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March 18, 2019
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UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM 10-K

(Mark One)

x **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the fiscal year ended December 31, 2018

or

¨ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

Commission file number: 001-34180

FLUIDIGM CORPORATION

(Exact name of registrant as specified in its charter)

Delaware	**77-0513190**
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification Number)
7000 Shoreline Court, Suite 100, South San Francisco, California	**94080**
(Address of principal executive offices)	(Zip Code)

Registrant's telephone number, including area code: **(650) 266-6000**

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	**Name of each exchange on which registered**
Common Stock, $0.001 Par Value per Share	The Nasdaq Global Select Market

Securities registered pursuant to Section 12(g) of the Act:

None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act of 1933, as amended. Yes x No ¨

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Securities Exchange Act of 1934, as amended. Yes ¨ No x

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes x No ¨

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). Yes x No ¨

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K is not contained herein, and will not be contained, to the best of the registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. x

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer", "smaller reporting company" and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer ¨

Accelerated filer x Non-accelerated filer ¨ Smaller reporting company x Emerging growth company ¨

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided, pursuant to Section 13(a) of the Exchange Act. ¨

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). Yes ¨ No x

As of June 30, 2018, the aggregate market value of voting and non-voting common equity held by non-affiliates of the registrant was approximately $151,752,358, based on the closing sale price on that date. Shares of common stock held by each executive officer and director and by each other person who may be deemed to be an affiliate of the Registrant have been excluded from this computation. The determination of affiliate status for this purpose is not necessarily a conclusive determination for other purposes.

As of March 13, 2019, there were 68,989,239 shares of the registrant's common stock outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's Proxy Statement in connection with the registrant's annual meeting of stockholders, scheduled to be held in June 2019, are incorporated by reference in Part III of this report. Except as expressly incorporated by reference, the registrant's Proxy Statement shall not be deemed to be part of this report.

Fluidigm Corporation
Fiscal Year 2018
Form 10-K
Annual Report

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Special Note Regarding Forward-looking Statements and Industry Data

This Form 10-K contains forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended, or Securities Act, and Section 21E of the Securities Exchange Act of 1934, as amended, or Exchange Act, that are based on our management's beliefs and assumptions and on information currently available to our management. The forward-looking statements are contained principally in the sections entitled "Business," "Risk factors," and "Management's discussion and analysis of financial condition and results of operations." Forward-looking statements include information concerning our possible or assumed future cash flow, revenue, sources of revenue and results of operations, cost of product revenue and product margin, operating and other expenses, unit sales and the selling prices of our products, business strategies, financing plans, expansion of our business, competitive position, industry environment, potential growth opportunities, market growth expectations, and the effects of competition. Forward-looking statements include statements that are not historical facts and can be identified by terms such as "anticipates," "believes," "could," "seeks," "estimates," "expects," "intends," "may," "plans," "potential," "predicts, "projects," "would," or similar expressions and the negatives of those terms.

Forward-looking statements involve known and unknown risks, uncertainties, and other factors that may cause our actual results, performance, or achievements to be materially different from any future results, performance, or achievements expressed or implied by the forward-looking statements. We discuss these risks in greater detail in the section entitled "Risk factors" and elsewhere in this Form 10-K. Given these uncertainties, you should not place undue reliance on these forward-looking statements.

Forward-looking statements represent our management's beliefs and assumptions only as of the date of this Form 10-K. Except as required by law, we assume no obligation to update these forward-looking statements, or to update the reasons actual results could differ materially from those anticipated in these forward-looking statements, even if new information becomes available in the future. You should read this Form 10-K completely and with the understanding that our actual future results may be materially different from what we expect.

"Fluidigm," the Fluidigm logo, "Access Array," "Advanta," "Biomark," "C1," "Callisto," "CyTOF," "Delta Gene," "Digital A "Dynamic Array," "EP1," "Flex Six," "Helios," "Hyperion," "Imaging Mass Cytometry," "IMC," "Juno," "Maxpar," "MSL," " Builder," "Singular," and "SNP Type" are trademarks or registered trademarks of Fluidigm Corporation. Other service marks, trademarks and trade names referred to in this Form 10-K are the property of their respective owners.

Unless the context requires otherwise, references in this Annual Report on Form 10-K to "Fluidigm," the "Company," "we," "us," and "our" refer to Fluidigm Corporation and its subsidiaries.

PART I

ITEM 1. BUSINESS

Overview

Fluidigm is a global company that improves life through comprehensive health insight. Our innovative technologies and multi-omic tools are used by researchers to reveal meaningful insights into health and disease, identify biomarkers to inform decisions, and accelerate the development of more effective therapies. We create, manufacture, and market a range of products and services, including instruments, reagents and software that are used by researchers worldwide. Our focus is on the most pressing needs in translational and clinical research, including cancer, immunology and immunotherapy. We use proprietary CyTOF® and microfluidics technologies to develop innovative end-to-end solutions that have the flexibility required to meet the needs of translational research and the robustness to support high-impact clinical research studies.

Our mass cytometry Helios™ system deeply profiles cell phenotype and function. Referenced by hundreds of peer-reviewed publications around the world, mass cytometry is setting a new standard in human immune profiling. Transforming biological imaging, our Hyperion™ Imaging System enables highly multiplexed protein biomarker detection in tissues and tumors while still preserving tissue architecture and cellular morphology information using Imaging Mass Cytometry™ (IMC™). Our microfluidic systems complement our mass cytometry offerings by providing highly scalable and automated workflows for quantitative polymerase chain reaction, or PCR, gene expression, copy number variation analysis, and next-generation sequencing library preparation. Used to detect somatic and genomic variations from a range of different sample types, these automated systems provide the cost efficiencies, flexibility and proven analytical performance that customers need to meet the increasing demands of molecular biomarker analysis.

We are a trusted partner of leading academic, government, pharmaceutical, biotechnology, and plant and animal research laboratories worldwide and we strive to increase the quality of life for all.

Market Opportunity

The current markets for our products address a broad range of biological analysis approaches, including the genome, proteome, transcriptome, epigenomics and microbiome used by academic life science research customers, as well as applied markets customers, including clinical research laboratories, biopharmaceutical companies, biorepositories and agricultural biotechnology entities. Our markets are increasingly looking to study data sets across these approaches in a concerted manner to answer pressing questions about immune function across cancer, immunology and immunotherapy.

Strategy

Key elements of our strategy include:

Offering innovative, differentiated products to researchers based on our mass cytometry and microfluidic technologies.

