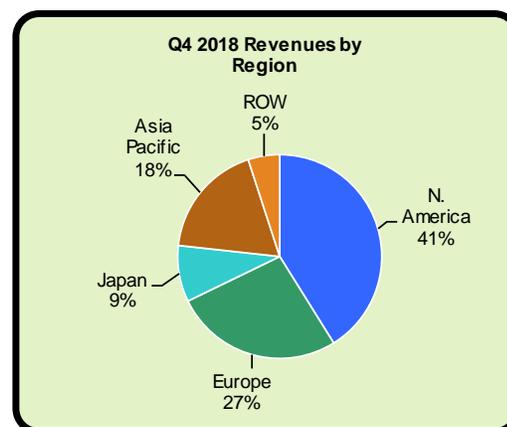
Total revenues in the fourth quarter of 2018 approached \$12.8 billion, an increase of 7.4% compared to the same period in 2017. The life science (LS) market (cell analysis, life science instrumentation, sample prep, and reagents) was again the strongest individual segment, climbing 9.3% and making up more than a third of total demand. Chromatography, mass spectrometry, & laboratory automation (CMSA) was the next largest segment, and grew faster than the remaining instrumentation segment, spectroscopy and materials analysis (SMA). Analytical chemicals experienced solid growth of 7.8% in the quarter, representing 4% of total market revenues.



Q4 Revenues by Region

\$Mil	2018	2017	Growth
N. America	5,262	4,851	8.5%
Europe	3,413	3,218	6.0%
Japan	1,144	1,090	5.0%
Asia Pacific	2,337	2,128	9.8%
ROW	639	625	2.3%
Total	12,795	11,912	7.4%

North America ended the year on a strong note with growth above the overall average, buoyed by both private and public increases in demand. Nevertheless, Asia Pacific continued to be the growth leader for instrumentation, with growth that would have been in double digits had currency effects not provided a headwind. European and Japanese growth were both solidly in the mid-single digits. However, the developing nations of Rest-of-World were rather weak in the fourth quarter, with growth of just 2.3% in the quarter compared to last year.

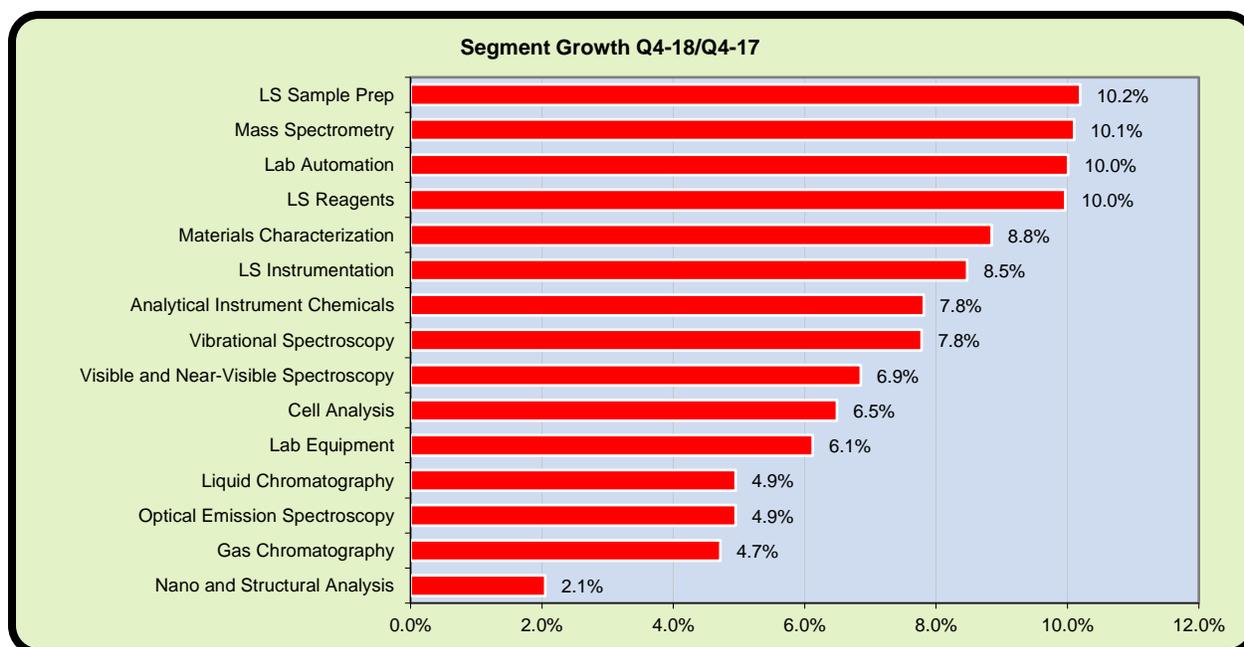


The market defined by ALDA consists of about 50 technology segments and accounts for 75–80% of the worldwide revenues for analytical and life science instrumentation. There are about twenty-five technology segments not included in the ALDA IMAQ Review such as surface science techniques (e.g., optical microscopes), informatics (e.g., LIMS, bio/cheminformatics), separation techniques (e.g., flash chromatography, TLC, CE), physical testing, elemental analyzers, radioactivity and several other technologies.

1. Q4 2018 Revenues by Product

Q4 Revenues by Product

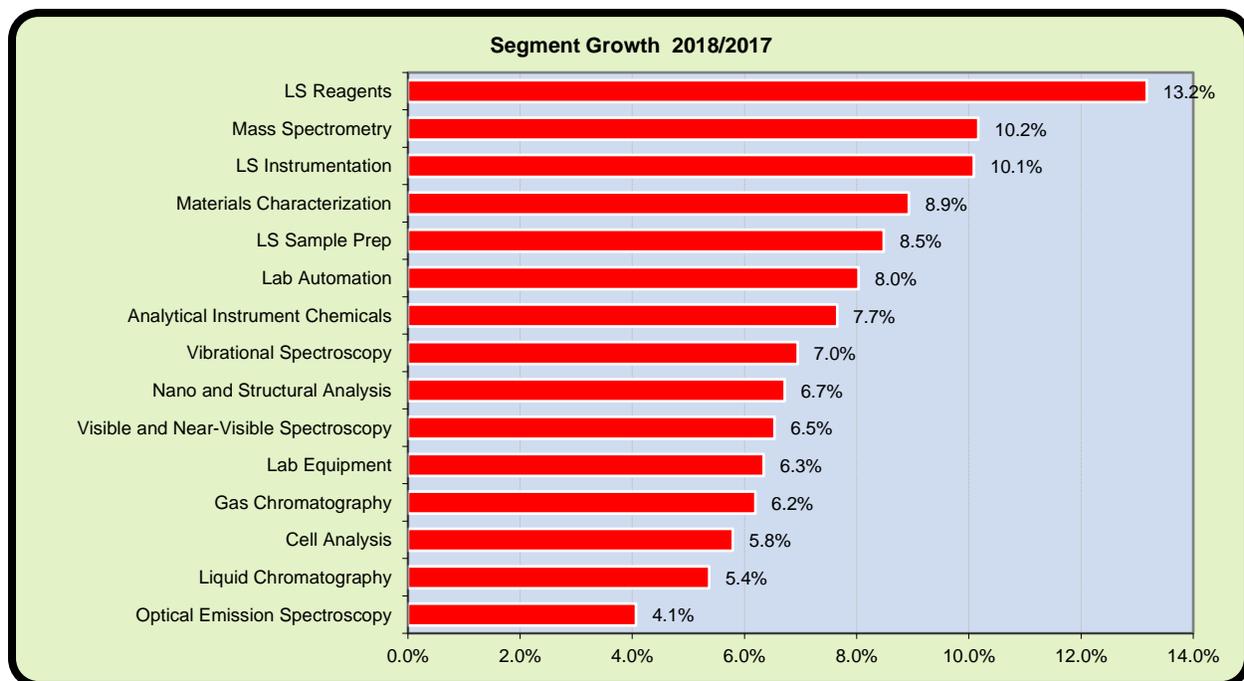
\$Mil	2018	2017	Growth
Spectroscopy and Materials Analysis	3,880	3,686	5.2%
Laboratory Equipment	763	719	6.1%
Materials Characterization	571	524	8.8%
Nano and Structural Analysis	1,327	1,301	2.1%
Optical Emission Spectroscopy	333	318	4.9%
Vibrational Spectroscopy	452	420	7.8%
Visible and Near-Visible Spectroscopy	433	405	6.9%
Chrom, Mass Spec & Automation	3,993	3,717	7.4%
Gas Chromatography	615	587	4.7%
Laboratory Automation	917	833	10.0%
Liquid Chromatography	1,358	1,294	4.9%
Mass Spectrometry	1,103	1,002	10.1%
Life Science	4,442	4,063	9.3%
Cell Analysis	369	347	6.5%
Life Science Instrumentation	1,163	1,072	8.5%
Life Science Reagents	1,982	1,803	10.0%
Life Science Sample Prep	927	842	10.2%
Analytical Chemicals	480	445	7.8%
Total	12,795	11,912	7.4%