- Mass cytometry is a leading solution to analyze many cell-surface and intracellular proteins simultaneously in cell suspensions including blood and disassociated tissues. Our products enable innovative methods to characterize cells and other sample types not commonly achieved with other conventional technologies.
- Imaging Mass Cytometry is a pioneering technology allowing for high multiplexed imaging to understand the composition of tissue microenvironments at a subcellular resolution.
- Our microfluidic technologies enable a scalable and sensitive solution in fields requiring high-throughput molecular biomarker analysis, whether it be for the analysis of gene expression profiles, genotyping or library preparation in advance of gene sequencing. Microfluidic solutions also enable single-cell genomic analysis across a broad menu of applications.

Expanding addressable markets through attention to assay content, workflow efficiency, software improvements, desirable strategic partnerships and inorganic growth opportunities.

Our strategy addresses expanded and enhanced applications, workflows and analytics to allow our customers better productivity, increasing the value of our toolsets across our mass cytometry and microfluidics products.

- We have developed a new workflow for comprehensive human immune monitoring for use with our Helios system, as well as application, sample protocol, antibodies and reagents that researchers use to design their own experiments. We have collaborated with industry partners to enable workflows and software for both the Helios and Hyperion systems.
- We have developed and collaborated with industry partners to build our applications, software and assays on our microfluidic platforms for gene expression, genotyping and sequencing library preparations as well as single-cell applications for our C1 system. Our future development will leverage both in-house informatics as well as externally-partnered solutions to drive towards sample-to-answer functionality across all our platforms.

Products

We market innovative technologies and life science tools, including preparatory and analytical instruments for Mass Cytometry, PCR, Library Prep, Single Cell Genomics, and consumables, including integrated fluidic circuits (IFCs), assays, and reagents. Our primary product offerings are summarized in the table below:

Product	Product Description	Applications
Mass Cytometry		
Analytical Systems:		
Helios™, a CyTOF system	The Helios mass cytometry system performs high-parameter single-cell analysis using antibodies conjugated to metal isotopes.	Mass Cytometry
Hyperion™ Imaging System	The Hyperion Imaging System brings together imaging capability with proven high-parameter CyTOF technology to enable the simultaneous detection of up to 37 protein markers in the spatial context of the tissue microenvironment.	Imaging Mass Cytometry
Hyperion™ Tissue Imager	The Hyperion Tissue Imager scans tissues at 1 micron resolution. It can be purchased as an upgrade for the Helios system to enable imaging capability, then referred to as Hyperion Imaging System.	Imaging Mass Cytometry
Assays and Reagents:		
Maxpar® Reagents	Maxpar® reagents are included in multiple product lines addressing needs in functional and phenotypic profiling of single cells, as well as nucleic acid detection. The product lines include pre-conjugated antibodies, application specific kits, and custom antibody labeling services.	Mass Cytometry and Imaging Mass Cytometry.
Maxpar Human Immune Monitoring Panel Kit and Workflow	The kit contains 29 pre-titrated antibodies designed and optimized for deep immune profiling of human peripheral blood mononuclear cells. Enables comprehensive identification and characterization of key immune cell populations. The workflow includes protocol and data analysis.	Mass Cytometry

Product Microfluidics	Product Description	Applications
Preparatory Instruments:		
Access Array System	A modular, flexible system that automates amplicon-based library preparation of up to 480 amplicons across 48 unique samples per processing run. The resulting barcoded libraries are ready for targeted DNA sequencing on next-generation sequencing (NGS) platforms from Illumina® and Ion Torrent®.	Library preparation for targeted DNA sequencing on NGS systems
Juno System	An integrated system that automates the preparation of amplicon-based libraries for targeted next-generation DNA sequencing. Additionally, Juno automates microfluidic workflows for PCR-based gene expression, genotyping, digital PCR, and copy number variant analysis by processing IFCs prior to analysis on Biomark HD or EP1 platforms.	Library preparation for targeted DNA sequencing on NGS systems. End-Point PCR, SNP Genotyping, sample identification, Gene Expression, and digital PCR
Analytical Instruments:		
Biomark HD System	Real-time PCR analytical instrument for microfluidics-based analysis of gene expression, single-cell targeted gene expression, microRNA expression, sample identification, SNP genotyping, and real-time digital PCR.	SNP Genotyping, sample identification, Digital PCR, and Gene Expression, including Single-Cell Targeted Gene Expression
EP1 System	End-point PCR analytical instrument for microfluidics-based analysis of SNP genotyping and end-point digital PCR.	SNP Genotyping, sample identification, and Digital PCR
Integrated Fluidic Circuits (IFCs):		
LP IFCs	Library Preparation IFCs to support targeted DNA sequencing of 48 or 192 samples on next generation sequencing instruments.	Library preparation for targeted next-generation DNA sequencing
Juno Genotyping IFC	IFC that incorporates preamplification for genotyping of 96 samples and 96 markers on a single run.	Genotyping, sample identification
Dynamic Array IFCs	IFCs based on matrix architecture, allowing users to (i) individually assay up to 24 samples against up to 192 assays, (ii) individually assay up to 48 samples against up to 48 assays, (iii) individually assay up to 96 samples against up to 96 assays, or (iv) individually assay up to 192 samples against up to 24 assays.	Real-time qPCR, End-Point PCR, SNP Genotyping and Gene Expression, including Single-Cell Targeted Gene Expression, sample identification, copy number variant analysis

Digital Array IFCs	IFCs based on partitioning architecture allowing users to (i) individually assay up to 12 samples or panels across 765 chambers, or to (ii) individually assay up to 48 samples across 770 chambers per IFC.	Digital PCR, Copy Number Variation and Variant Detection
Flex Six IFC	IFC that incorporates six 12 X 12 partitions that can be organized in any configuration, in up to six separate experimental runs.	Gene Expression and SNP Genotyping