2. 2018 Revenues by Product

Twelve Months Revenues by Product

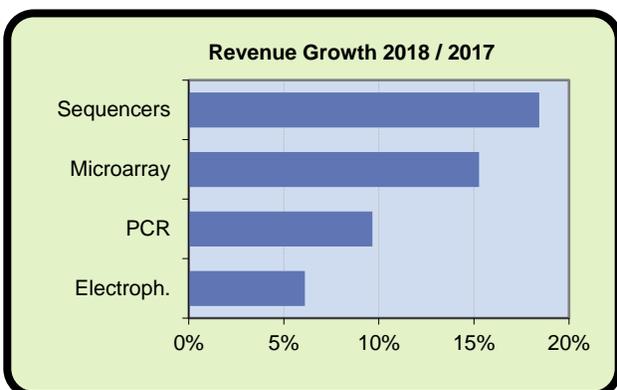
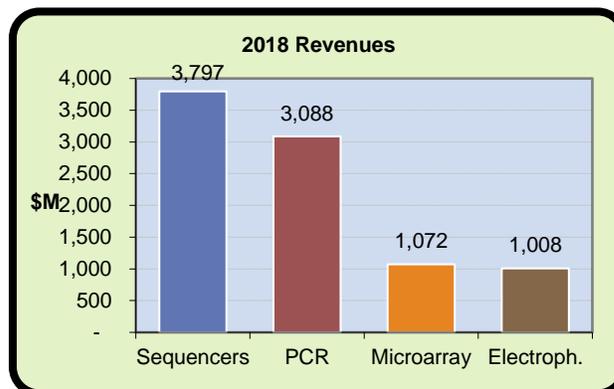
\$Mil	2018	2017	Growth
Spectroscopy and Materials Analysis	14,257	13,358	6.7%
Laboratory Equipment	2,630	2,473	6.3%
Materials Characterization	2,012	1,847	8.9%
Nano and Structural Analysis	5,183	4,857	6.7%
Optical Emission Spectroscopy	1,225	1,177	4.1%
Vibrational Spectroscopy	1,662	1,554	7.0%
Visible and Near-Visible Spectroscopy	1,547	1,452	6.5%
Chrom, Mass Spec & Automation	14,760	13,742	7.4%
Gas Chromatography	2,448	2,305	6.2%
Laboratory Automation	3,249	3,007	8.0%
Liquid Chromatography	4,933	4,682	5.4%
Mass Spectrometry	4,129	3,748	10.2%
Life Science	16,150	14,594	10.7%
Cell Analysis	1,269	1,199	5.8%
Life Science Instrumentation	4,383	3,982	10.1%
Life Science Reagents	6,904	6,101	13.2%
Life Science Sample Prep	3,594	3,313	8.5%
Analytical Chemicals	1,834	1,703	7.7%
Total	47,001	43,399	8.3%



3. Life Science & Cell Analysis Review 2018

Life Science Instrumentation Market Size

With reagents and chemicals folded back into the product mix, total revenues for life science instrumentation reached nearly \$9 billion in 2018. Sequencing continues to be the biggest engine of growth, with NGS and newer long-read technologies sparking interest. PCR revenues exceeded \$3 billion for the first time, while electrophoresis and microarray demand each topped \$1 billion.

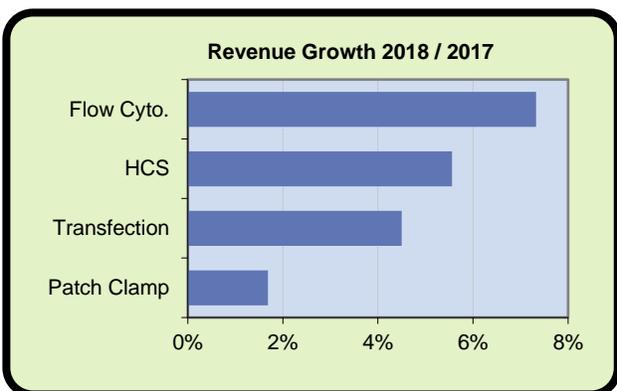
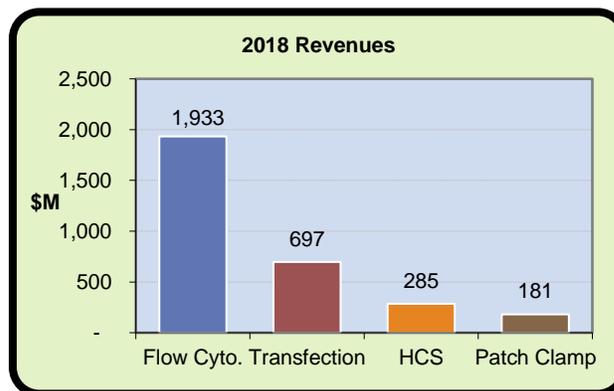


Life Science Instrumentation Market Growth

The sequencing market set a blistering pace, with growth approaching 20% for the year, as new technologies and established workhorses are all seeing usage explode. Microarray technology also had a banner year, as a new revenue stream for direct to consumer testing opens up new opportunities. PCR demand grew in the high single digits, while electrophoresis advanced more modestly at 6.1% compared to the prior year.

Cell Analysis Market Size

Including systems, aftermarket, and service, total revenues for cell analysis technologies were \$3.1 billion in 2018. Total growth for the year is estimated at 6.2%. Flow cytometry is the largest product segment, with total 2018 revenues of nearly \$2 billion. Transfection demand made up 23% of the cell analysis market, while high content screening/analysis and electrophysiology/patch clamp techniques represented 9% and 6% of the market, respectively.



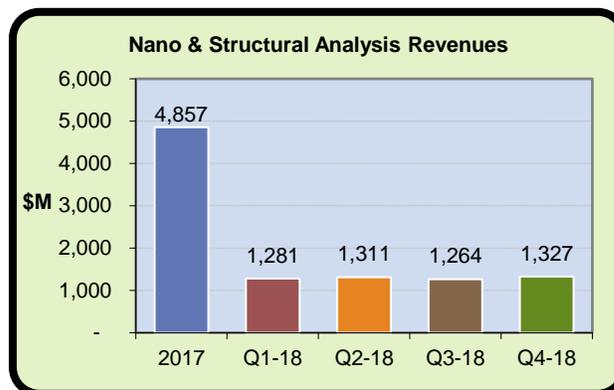
Cell Analysis Market Growth

Flow cytometry had an excellent year, and led in terms of growth for the cell market. Benchtop systems appeal to researchers who can have a 'personal' instrument, while the clinical market drives growth for full-featured systems. HCS and Transfection had 2018 growth in the mid-single digits, while patch clamp advanced the least for the year. Manual patch clamp systems are losing favor in the market, while automated systems may have plateaued for the moment.