Product	Product Description	Applications
Assays and Reagents:		
Delta Gene and SNP Type Assays	Custom designed assays targeted to genomic regions of interest for genotyping and gene expression.	Gene Expression, Single-Cell Targeted Gene Expression, SNP Genotyping
Access Array Target-Specific Primers and Targeted Sequencing Prep Primers	Custom designed assays for NGS library preparation using Access Array chemistry on the Access Array or Juno systems.	Library preparation for targeted next-generation DNA sequencing
Targeted DNA Seq Library Assays	Custom designed assays for NGS library preparation using Targeted DNA Sequencing Library Preparation chemistry on the Access Array or Juno systems.	Library preparation for targeted next-generation DNA sequencing
Single Cell Microfluidics		
Preparatory Instrument:		
C1 System	Sample preparation system that rapidly and reliably isolates and processes individual cells for genomic analysis.	Single-Cell Targeted Gene Expression, Single-Cell microRNA Analysis, Single-Cell mRNA Sequencing (Full Length and End-Counting), Single-Cell Targeted DNA Sequencing, Single-Cell Whole Exome Sequencing, and Single-Cell Whole Genome DNA Sequencing, Single-Cell Epigenetics, Total RNA sequencing, T-ATAC-seq, REAP-Seq (RNA and Protein)
Preparatory Analytical Instruments:		
Polaris System	System and IFC that enables single cell contextual studies by facilitating active/live cell selection, isolation, imaging, dosing, and cell culturing workflows.	Functional Genomics Using Single-Cell mRNA Sequencing
C1 IFCs	IFCs that capture up to 800 cells between 5-25 microns in diameter and then automatically process the cells for a variety of genomic analysis using thermal and pneumatic controls at nanoliter scale.	Single-Cell Targeted Gene Expression, Single-Cell microRNA Analysis, Single-Cell mRNA Sequencing (Full Length and End-Counting), Single-Cell Targeted DNA Sequencing, Single-Cell Whole Exome DNA Sequencing, and Single-Cell Whole Genome DNA Sequencing, Total RNA sequencing, T-ATAC-seq, REAP-Seq (RNA and Protein). Additional customer and

		3rd-party developed applications available through Fluidigm Script Hub
Polaris IFC	IFC that actively selects, captures and cultures up to 48 single-cells for up to 24 hours. It integrates media exchange, dosing and time course studies followed by cell lysis, reverse transcriptions and library preparation for single cell mRNA sequencing.	Functional Genomics of Single Cells

Technology

Multi-Layer Soft Lithography

Our IFCs are manufactured using multi-layer soft lithography technology, or MSL technology, to create valves, chambers, channels and other fluidic components on our IFCs that allow nanoliter quantities of fluids to be precisely manipulated within the IFC. We have developed commercial manufacturing processes to fabricate valves, channels, vias, and chambers with dimensions in the ten to 100 micron range, at high density and with high yields.

Integrated Fluidic Circuits

Our IFCs incorporate several different types of technology that together enable us to use MSL technology to rapidly design and deploy new microfluidic applications. The first level of our IFC technology is a library of components that perform basic microfluidic functions, such as pumps, mixers, single-cell capture chambers, separation columns, control logic, and reaction chambers. The second level of our IFC technology comprises the architectures we have designed to exploit our ability to conduct thousands of reactions on a single IFC. The third level of our IFC technology involves the interaction of our IFCs with the actual laboratory environment. Our IFCs are built on specially designed input frames that are compatible with most commonly used laboratory systems.

Instrumentation and Software

Our mass cytometry instrumentation technology includes a custom-designed inductively coupled plasma ion source, ion-optical and vacuum systems, and instrument control electronics. With our Helios system, which is an enhanced version of our CyTOF 2 system, individual cells are atomized, ionized, and extracted. A time-of-flight mass analyzer separates atomic ions of different mass-to-charge ratios, providing information on temporal distribution of ions. The Hyperion Imaging System combines mass cytometry technology with imaging capability to enable simultaneous interrogation of up to 37 protein markers in the spatial context of the tissue microenvironment. Our systems have the ability to utilize up to 135 channels to detect additional parameters to meet future market needs.

Our Biomark HD system includes our custom thermal cycler, the FC1 cycler, and a sophisticated fluorescence imaging system. Our EP1 instrument is a fluorescence reader designed for end-point imaging, suitable for genotyping and digital PCR applications. Our C1 system combines the hardware elements of our IFC controllers and FC1 cycler with sophisticated scripting and protocol control software to enable automation of single-cell capture and preparation for subsequent analysis. Certain capabilities of the C1 system have been used to create our Juno system, which serves as a universal controller and cycler for our Dynamic Array IFCs. Our Polaris system combines the capabilities of all these instruments by incorporating thermal cycling, IFC control, environmental regulation, and imaging.

We have developed instrumentation technology to load samples and reagents onto our IFCs and to control and monitor reactions within our IFCs. Our line of IFC controllers consists of commercial pneumatic components and both custom and commercial electronics. They apply precise control of multiple pressures to move fluid and control valve states in a microfluidic IFC.

We have also developed specialized software to manage and analyze the unusually large amounts of data produced by our systems. We offer Fluidigm Cytobank, our cloud-based platform of analytical tools, for use with the Helios system. Our bioinformatic toolset, the Singular software, facilitates the analysis and visualization of single-cell gene expression data. More recently, we extended the scope of the toolset to include DNA analysis tools. We also developed the C1 Script Builder software to enable customers to take full advantage of the flexibility of C1 IFC architecture by allowing them to program their own control scripts for the C1 system.

Assays and Reagents

We manufacture metal-conjugated antibodies for use with our mass cytometry instruments to allow detection of up to approximately 37 protein targets simultaneously in a single cell. Our metal-conjugated antibodies are manufactured using metal-chelating polymers, which are produced using proprietary polymerization processes and subsequent post-polymerization modifications.

Our Delta Gene and single-nucleotide polymorphism type, or SNP Type, assay products consist of assay design and custom content delivery systems for gene expression and genotyping, respectively. These offerings provide low-cost alternatives to other available chemistries, and allow customers to use IFCs in more flexible ways. PCR assay reagents need to be specific to the gene targets of interest but the process of designing a set of assays may delay the implementation experiments or require the use of expensive pre-designed assays. We have developed a process to provide customers with validated assays for their targets of interest.

5

Life Science Research

Our products enable comprehensive interrogation of biological samples across a range of genomic and protein molecular biomarkers.

Genomics

One primary area of focus within life science research is genetic analysis, the study of genes and their functions. The hereditary material or nucleic acid of an organism is often referred to as its genome, the protein-encoding regions of which are commonly known as genes. Analysis of variations in genomes, genes and gene activity in and between organisms can provide valuable insight into their health and functioning. Single-cell genomics is the study of the sequence and expression of genes and their ultimate functions at the individual cell level.

There are several forms of genetic analysis in use today, including genotyping, gene expression analysis and DNA sequencing:

- Genotyping involves the analysis of DNA variations across individual genomes. There are multiple forms of variants, including single nucleotide polymorphism, or SNPs, insertion-deletions and copy number variation. A common application of genotyping focuses on analyzing SNPs to determine whether a SNP or group of SNPs are associated with a particular genetic trait, such as propensity for a disease.
- Gene expression analysis involves measuring the levels of particular ribonucleic acid sequences known as messenger RNAs, or mRNAs, which have been transcribed from genes. Determining these levels is important because mRNAs are often translated by the cell into proteins, and may affect the activity of the cell or the larger organism.
- DNA sequencing is a process by which researchers are able to determine the particular order of nucleotide bases that comprise all or a portion of a particular gene or genome, and typically improves with target enrichment, such as complex sample preparation and tagging processes. Researchers are increasingly using next-generation DNA sequencers to rapidly and cost-effectively sequence portions of genomes, which is important for the identification of genetic variations that correlate with particular phenotypes.