PART B. NANO AND STRUCTURAL ANALYSIS

Overview

The nano and structural analysis market is composed of four segments: nuclear magnetic resonance (NMR), electron microscopy, X-ray diffraction (XRD) and X-ray fluorescence (XRF). Revenue estimates include initial systems, components, consumables, and service, but exclude small amounts of life science reagents and analytical chemicals, which are considered elsewhere. Currency headwinds and a strong prior comparison curbed quarterly growth to 2.1%. For the year, growth was 6.7% over 2017.

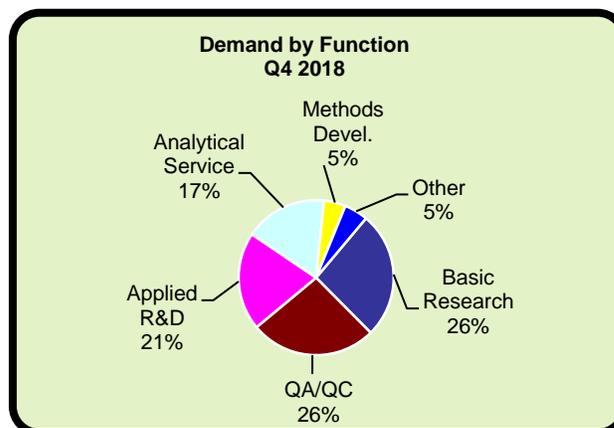


Regional Demand

North American demand saw the greatest advance in the fourth quarter, slightly edging out Asia-Pacific growth, which was dragged down by cooling economies and currency headwinds in India and China. While Europe and Japan managed positive growth for the quarter, the Rest-of-World segment contracted more than 2%. Commodities industries in Latin America and South Africa were particularly poor, and government demand did not overcome this industrial weakness.

End-User Markets

The functional distribution for these techniques is quite broad. Basic research and quality control each account for about 26% of the market. While all of the techniques contribute to both markets, NMR and XRD are more research oriented on the whole, while XRF has much stronger usage for quality control applications. Electron microscopy has perhaps the broadest possible functional usage, with applications ranging from structural research on proteins to examining defects in semiconductor devices.



Market Developments

In October, Hitachi High-Tech introduced a new entry-level handheld X-ray fluorescence (XRF) X-MET8000 Smart model to offer users a more competitively priced option. Also in October, Quantum Analytics signed a distribution deal covering Bruker benchtop XRF and XRD products in the United States.

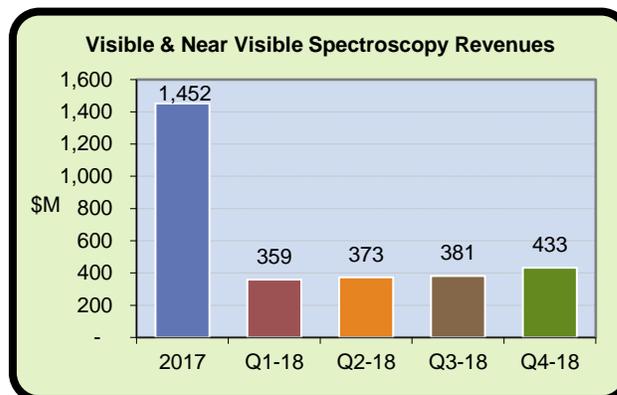
Near Term Prospects

There are signs of a new trade deal between China and the US, which should alleviate some of the barriers to trade that currently exist. If that comes to fruition, this would provide a boon to these technologies, particularly for XRF.

PART C. VISIBLE AND NEAR VISIBLE METHODS

Overview

The visible and near-visible methods market comprises UV/Visible spectroscopy, fluorescence, color measurement, ellipsometry, polarimetry, and refractometry. Revenue estimates include initial systems, components, consumables, and service, but exclude life science reagents and analytical chemicals, considered elsewhere. Over the fourth quarter of 2018, the market grew by 6.9% from 2017.

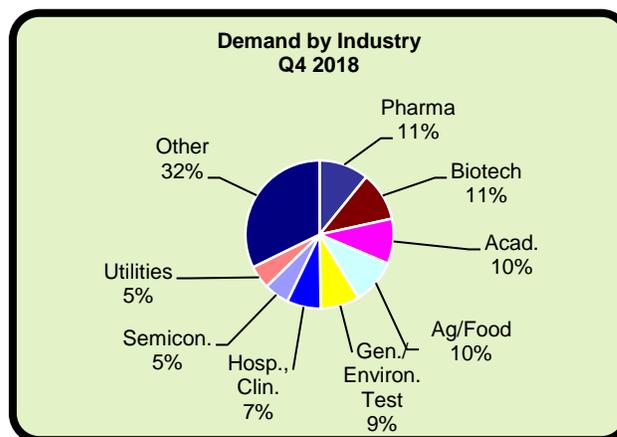


Regional Demand

The most growth for Q4 came from Asia-Pacific and North America, in both cases largely from the pharma/bio sector. Contrasting this high growth was a slowdown in Europe, partly over concerns of the looming possibility of a hard Brexit. Similar growth was seen in Japan and ROW, where slowing aerospace/automobile and metals/mining industries offset growth in other industries.

End-User Markets

Demand by industry in Q4 was led by the pharma/bio sector, supported by strong growth across most geographies. Applied markets also saw strong growth this quarter, mostly coming from the ag/food industry and general/environmental testing. In particular, UV/Vis spectroscopy is one of the main techniques utilized when testing for water quality. Similar testing is carried out by utilities, which also saw moderate growth for the quarter. Growth from the semiconductor industry remained strong, despite some signs of slowing.



Market Developments

Agilent introduced the Cary 3500 UV/Vis spectrophotometer. PicoQuant launched the new FluoTime time-resolved fluorescence spectrometer.

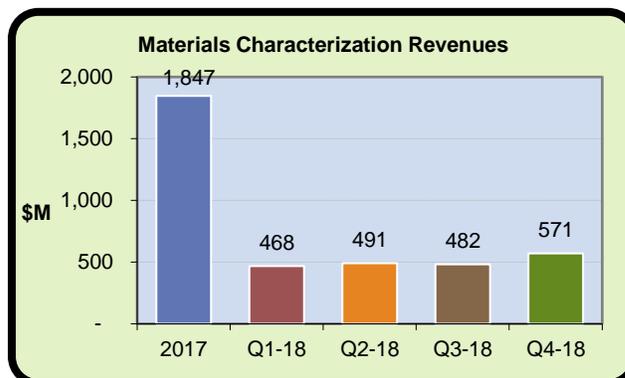
Near Term Prospects

Environmental testing has been, and will continue to be a major source of demand with emerging markets continuing to push for ways to fight pollution and climate change.

PART D. MATERIALS CHARACTERIZATION

Overview

The materials characterization market comprises thermal analysis, calorimetry, particle characterization (now including particle counters), and viscometry/rheometry. Revenue estimates encompass initial systems, components, consumables, and service, but exclude small amounts of life science reagents and analytical chemicals. Fourth quarter revenues grew 8.8% compared to last year, in line with the full year growth rate of 8.9% for 2018 over 2017.

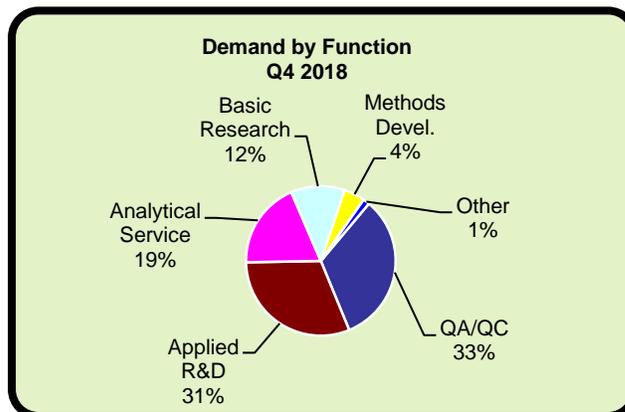


Regional Demand

Asia-Pacific grew the fastest with a double-digit rate driven by strong demand from pharma, polymers, semiconductors, and environmental testing in China, South Korea, and Taiwan. North America had a high single-digit growth rate supported by solid performances in the pharmaceuticals industry. Similarly, Europe is growing moderately due to big pharma and chemical companies, but offset by Brexit and tariff issues. Japan also had a strong performance in chemicals and pharma/bio, but slower industrial demand.

End-user Market

Quality control applications were the largest functional segment of demand in the fourth quarter, making up about a third of the total. Polymers, chemicals, and oil & gas industries commonly employ material characterization techniques as a part of their QC process. Applied R&D was the next largest segment, with strong contributions from the pharmaceutical industry, where technologies such as thermal analyzers, particle analyzers, and calorimetry are used to refine formulations, ingredients, and excipients.



Market Developments

In October, Particle Testing Authority, a division, of Micromeritics, acquired Freeman Technologies' FT4 Powder Rheometer and Mettler Toledo's Mastersizer 3000 product lines. In December, HORIBA launched the Partica LA-960V2, an upgrade of the current model, with nanoparticle measurement resolving peaks at 20 nanometers.

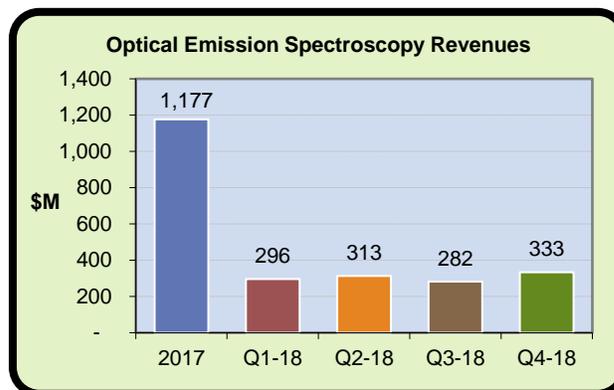
Near Term Prospects

Materials characterization is estimated to grow high single-digit in the first quarter of 2019. Continuing strong demand from semiconductors and environmental testing will drive the market, especially in Asian countries. However, oil prices volatility and tariff uncertainties, especially for metals and consumer products, still cloud the potential for this market.

PART E. OPTICAL EMISSION SPECTROSCOPY

Overview

The optical emission spectroscopy market comprises atomic absorbance (AA), inductively coupled plasma (ICP) and arc/spark optical emission spectroscopy. Revenue estimates encompass initial systems, components, consumables, and service, but exclude analytical chemicals, which are considered elsewhere. These technologies ended on a high note, with revenues increasing 4.9% in the fourth quarter. For the year, sales rose 4.1%.

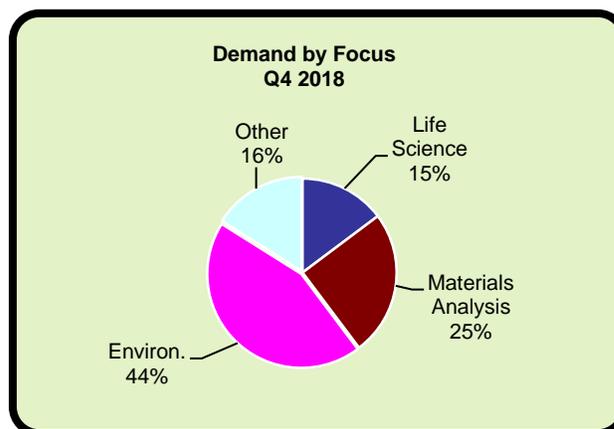


Regional Demand

Asia-Pacific sales continue to lead the pack, with Chinese environmental spending remaining very strong for these instruments. North America also achieved excellent growth across numerous industries and government testing labs. The Rest-of-World segment saw some renewed strength not just for environmental testing, but also for the arc/spark market, important to metals production and mining.

End-User Markets

Nearly half of the market for these instruments is involved in environmental testing as a primary focus. This stems not just from environmental test labs, but also government regulatory agencies and labs situated in the regulated industries. Although the materials analysis segment has declined slightly compared with last year, the signals are starting to turn around, presaging better prospects from the metals industry, and industries that rely on alloys, such as the automotive and aerospace industry.



Market Developments

In November, AMETEK announced its acquisition of Spectro Scientific, which had annual sales across all product lines of about \$50 million. Arc/spark spectroscopy for oil analysis is a major product for the company.

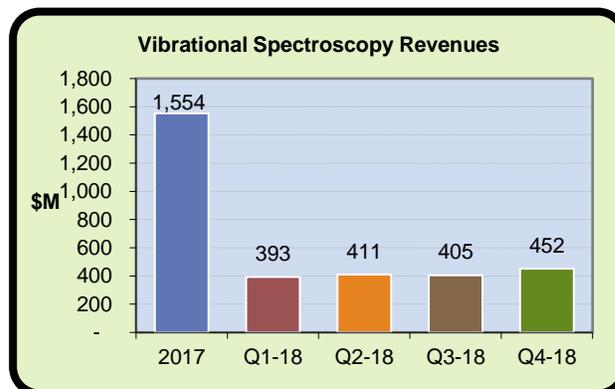
Near Term Prospects

Applied markets, including not only environmental testing, but also important agriculture and food applications, will increase demand for AA and ICP. Stronger spending from metals on arc/spark instrumentation should continue through 2019.

PART F. VIBRATIONAL SPECTROSCOPY

Overview

The vibrational spectroscopy market comprises infra-red, near-infrared (NIR), and Raman spectroscopy, including both conventional and Fourier transform (FT) methods. Revenue estimates encompass initial systems, components, consumables, and service, but exclude analytical chemicals, considered elsewhere. Quarterly market demand increased 7.8% over Q4 last year.

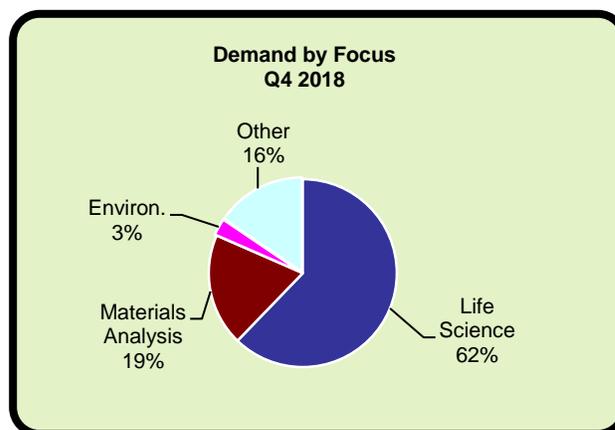


Regional Demand

Despite political concerns in the US around the partial government shutdown and trade with China, North America saw strong growth over the quarter. This growth was only outpaced by Asia-Pacific, which saw strong performance from pharmaceuticals and semi-conductors in countries like China and South Korea. A slower European economy and concerns around Brexit kept growth low, while Japan saw better growth from better performance from its pharmaceutical and chemical industries.

Laboratory Focus

Life science makes up the majority of demand for vibrational spectroscopy instruments. This lab focus saw the fastest growth over the quarter driven by strong pharmaceutical spending over the quarter. Materials analysis and other made up about one-third of demand, and both of these lab segments saw mid-single digit growth, driven in part by growth in the ag/food and semiconductor/electronics industries. Environmental also saw mid-single digit growth and makes up the smallest share of laboratory focus.



Market Developments

Thermo Fisher introduced the Nicolet iS20 FTIR spectrometer, and Bruker launched the INVENIO S FTIR spectrometer. Spectro Scientific released new versions of its FluidScan MIR spectrometer, the FluidScan 1000 and 1100.

Near Term Prospects

Regulatory reforms to the ag/food industry in China are nearing completion, which will slightly lessen demand for vibrational spectroscopy in that region. The event of a hard Brexit will not change the short-term demand for these technologies, but could pose a significant challenge to future trade with the UK.