Gene expression and genotyping are studied through a combination of various technology platforms that characterize gene function and genetic variation. These platforms often rely on PCR amplification to generate exponential copies of a DNA sample to provide sufficient signal to facilitate detection. Real-time quantitative PCR, or real-time qPCR, is a more advanced form of PCR that makes it possible to quantify the number of copies of DNA present in a sample.

Proteomics

Another focus within life science research is protein analysis, the study of proteins and their structures and functions. Proteins perform a vast array of functions within living organisms, including catalyzing metabolic reactions, replicating DNA, signaling response to stimuli and transporting molecules from one location to another. The proteome varies and is dynamic. Every cell in an individual organism has the same set of genes, but the set of proteins produced in different tissues differ from one another and are dependent on gene expression. Protein analysis is required to profile and understand cellular function as well as the interaction in tissues and other complex microenvironments.

There are several forms of high-throughput protein analysis in use today, including mass spectrometry, traditional flow cytometry, immunohistochemistry and both suspension and imaging mass cytometry.

- Mass spectrometry is an analytical chemistry technique that measures the mass-to-charge ratio in molecules using external electric and magnetic fields. Mass spectrometry techniques are limited to bulk samples and provide an understanding of global protein dynamics on a tissue or organism level, but do not, by themselves, enable researchers to analyze data at a single cell level.
- Traditional flow cytometry utilizes a suspension of cells in a stream of fluid and passes them through an electronic detection apparatus to allow simultaneous multi-parameter analysis of the physical and chemical characteristics of up to thousands of cells per second. Although traditional flow cytometry technologies are high-throughput with single-cell analysis capabilities, a key limitation is the use of fluorescent dyes to label antibodies for detection. These fluorescent labels have emission spectra that typically overlap, making it challenging to optimize reagents to analyze many protein markers at once. In general, the number of protein targets for conventional flow cytometry is less than about 10 with significant reagent optimization often involved.

Immunohistochemistry is a method by which cells in a tissue section are stained with antibodies and then imaged with a conventional or fluorescent microscope. Antibodies selected to bind to proteins of interest can be conjugated with either chromogenic or fluorescent labels, allowing cellular proteins to be visualized in spatial context. Immunohistochemistry is used broadly throughout the life sciences industry, and in clinical research to better understand the characteristics and relationship of cancerous versus normal cells in biopsy tissue. In general, the number of simultaneously imageable proteins is less than five, with researchers only able to achieve a higher-parameter resolution using serial sections (several adjacent sections of the same tissue) or other highly laborious, more serial staining methods.

- Suspension mass cytometry is similar to traditional flow cytometry but is based primarily on antibodies using heavy metal isotope labels rather than fluorescent labels for detection of proteins, enabling the significant expansion of the number of parameters analyzed per individual cell versus conventional flow cytometry technologies. With high-throughput, single-cell analysis capabilities and the ability to analyze more protein markers per individual cell, researchers have more granular information, which allows them to identify and characterize even finer subpopulations of cells.
- Imaging mass cytometry is similar to immunohistochemistry, but is also based primarily on antibodies using heavy metal isotope labels rather than fluorescent or chromogenic labels for detection of proteins. This method enables a significant expansion of the number of parameters simultaneously analyzed per tissue section rather than in adjacent sections or via serial staining protocols.

Customers

We sell our instruments to leading academic research institutions, translational research and medicine centers, cancer centers, clinical research laboratories, and biopharmaceutical, biotechnology, and plant and animal research companies. No single customer represented more than 10% of our total revenue for 2018, 2017, or 2016.

Marketing, Sales, Service and Support

We distribute our systems through our direct sales force and support organizations located in North America, Europe, and Asia-Pacific, and through distributors or sales agents in several European, Latin American, Middle Eastern, and Asia-Pacific countries. Our sales and marketing efforts are targeted at laboratory directors and principal investigators at leading academic, translational research, healthcare consortiums, and biopharmaceutical companies who need reliable life science automation solutions to power their disease research with the goal of providing actionable insights.

Our sales process often involves numerous interactions and demonstrations with multiple people within an organization. Some potential customers conduct in-depth evaluations of the system, including running experiments on our system and competing systems. In addition, in most countries, sales to academic or governmental institutions require participation in a tender process involving preparation of extensive documentation and a lengthy review process. As a result of these factors and the budget cycles of our customers, our sales cycle, the time from initial contact with a customer to our receipt of a purchase order, can often be 12 months or longer.

As of December 31, 2018, we had 190 people employed in sales, technical support, and marketing, including 82 sales representatives and applications specialists located in the field.

Manufacturing

Our manufacturing operations are primarily located in Singapore and Canada. Our facility in Singapore manufactures our IFCs and manages production of our genomics instruments, which are assembled by our contract manufacturer located within our Singapore facility. All of our IFCs for commercial sale and some IFCs for our research and development purposes are also fabricated at our Singapore facility. Our mass cytometry instruments for commercial sale, as well as for internal research and development purposes, are manufactured at our facility in Canada. We also manufacture assays and reagents at our facilities in the United States. As part of our on-going efforts related to operational excellence and improving efficiencies, we are consolidating our North American production activities into our Canadian facility.

We rely on a limited number of suppliers for certain components and materials used in our products. Key components in our products that are supplied by sole or limited source suppliers include a specialized polymer and other specialized materials from which our IFC cores are fabricated, specialized custom camera lenses, fiber light guides, and other components required for the reader of our Biomark system; specialized pneumatic and electronic

components for our C1, Juno, Callisto, and Polaris systems; the electron multiplier detector included in, and certain metal isotopes used with, our

Helios system; specially developed lasers used in our Hyperion Imaging System; and certain raw materials for our Delta Gene and SNP Type assays and Access Array Target-Specific primers. The loss of a single or sole source supplier would require significant time and effort to locate and qualify an alternative source of supply, if at all, and could adversely impact our business. For additional information, please see the section entitled “Risk factors” in Part I, Item 1A of this Form 10-K.

Research and Development

We have assembled experienced research and development teams at our South San Francisco, California, Markham, Ontario, Canada, and Singapore locations with the scientific, engineering, software, bioinformatic, and process talent that we believe is required to grow our business.