PART G. LAB EQUIPMENT

Overview

The lab equipment market is comprised of a group of relatively low-cost instruments including: centrifuges, electrochemistry products, and laboratory balances. The market includes initial systems sales, aftermarket purchases and service. The fourth quarter of 2018 experienced 6.1% year-over-year growth.

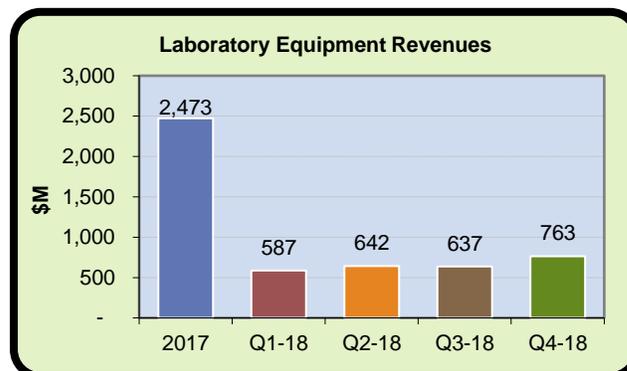


End-User Markets

Basic research and applied R&D drove lab equipment demand and together accounted for over half of the total lab equipment demand by function during the fourth quarter of 2018. Applied R&D and analytical service demand of lab equipment experienced growth due to the expansion of environmental and clinical labs globally. Additionally, QA/QC demand's increase is driven by increased global competition and adoption of tighter quality standards.

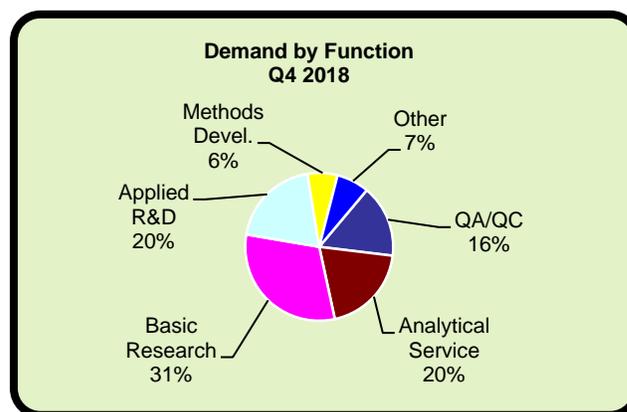
Market Developments

Shimadzu launched the AP225W semi-micro analytical balance, its highest-end model, capable of measuring up to 220 grams and a minimum reading of 0.01 mg. HERMLE LaborTechnik released the mini centrifuge Z 167 M with a max. speed of 14,000 rpm. It is ideally suited for the routine centrifugation of reaction tubes. It has a capacity of 18 x 1.5/2.0 ml.



Regional Demand

Asia-Pacific led lab equipment in the fourth quarter, spurred by China in general and the expansion of pharm/bio facilities throughout Asia. North America's growth outperformed Europe and Japan and was driven by pharm/bio expansion yet limited by high saturation and global trade concerns. The ROW also experienced robust growth as pharm/bio and academic labs continued to expand globally.



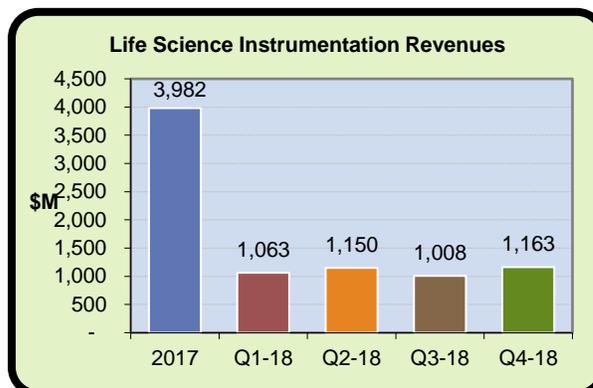
Near Term Prospects

Growth of lab equipment will remain solid in the middle single digits on average. China is driving demand as its pharm/bio industry expands along with other Asian countries. North America, Europe, and Japan will continue to be the largest markets for lab equipment but are limited by high installed base and product saturation.

PART H. LIFE SCIENCE INSTRUMENTATION

Overview

The life science instrumentation market comprises nucleic acid amplification/PCR, microarrays, sequencers, and electrophoresis hardware. Revenue estimates encompass initial systems, components, consumables, and service, but exclude life science reagents, considered elsewhere. Market demand increased approximately 8.5% in Q4 2018 compared to the same period last year.

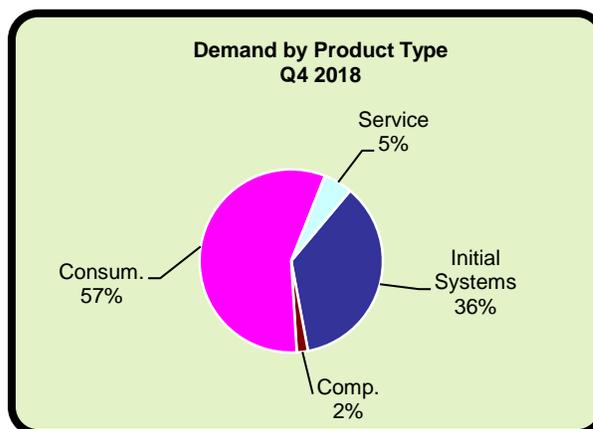


Regional Demand

Despite some hindrance from the trade war between the US and China, the Asia-Pacific region led growth for life science instrumentation. Demand in Europe improved sequentially over Q3, in spite of economic and political uncertainties as Brexit looms. Japan continues its economic recovery, which has improved demand for scientific instruments and consumables, rivalling the other fully industrialized regions in terms of growth.

Demand by Product Type

Consumables made up over half of the total life sciences instrumentation market in Q4. Demand was softened as customers in some regions shifted their purchases to earlier quarters to stock ahead of tariff implementation.



Market Developments

Illumina announced an agreement to acquire rival Pacific Biosciences. The acquisition will bring together the largest short-read and largest long-read sequencing companies, respectively. 10x Genomics acquired Spatial Transcriptomics for an undisclosed sum. Spatial Transcriptomics' technology captures the transcriptome from tissue section.

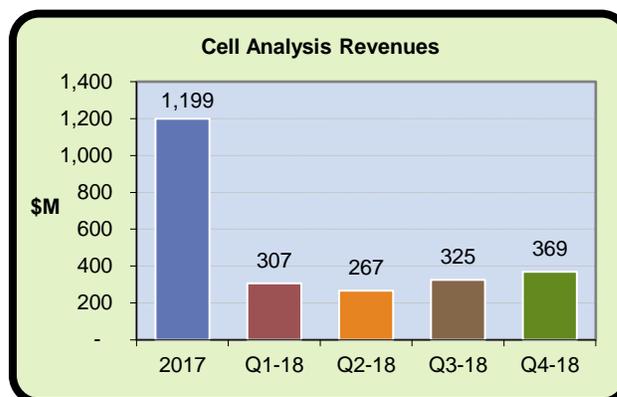
Near Term Prospects

Brexit is expected to cause supply chain disruptions in Europe, affecting demand in the region, and operations for Europe-based suppliers.

PART I. CELL ANALYSIS

Overview

The cell analysis market comprises flow cytometers, transfection, high content screening, and patch clamp systems. Revenue estimates encompass initial systems, components, consumables, and service, but exclude life science reagents, considered elsewhere. Market demand grew 6.5% year-over-year in Q4 2018.

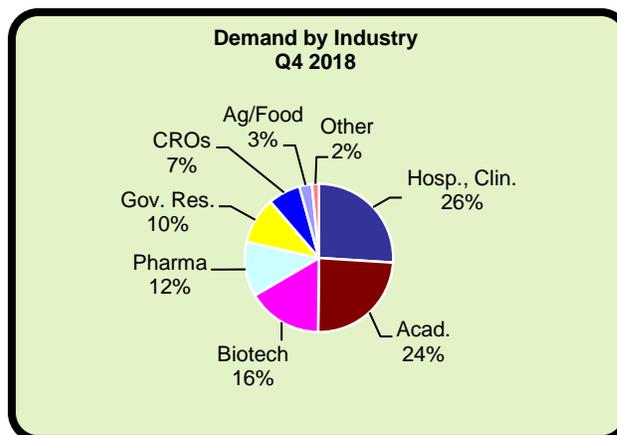


Regional Demand

The Asia-Pacific region led growth in the quarter, driven by strong demand in China. Demand in Japan continues to recover. Demand in Europe was stronger than Q3, but economic uncertainties continue to depress growth. Rest-of-World growth was negligible.