The largest component of our current research and development effort is in the areas of new products, new applications and new content. We developed a high-throughput C1 IFC (HT IFC) for handling up to 800 medium sized cell types applied to the work-flows of the Fluidigm-installed base instruments. In the area of mass cytometry, we developed an initial prototype imaging mass cytometer instrument in 2016, and successfully launched the commercial Hyperion Imaging System in October 2017. The imaging mass cytometer system provides spatial resolution of protein expression in complex tissue samples at the single-cell level, quantitative measurement using metal isotope tags, and analysis of up to 37 proteins. We also developed metal-labeled antibodies compatible with formalin fixed paraffin embedded tissue samples, to be used with the Hyperion. We also invest significantly in research and development efforts to expand our single-cell and production genomics applications. For example, we continue to develop and commercialize various panel sets for cancer research for use with our systems. In 2017, we successfully launched the Advanta™ Immuno-Oncology Gene Expression Assay, which is a 170-gene expression qPCR assay that enables profiling of tumor immunobiology and new biomarker identification.

The second component of our research and development effort is to continuously develop new manufacturing processes and test methods to drive down manufacturing costs, increase manufacturing throughput, widen fabrication process capability, and support new microfluidic devices and designs.

Our research and development expenses were $30.0 million, $30.8 million and $38.4 million in 2018, 2017, and 2016 respectively. As of December 31, 2018, 103 of our employees were engaged in research and development activities.

Competition

The life science markets are highly competitive and expected to grow more competitive with the increasing knowledge gained from ongoing research and development. We believe that the principal competitive factors in our target markets include competition for human resources; cost of capital equipment and supplies; reputation among customers; innovation in product offerings; flexibility and ease of use; accuracy and reproducibility of results; and compatibility with existing laboratory processes, tools, and methods.

We compete with both established and development stage life science companies that design, manufacture, and market instruments for gene expression analysis, genotyping, other nucleic acid detection, protein expression analysis, imaging, and additional applications. In addition, a number of other companies and academic groups are in the process of developing novel technologies for life science markets. Many of our competitors enjoy several competitive advantages over us, including significantly greater name recognition; greater financial and human resources; broader product lines and product packages; larger sales forces and eCommerce channels; larger and more geographically dispersed customer support organization; substantial intellectual property portfolios; larger and more established customer bases and relationships; greater resources dedicated to marketing efforts; better established and larger scale manufacturing capability; and greater resources and longer experience in research and development. For additional information, please see the section entitled “Risk factors” in Part I, Item 1A of this Form 10-K.

To successfully compete with existing products and future technologies, we need to demonstrate to potential customers that the performance of our technologies and products, the solutions we provide our customers, as well as our customer support capabilities, are superior to those of our competitors. To differentiate our company from other, larger enterprises, we need to introduce new and innovative offerings regularly and maintain a well-staffed commercial team “in the field” to successfully communicate the advantages of our products and overcome potential obstacles to acceptance of our products. In addition, ongoing collaborations and partnerships with key opinion leaders are desirable to demonstrate both biological innovation and applications that solve customer problems.

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Intellectual Property

Patents

We have developed a portfolio of issued patents and patent applications directed to commercial products and technologies in development. As of December 31, 2018, we owned or licensed over 550 patents and we had approximately 155 pending patent applications worldwide. Our patents have expiration dates ranging up to 2036.

License Agreements

We have entered into licenses for technologies from various companies and academic institutions.

Microfluidic Technologies. Our core microfluidics technology originated at the California Institute of Technology, or Caltech, in the laboratory of Professor Stephen Quake, who is a co-founder of Fluidigm. We license microfluidics technology from Caltech, Harvard University, and Caliper Life Sciences, Inc. (Caliper), which subsequently became a PerkinElmer company:

- We exclusively license from Caltech relevant patent filings relating to developed technologies that enable the production of specialized valves and pumps capable of controlling fluid flow at nanoliter volumes. The license agreement will terminate as to each country and licensed product upon expiration of the last-to-expire patent covering licensed products in each country. The U.S. issued patents we have licensed from Caltech expire between 2017 and 2030.
- We have entered into a co-exclusive license agreement with Harvard University for the license of relevant patent filings relating to microfluidic technology. The license agreement will terminate with the last-to-expire of the licensed patents. The U.S. issued patents we have licensed from Harvard University expire between 2019 and 2027.
- In May 2011, we entered into a license agreement with Caliper to license Caliper's existing patent portfolio in certain fields. The license agreement will terminate with the last-to-expire of the licensed patents. As later amended, the license agreement provides for certain royalty payments until mid-2018 for our existing products at the time of amendment and their future equivalents.

Instrumentation and Digital PCR. On June 30, 2011, we settled litigation and entered into a series of patent cross-license and sub-license agreements with Life Technologies Corporation (now part of Thermo Fisher Scientific) and its subsidiary Applied Biosystems, LLC, referred to as Life. The agreements involve a cross-license concerning our imaging readers and other patent filings and certain of Life's patent families relating to methods and instruments for conducting nucleic acid amplification, such as with PCR; a sub-license that provides us access to certain of Life's digital PCR patents; and a sublicense that provides Life access to certain of our non-core technology patents licensed from Caltech. In July 2011, pursuant to the terms of the agreements, we paid Life $2.0 million in connection with our exercise of an option to preclude Life from initiating litigation under its patents existing as of June 30, 2011 against our customers for two years and against our company, with respect to our current products and equivalent future products, for four years, subject to certain exceptions. In November 2017, we settled pending litigation with Life and, pursuant to the terms of the settlement, one of the patent license agreements was amended to provide Life with a fully paid-up license under the patents covered by the agreement, subject to certain field of use restrictions. The license agreement will terminate with the last-to-expire of the licensed patents, which is expected to be in 2028.

Mass Cytometry. Some of the intellectual property rights covering our mass cytometry products were subject to a license agreement, referred to as the Original License Agreement, between Fluidigm Canada Inc., referred to as Fluidigm Canada, and PerkinElmer Health Sciences, Inc., referred to as PerkinElmer. Under the Original License Agreement, Fluidigm Canada received an exclusive, royalty bearing, worldwide license to certain patents owned by PerkinElmer in the field of inductively coupled plasma, or ICP-based mass cytometry, including the analysis of elemental tagged materials in connection therewith, referred to as the Patents, and a non-exclusive license for reagents outside the field of ICP-based mass cytometry. On November 4, 2015, we entered into a patent purchase agreement with PerkinElmer pursuant to which we purchased the Patents for a purchase price of $6.5 million and a patent assignment agreement pursuant to which PerkinElmer transferred and assigned to us all rights, title, privileges, and interest in and to the Patents and the Original License Agreement. Accordingly, we have no further financial obligations to PerkinElmer under the Original License Agreement. Contemporaneously with the purchase of the Patents, we entered into a license agreement with PerkinElmer pursuant to which we granted PerkinElmer a worldwide, non-exclusive, fully paid-up license to the Patents in fields other than (i) ICP-based mass analysis of atomic elements associated with a biological material, including any elements that are unnaturally bound, directly or

indirectly, to such biological material (Mass Analysis) and (ii) the development, design,

manufacture, and use of equipment or associated reagents for such Mass Analysis. The license will terminate on the last expiration date of the Patents, currently expected to be in December 2025, unless earlier terminated pursuant to the terms of the license agreement.

Any loss, termination, or adverse modification of our licensed intellectual property rights could have a material adverse effect on our business, operating results, and financial condition. For additional information, please see the section entitled "Risk factors" in Part I, Item 1A of this Form 10-K.

Other

In addition to pursuing patents and licenses on key technologies, we have taken steps to protect our intellectual property and proprietary technology by entering into confidentiality agreements and intellectual property assignment agreements with our employees, consultants, corporate partners, and, when needed, our advisors.

Government Regulation

Our products are currently labeled and sold for research purposes only, and we sell them to academic institutions, life sciences and clinical research laboratories that conduct research, and biopharmaceutical and biotechnology companies for non-diagnostic and non-clinical purposes. Our products are not intended or promoted for use in clinical practice in the diagnosis of disease or other conditions, and they are labeled for research use only, not for use in diagnostic procedures. Accordingly, they are not subject to regulation by the U.S. Food and Drug Administration (FDA). Rather, while FDA regulations require that research use only products be labeled, "For Research Use Only. Not for use in diagnostic procedures," or RUO products, the regulations do not subject such products to the FDA's jurisdiction or the broader pre- and post-market controls for medical devices.

In November 2013, the FDA issued a final guidance document stating that merely including a labeling statement that the product is for research purposes only will not necessarily render the device exempt from the FDA's clearance, approval, or other regulatory requirements if the totality of circumstances surrounding the distribution of the product indicate that the manufacturer knows its product is being used by customers for diagnostic uses or the manufacturer intends such a use. These circumstances may include, among other things, written or verbal marketing claims regarding a product's performance in clinical diagnostic applications and a manufacturer's provision of technical support for such activities. In the future, certain of our products or related applications could become subject to regulation as medical devices by the FDA. If we wish to label and market our products for use in performing clinical diagnostics, thus subjecting them to regulation by the FDA under premarket and postmarket control as medical devices, unless an exemption applies, we would be required to obtain either prior 510(k) clearance or prior pre-market approval from the FDA before commercializing the product. The FDA classifies medical devices into one of three classes. Devices deemed to pose lower risk to the patient are placed in either class I or II, which, unless an exemption applies, requires the manufacturer to submit a pre-market notification requesting FDA clearance for commercial distribution pursuant to Section 510(k) of the FFDCA. This process, known as 510(k) clearance, requires that the manufacturer demonstrate that the device is substantially equivalent to a previously cleared and legally marketed 510(k) device or a "pre-amendment" class III device for which pre-market approval applications, or PMAs, have not been required by the FDA. This FDA review process typically takes from four to twelve months, although it can take longer. Most class I devices are exempted from this 510(k) premarket submission requirement. Devices deemed by the FDA to pose the greatest risk, such as life-sustaining, life-supporting, or implantable devices, or those deemed not substantially equivalent to a legally marketed predicate device, are placed in class III. Class III devices typically require PMA approval. To obtain PMA approval, an applicant must demonstrate the reasonable safety and effectiveness of the device based, in part, on data obtained in clinical studies. PMA reviews generally last between one and two years, although they can take longer. Both the 510(k) and the PMA processes can be expensive and lengthy and may not result in clearance or approval. If we are required to submit our products for pre-market review by the FDA, we may be required to delay marketing and commercialization while we obtain premarket clearance or approval from the FDA. There would be no assurance that we could ever obtain such clearance or approval.

In some cases, our customers may use our RUO products in their own laboratory-developed tests, or LDTs, or in other FDA-regulated products for clinical diagnostic use. The FDA has historically exercised enforcement discretion in not enforcing the medical device regulations against LDTs and LDT manufacturers. However, on October 3, 2014, the FDA issued two draft guidance documents that set forth the FDA's proposed risk-based framework for regulating LDTs, which are designed, manufactured, and used within a single laboratory. In January 2017, the FDA announced

that it would not issue final guidance on the oversight of LDTs and LDT manufacturers, but would seek further public discussion on an appropriate oversight approach and give Congress an opportunity to develop a legislative solution. Any future legislative or administrative rule making or oversight of LDTs and LDT manufacturers if and when finalized, may impact the sales of our

products and how customers use our products, and may require us to change our business model in order to maintain compliance with these laws.

We would become subject to additional FDA requirements if our products are determined to be medical devices or if we elect to seek 510(k) clearance or pre-market approval. We would need to continue to invest significant time and other resources to ensure ongoing compliance with FDA quality system regulations and other post-market regulatory requirements. For additional information, please see the section entitled “Risk factors” in Part I, Item 1A of this Form 10-K.

International sales of medical devices are subject to foreign government regulations, which vary substantially from country to country. Outside of the EU, regulatory approval needs to be sought on a country-by-country basis in order to market medical devices. Although there is a trend towards harmonization of quality system, standards and regulations in each country may vary substantially which can affect timelines of introduction.

Environmental Matters

We are subject to many federal, state, local, and foreign environmental regulations. To comply with applicable regulations, we have and will continue to incur significant expense and allocate valuable internal resources to manage compliance-related issues. In addition, such regulations could restrict our ability to expand or equip our facilities, or could require us to acquire costly equipment or to incur other significant expenses to comply with the regulations. For example, the Restriction on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Directive (RoHS) and the Waste Electrical and Electronic Equipment Directive (WEEE), both enacted in the European Union, regulate the use of certain hazardous substances in, and require the collection, reuse, and recycling of waste from, products we manufacture. Certain of our products sold in these countries are subject to RoHS and WEEE requirements. If we fail to comply with any present and future regulations, we could be subject to future fines, penalties, and restrictions, such as the suspension of manufacturing of our products or a prohibition on the sale of products we manufacture. For additional information, please see the section entitled “Risk factors” in Part I, Item 1A of this Form 10-K.