Demand by Industry

The hospital and clinical industry led demand for cell analysis, with high single-digit growth. Clinical testing laboratories rely on flow cytometry to handle increasing workloads. The pharmaceutical industry saw the greatest growth in Q4, with sequentially improving growth over Q3.



Market Developments

In October 2018, MilliporeSigma (Merck) agreed to sell its flow cytometry business to Luminex for \$75 million. Mirus Bio introduced its first transfection instrument, the Ingenio EZporator, in December.

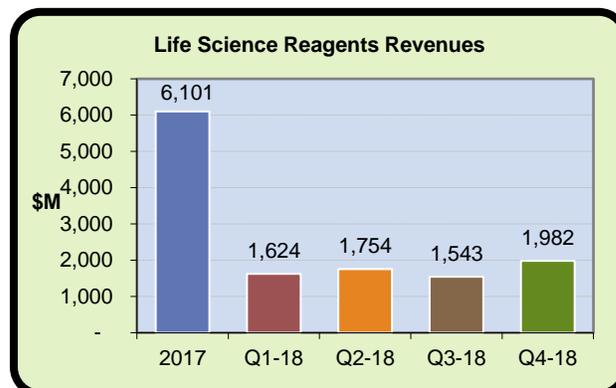
Near Term Prospects

Demand for cell analysis techniques continue to grow as applications develop in multiple industries. As microfluidics-based instruments become more available, bioprocess users will benefit from reduced contamination risk.

PART J. LIFE SCIENCE INSTRUMENT REAGENTS

Overview

Products considered in this section are primarily consumables used with life science instrumentation, cell analysis, and laboratory automation systems. Total revenues for life science instrument reagents neared \$2 billion for the fourth quarter of 2018, representing year-over-year growth of 10.0%. For the year, demand grew 13.2%.

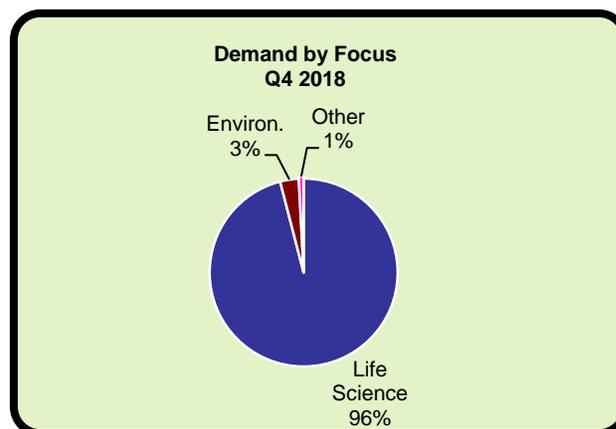


Regional Demand

Asia-Pacific growth continued to slow over the course of the year, in part due to sliding currencies in the region; nevertheless, the region produced the most growth for life science reagents. The North American market was also very strong in the quarter, achieving double-digit growth and nearly surpassing Asia-Pacific growth for the quarter.

End-User Markets

Understandably, laboratories with a life science focus made up the majority of demand for these consumables and reagents. Environmental demand made up just 3% of the total demand, but increasing interest in the environmental microbiome is slowly transforming from research to application, driving growth in these reagents into more customary environmental labs.



Market Developments

In September, BelHealth Investment Partners LLC acquired Gemini Bio-Products Inc. Gemini produces life science supplements and reagents primarily for cell culture applications, as well as sera and media.

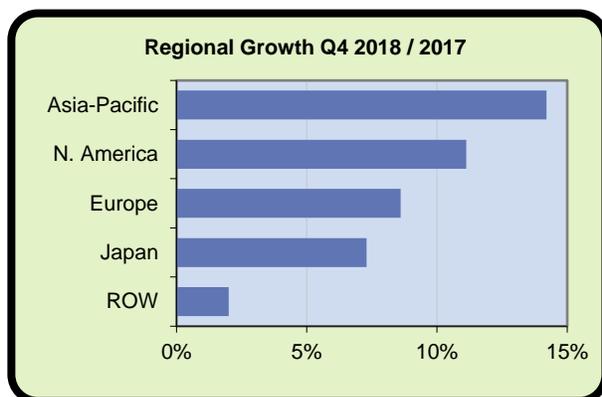
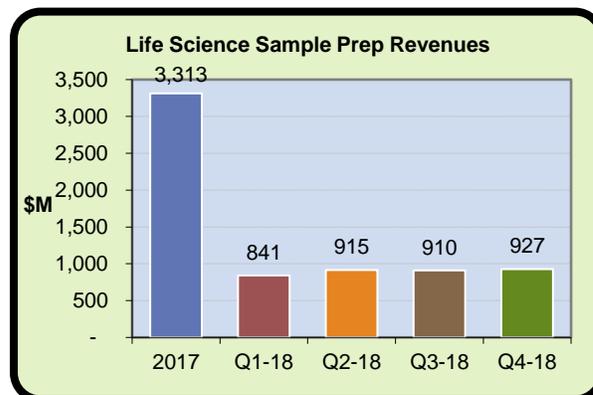
Near Term Prospects

The past year was very strong for life science reagents, with double digit growth. Although some drawback may be anticipated in 2019, prospects should still be in the high single digits to low double digits.

PART K. LIFE SCIENCE SAMPLE PREPARATION

Overview

Life science sample preparation includes both automated purification systems and magnetic bead purification systems, in addition to related components, consumables, and service. This segment does not include diagnostic applications, but instead focuses on life science research. Demand grew by 10.2% year-over-year in Q4 2018.



Regional Demand

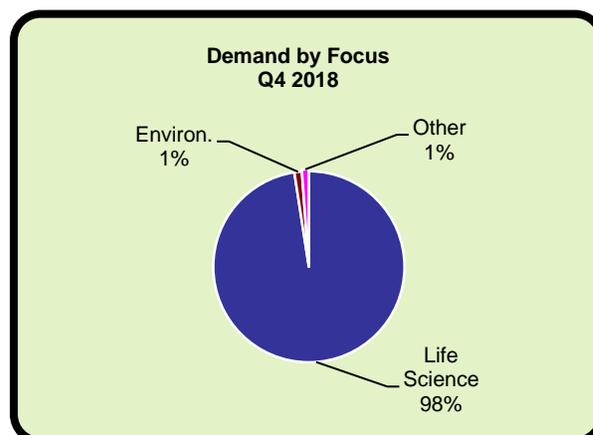
The Asia Pacific region continues to lead growth for life science sample prep. Several major sequencing initiatives are either currently or soon to be underway that are boosting demand for sample prep, notably in China and Bangladesh.

Growth in North America continued to benefit from increased public funding. Funding levels will increase incrementally in 2019.

Demand by Focus

Applications that require life science sample preparation is nearly exclusively focused on life science research. The rapid growth of sequencing drives the growth of the sample prep market.

A small but growing focus for sample prep is environmental testing, where the genetic identification of species has several applications. For example, metagenomic testing is used to identify organisms present in an environment.



Market Developments

In November, Rheonix introduced the OnePrep solution, an integrated, automated method for DNA extraction and NGS library preparation using its Encompass Optimum workstation. The NGS OnePrep solution streamlines the separate and distinct processes of nucleic acid extraction and NGS library preparation on a single instrument.

Near Term Prospects

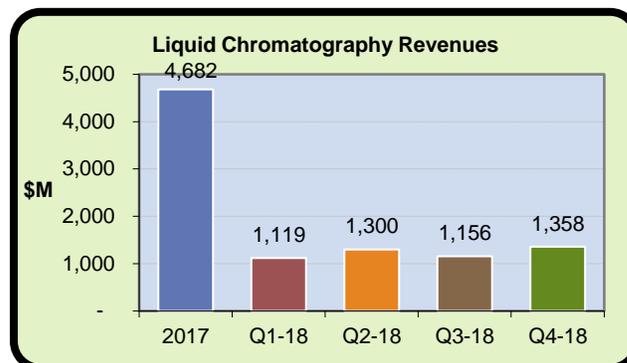
The sequencing market continues to see impressive growth, fueling the need for sample preparation.

While demand in Europe is expected to be negatively impacted in the near term by economic and political woes there is some good news, as Britain's National Health Services has launched a 10-year plan to expand use of genetic testing and whole-genome sequencing.

PART L. LIQUID CHROMATOGRAPHY

Overview

The liquid chromatography market comprises HPLC, IC and LPLC. Revenue estimates encompass initial systems, components, consumables, and service, but exclude analytical chemicals, considered elsewhere. Demand for liquid chromatography grew by 4.9% in the fourth quarter compared to last year, which resulted in full-year growth of 5.4% for 2018.

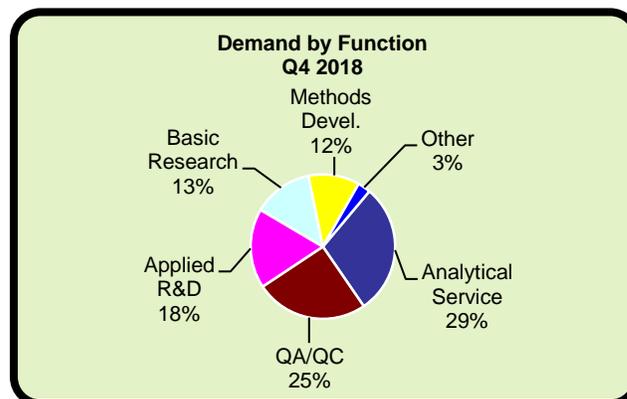


Regional Demand

Asia-Pacific grew the fastest led by China where increasing government investment in universities and biopharma facilities is driving growth. In India, adverse effects from new tax applications and weak currency inhibited growth in the country. Demand in North America and Europe is supported by big pharma companies but offset by political maneuvers, such as trade wars and Brexit. Meanwhile, Japan's reinvigorated economy bolstered market growth.

End-User Markets

Analytical service represents the most significant application function, as demand for food and environmental testing is growing, especially in Asian countries. QA/QC applications are the second largest with heavy utilization in chemical compound purifications and drug manufacturing processes. Applied R&D and method development are supported by high investment from pharma and biotech, while basic research labs saw robust academic sales in the US and China.



Market Developments

In November, TOSOH announced an investment in Semba Biosciences with the intention of acquiring full ownership. Also in November, Shimadzu released its new Shim-pack Velox columns with core-shell technology. In December, Biotage acquired PhyNexus and strengthens its position in lab-scale purification of biomolecules

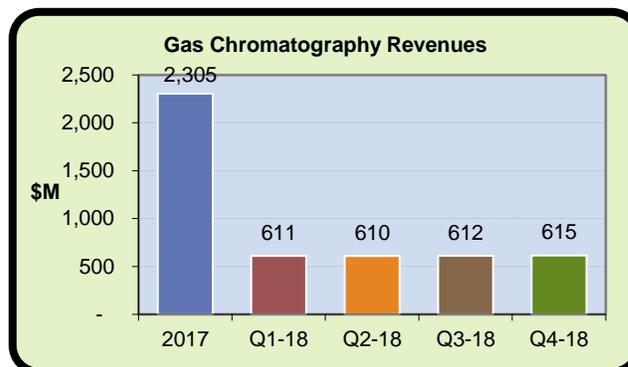
Near Term Prospects

The market is expected to grow mid-single digit in the first quarter of 2019. Large investments in the pharma/bio sector, along with continuing growth in food and environmental testing in Asia, will drive demand for liquid chromatography. In Academia, the US shows good prospects, with increasing government budget for basic research, especially in the life science field. The US government increased the NIH budget for 2019.

PART M. GAS CHROMATOGRAPHY

Overview

The gas chromatography market comprises not just the chromatographs, but also associated detectors, including mass spectrometry (GC-MS). Revenue estimates encompass initial systems, components, consumables, and service, but exclude analytical chemicals, considered elsewhere. Market demand grew by 4.7% in the fourth quarter of 2018 compared to last year. This means that full-year 2018 growth was 6.2%.

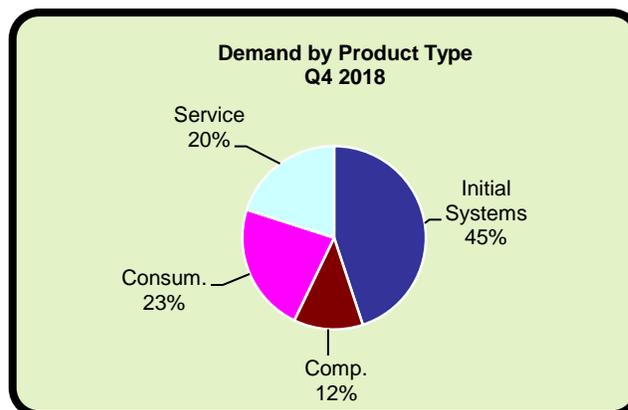


Regional Demand

Asia-Pacific grew the fastest with strong environmental testing demand from China but hindered by weak currency in India. North America and Europe remain the biggest regional market supported by big oil & gas and chemical industries. Japan had healthy growth due to its strong economy and currency. Meanwhile, ROW had mild growth as large oil & gas demand in the Middle East is offset by political turmoil in Latin America.

Product Segmentation

Initial systems represented the largest portion in the market driven by growing GC/MS applications in volatile sample analysis. Triple quadrupole GC/MS along with micro/portable GC led the growth of initial systems. Meanwhile, GC aftermarket sales are supported by substantial revenues from columns, carrier gas, and volatile extraction instruments. Increasing demand for environmental testing also bolstered the growth of the overall market.



Market Developments

In October, Teledyne Instruments acquired Falcon Analytical Systems & Technologies, a manufacturer of compact GC for process and laboratory applications. In the same month, VUV Analytics announced a Global Solutions Distribution agreement with Shimadzu, which combines the VGS GC detectors from VUV Analytics with Shimadzu GC product line.

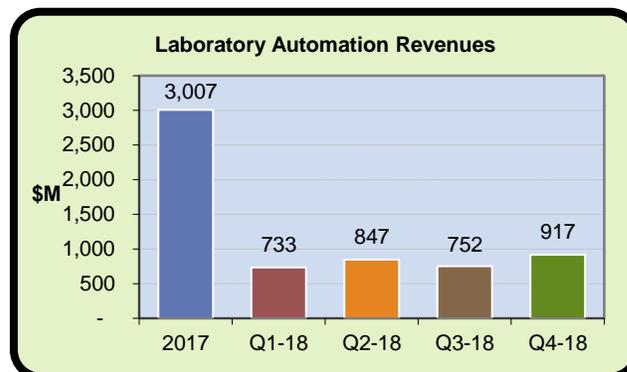
Near Term Prospects

The gas chromatography market is projected to grow mid-single-digit in the first quarter of 2019. Environmental testing demand in Asia will continue to drive the growth of GC and GC/MS market. Demand from pharmaceutical companies will also continue to sustain the market. Meanwhile, the volatility of oil prices creates uncertainties in oil & gas and other industries, which dampen the potential growth of the industrial sector.

PART N. LAB AUTOMATION

Overview

The lab automation market is composed of liquid handlers, robots, microplate readers, and multiplex/high-throughput ELISA systems. Revenue estimates encompass initial systems, components, consumables, and service, but exclude life science reagents, considered elsewhere. Market demand increased 10% from Q4 of last year to \$917 million in the fourth quarter of 2018.