Additionally, our research and development and manufacturing processes involve the controlled use of hazardous materials, including flammables, toxics, corrosives, and biologics. Our research and manufacturing operations produce hazardous biological and chemical waste products. We seek to comply with applicable laws regarding the handling and disposal of such materials. The volume of such materials used or generated at our facilities is small. However, we cannot eliminate the risk of accidental contamination or discharge and any resultant injury from these materials. We do not currently maintain separate environmental liability coverage and any such contamination or discharge could result in significant cost to us in penalties, damages, and suspension of our operations.

Geographic Area Information

During the last three years, a significant portion of our revenue was generated outside of the United States. Total revenue received from customers outside the United States totaled $64.8 million, or 57% of our total revenue, in 2018, compared to $56.1 million, or 55% of our total revenue, in 2017, and $51.8 million, or 50% of our total revenue, in 2016. The majority of our long-lived assets are located within the United States, in Singapore and in Canada. Please see Note 3 and Note 12 to our audited consolidated financial statements for additional information regarding geographic areas.

Seasonality

Our business is not subject to significant seasonality. However, the timing of customer orders and shipments, customer budget and spending cycles, and new product releases can result in variability in our quarterly revenues.

Raw Materials

Certain raw materials used in our Delta Gene and SNP Type assays and Access Array target-specific primers are available from a limited number of sources. Additionally, certain metals used in our Maxpar reagents are available from a sole source. Currently, we do not have supply agreements with these suppliers. While we generally attempt to keep our inventory at minimal levels, we purchase incremental inventory as circumstances warrant to protect our supply chain.

Backlog

We manufacture products based on forecasts of our customers’ demand and advance non-binding commitments from customers as to future purchases. Our customers generally do not place purchase orders far in advance. A substantial

portion

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of our products are sold on the basis of standard purchase orders that are cancellable prior to shipment without penalty. Accordingly, backlog at any given time is not a meaningful indicator of future sales.

Employees

As of December 31, 2018, we had 535 employees, of which 103 work in research and development, 107 work in general and administrative, 135 work in manufacturing, and 190 work in sales, technical support, and marketing. None of our employees are represented by a labor union nor are they subject to a collective bargaining agreement.

Corporate and Available Information

We were incorporated in California in May 1999 as Mycometrix Corporation, changed our name to Fluidigm Corporation in April 2001, and reincorporated in Delaware in July 2007. Our principal executive offices are located at 7000 Shoreline Court, Suite 100, South San Francisco, California 94080. Our telephone number is (650) 266-6000. Our website address is www.fluidigm.com. We make available on our website, free of charge, our Annual Report on Form 10-K, Quarterly Reports on Form 10-Q, Current Reports on Form 8-K, and any amendments to those reports, as soon as reasonably practicable after we electronically file such material with, or furnish it to, the Securities and Exchange Commission, or SEC. Our SEC reports can be accessed through the investor relations page of our website located at http://investors.fluidigm.com. The SEC also maintains an Internet site at www.sec.gov that contains reports, proxy and information statements, and other information regarding issuers that electronically file with the SEC.

The contents of our website are not a part of, and are not incorporated by reference into, this Annual Report on Form 10-K or any other report or document we file with the SEC. Any reference to our website is intended to be an inactive textual reference only.

ITEM 1A. RISK FACTORS

We operate in a rapidly changing environment that involves numerous uncertainties and risks. The following risks and uncertainties may have a material and adverse effect on our business, financial condition, or results of operations. You should consider these risks and uncertainties carefully, together with all of the other information included or incorporated by reference in this Form 10-K. The risks described below are not the only ones we face. Our business is also subject to the risks that affect many other companies, such as employment relations, general economic conditions, geopolitical events and international operations. Further, additional risks not currently known to us or that we currently believe are immaterial may in the future materially and adversely affect our business, operations, liquidity and stock price. If any of the risks or uncertainties we face were to occur, the trading price of our securities could decline, and you may lose all or part of your investment.

Risks Related to Fluidigm's Business and Strategy

Our financial results and revenue growth rates have varied significantly from quarter-to-quarter and year-to-year due to a number of factors, and a significant variance in our operating results or rates of growth, if any, could lead to substantial volatility in our stock price.

Our revenue, results of operations, and revenue growth rates have varied in the past and may continue to vary significantly from quarter-to-quarter or year-to-year. We may experience substantial variability in our product mix from period-to-period as revenue from sales of our instruments relative to sales of our consumables may fluctuate or deviate significantly from expectations. For example, our revenue declined year-over-year in 2016 compared to 2015, and in 2017 compared to 2016. In 2018, we returned to revenue growth, but we may not be able to achieve similar revenue growth in future periods. We are also increasingly dependent on our mass cytometry business, which is very capital intensive. Variability in our quarterly or annual results of operations, mix of product revenue, including any decline in our mass cytometry revenue, or variability in rates of revenue growth, if any, may lead to volatility in our stock price as research analysts and investors respond to these fluctuations. These fluctuations are due to numerous factors that are difficult to forecast, including: fluctuations in demand for our products; changes in customer budget cycles and capital spending; seasonal variations in customer operations; tendencies among some customers to defer purchase decisions to the end of the quarter; the large unit value of our systems, particularly our proteomics systems; changes in our pricing and sales policies or the pricing and sales policies of our competitors; our ability to design, manufacture, market, sell, and deliver products to our customers in a timely and cost-effective manner; fluctuations or reductions in revenue from sales of legacy instruments that may have contributed significant revenue in prior periods; quality control or yield problems in our manufacturing operations; our ability to timely obtain adequate quantities of the materials or components used in our products, which in certain cases are purchased through sole and single source suppliers; new product introductions and enhancements by us and our competitors; unanticipated increases in costs or expenses; our complex, variable and, at times, lengthy sales cycle; global economic conditions; and fluctuations in foreign currency exchange rates. Additionally, we have certain customers who have historically placed large orders in multiple quarters during a calendar year. A significant reduction in orders from one or more of these customers could adversely affect our revenue and operating results, and if these customers defer or cancel purchases or otherwise alter their purchasing patterns, our financial results and actual results of operations could be significantly impacted. Other unknown or unpredictable factors also could harm our results.