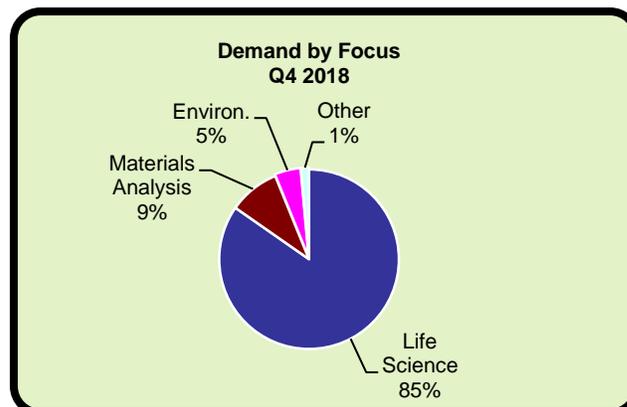


Regional Demand

Asia-Pacific market growth was 15% for the quarter, with China leading the way due to continued expansion of its pharma/bio industry. European growth, while solid, trailed North America and Asia-Pacific. Japan and the Rest-of-World experienced high single digit growth in the quarter.

End-User Markets

Life science use continued to drive lab automation demand in the fourth quarter of 2018. Integration and adoption of automation products into existing labs along with the expansion of new life science labs, especially in China and other Asian countries, are primary reasons for growth. Environmental labs are also increasingly expanding and using automation products due to increasing environmental awareness and regulations globally.



Market Developments

In October, Brooks Automation, which supplies automation and cryogenic solutions, agreed to acquire GENEWIZ for \$450 million in cash. GENEWIZ provides gene sequencing and synthesis services serving over four thousand customers.

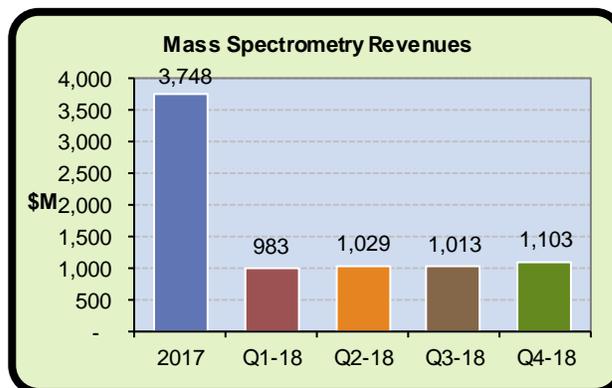
Near Term Prospects

Increasing global competition along with increasing regulatory compliance, will continue to drive worldwide demand for lab automation solutions in the near future.

PART O. MASS SPECTROMETRY

Overview

The mass spectrometry market comprises LC-MS, MALDI-TOF, SIMS, ICP-MS, magnetic sector and FT-MS instrumentation. Revenue estimates encompass initial systems, components, consumables, and service, but exclude analytical chemicals, considered elsewhere. Market demand increased by 10.3% in the third quarter of 2018 compared to that of last year, with growth across all technologies.

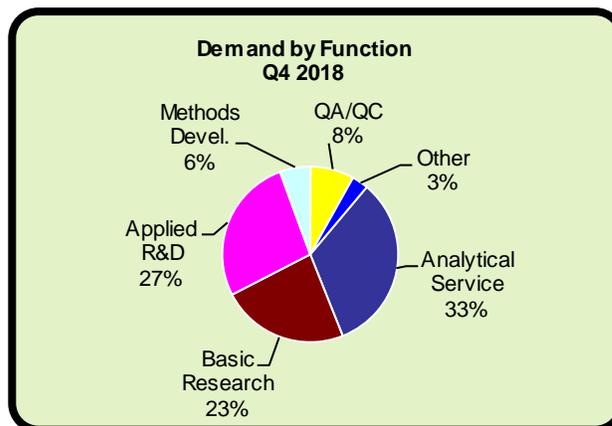


Regional Demand

Asia-Pacific was once again the top contributor of growth in the fourth quarter, led by China but offset by soft spending in India and currency headwinds. The North American market also performed well across a variety of industries, but most of the growth in this geography came from pharma. Growth in Europe was relatively modest, affected by weak spending from academia and the industrial sector.

Product Segmentation

Analytical service functions comprise about one-third of the demand for mass spectrometers. Revenues for this function performed quite well in the fourth quarter, thanks to the emergence of increasingly sophisticated and costly systems. Basic research is largely attributable to academic and government labs, but it continues to perform well, in some cases being funded by pharma companies. Applied R&D comprises just over a quarter of total sales and also faced robust expansion during the quarter.



Market Developments

PerkinElmer debuted the dual-source QSight 400 Series Triple Quadrupole MS System designed for rapid identification and quantitation of pesticides, mycotoxins, and emerging contaminants in food, cannabis, and environmental samples.

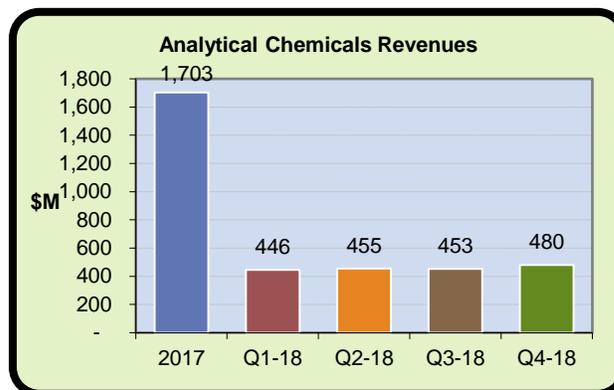
Near Term Prospects

The mass spec market will continue to grow robustly in general, especially in China. However, soft growth in Europe is likely to persist. Growth in the industrial sector is predicted to begin slowing as well.

PART P. ANALYTICAL CHEMICALS

Overview

In Q4 2018, total demand for analytical chemicals and solvents grew 7.8% year over year, amounting to \$480 million in revenues; this figure includes chemicals used directly in concert with the instrumentation considered in other sections. Demand stayed relatively stable through the whole year 2018. Full year revenues advanced 7.7% compared to the prior year.

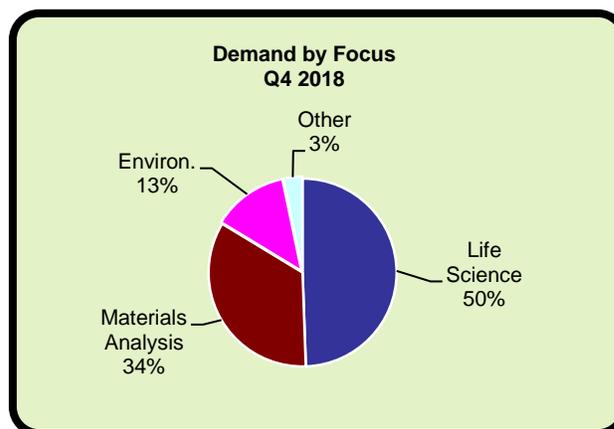


Regional Demand

By geography, growth was led by Asia-Pacific and North American markets, which achieved high single digit growth for the quarter. Asia-Pacific grew slightly more rapidly, but the difference would be more marked, if the region had not been affected by some negative currency translation effects. Other regions also provided growth, although the Rest-of-World segment saw the slowest increases.

End-User Markets

Fully half of the demand for analytical chemicals comes from life science applications. Sample preparation, imaging tags, solvents and other chemicals have important uses in the life science arena. Materials analysis makes up more than a third of demand, and saw strong advances in 2018 as many industrial markets improved markedly over 2017. Environmental analysis is the remaining significant market segment.



Market Developments

In February, Avantor filed plans to conduct an initial public offering. The company offers many brands of fine chemicals for laboratories, and also has its important laboratory distribution business, VWR.

Near Term Prospects

Growth stayed strong to close out the year. If some of this spending was overstocking to close out the calendar year and budgets, there may be some relaxation in the early part of 2019.