The foregoing factors, as well as other factors, could materially and adversely affect our quarterly and annual results of operations and rates of revenue growth, if any. We have experienced significant revenue growth in the past but we may not achieve similar growth rates in future periods. You should not rely on our operating results for any prior quarterly or annual period as an indication of our future operating performance. If we are unable to achieve adequate revenue growth, our operating results could suffer and our stock price could decline. In addition, a significant amount of our operating expenses are relatively fixed due to our manufacturing, research and development, and sales and general administrative efforts. Any failure to adjust spending quickly enough to compensate for a shortfall relative to our anticipated revenue could magnify the adverse impact of such shortfalls on our results of operations. We expect that our sales will continue to fluctuate on an annual and quarterly basis and that our financial results for some periods may be below those projected by securities analysts, which could significantly decrease the price of our common stock.

We have incurred losses since inception, and we may continue to incur substantial losses for the foreseeable future.

We have incurred significant losses in each fiscal year since our inception, including net losses of $59.0 million, $60.5 million, and $76.0 million during the years 2018, 2017, and 2016, respectively. As of December 31, 2018, we had an accumulated deficit of $558.9 million. These losses have resulted principally from costs incurred in our research and development programs, and from our manufacturing costs and selling, general, and administrative expenses. To date, we have funded our operations primarily through equity offerings, the issuance of debt instruments, and from sales of our products.

Until we are able to generate additional revenue to support our level of operating expenses, we will continue to incur operating and net losses and negative cash flow from operations. We believe that our continued investment in research and development, sales, and marketing is essential to our long-term competitive position and future revenue growth and, as a result, we may incur operating losses for the foreseeable future and may never achieve profitability.

The life science markets are highly competitive and subject to rapid technological change, and we may not be able to successfully compete.

The markets for our products are characterized by rapidly changing technology, evolving industry standards, changes in customer needs, emerging competition, new product introductions, and strong price competition. We compete with both established and development stage life science research companies that design, manufacture, and market instruments and consumables for gene expression analysis, single-cell targeted gene expression or protein expression analysis, single nucleotide polymorphism genotyping, or SNP genotyping, polymerase chain reaction, or PCR, digital PCR, other nucleic acid detection, flow cytometry, cell imaging, and additional applications using well established laboratory techniques, as well as newer technologies such as bead encoded arrays, microfluidics, nanotechnology, high-throughput DNA sequencing, microdroplets, and photolithographic arrays. Most of our current competitors have significantly greater name recognition, greater financial and human resources, broader product lines and product packages, larger sales forces, larger existing installed bases, larger intellectual property portfolios, and greater experience and scale in research and development, manufacturing, and marketing than we do. For example, companies such as 10X Genomics, Inc., Affymetrix, Inc. (now part of Thermo Fisher Scientific Inc.), Agena Bioscience, Inc., Agilent Technologies, Inc., Becton, Dickinson and Company, Bio-Rad Laboratories, Inc., Cellular Research, Inc. (now a part of Becton, Dickinson and Company), Danaher Corporation, Illumina, Inc., Life Technologies Corporation (now part of Thermo Fisher Scientific Inc.), LGC Limited, Luminex Corporation, Millipore Corporation, NanoString Technologies, Inc., PerkinElmer, Inc. (through its acquisition of Caliper Life Sciences, Inc.), RainDance Technologies, Inc. (acquisition by Bio-Rad Laboratories, Inc. pending), Roche Diagnostics Corporation, Sony Corporation, Thermo Fisher Scientific Inc., WaferGen Bio-systems, Inc., Cytek Biosciences, Inc., Akoya Biosciences, Inc., Innova Biosciences Ltd., QIAGEN N.V., 1CellBio, Inc., Berkeley Lights, Inc., and Mission Bio, Inc. have products that compete in certain segments of the market in which we sell our products. In addition, we have experienced increased competition in the single-cell genomics market, including new product releases from 10X Genomics, Inc. and WaferGen Bio-systems, Inc., as well as the acquisition of Cellular Research by Becton Dickinson and Company and an announced exclusive partnership between Illumina, Inc. and Bio-Rad Laboratories, Inc. In addition, due to the release of our Hyperion imaging mass cytometry system, we now are exposed to competition from companies offering imaging-based systems, specialized reagents and/or services including Carl Zeiss Inc., Leica Biosystems, Nikon Corporation, Olympus America Inc., Roche Diagnostics Corporation, PerkinElmer, Inc., Agilent Technologies, Inc., IonPath Inc., Zellwerk GmbH, Bruker Corporation, Shimadzu Corporation, NanoString Technologies, Inc., and Neogenomics (Multiomyx).

Competitors may be able to respond more quickly and effectively than we can to new or changing opportunities, technologies, standards, or customer requirements. In light of these advantages, even if our technology is more effective than the product or service offerings of our competitors, current or potential customers might accept competitive products and services in lieu of purchasing our technology. We anticipate that we will continue to face increased competition in the future as existing companies and competitors develop new or improved products and as new companies enter the market with new technologies. Increased competition is likely to result in pricing pressures, which could reduce our profit margins and increase our sales and marketing expenses. In addition, mergers, consolidations, or other strategic transactions between two or more of our competitors, or between our competitor and one of our key customers, could change the competitive landscape and weaken our competitive position, adversely affecting our business.

Market opportunities may not develop as quickly as we expect, limiting our ability to successfully sell our products, or our product development and strategic plans may change and our entry into certain markets may be delayed, if it occurs at all.

The application of our technologies to high-throughput genomics, single-cell genomics and, particularly, mass cytometry applications are in many cases emerging market opportunities. We believe these opportunities will take several years to develop or mature and we cannot be certain that these market opportunities will develop as we expect.

The future growth of our markets and the success of our products depend on many factors beyond our control, including recognition and acceptance by the scientific community, and the growth, prevalence, and costs of competing methods of genetic and protein analysis. Additionally, our success depends on the ability of our sales organization to successfully sell our products into these new markets. If we are not able to successfully market and sell our products, or to achieve the revenue or margins we expect, our operating results may be harmed and we may not recover our product development and marketing expenditures. In addition, our product development and strategic plans may change, which could delay or impede our entry into these markets.

If our products fail to achieve and sustain sufficient market acceptance, our revenue will be adversely affected.
Our success depends on our ability to develop and market products that are recognized and accepted as reliable, enabling and cost-effective. Most of our potential customers already use expensive research systems in their laboratories and may be reluctant to replace those systems. Market acceptance of our systems will depend on many factors, including our ability to convince potential customers that our systems are an attractive alternative to existing technologies. Compared to some competing technologies, our technology is relatively new, and most potential customers have limited knowledge of, or experience with, our products. Prior to adopting our systems, some potential customers may need to devote time and effort to testing and validating our systems. Any failure of our systems to meet these customer benchmarks could result in customers choosing to retain their existing systems or to purchase systems other than ours, and revenue from the sale of legacy instruments that may have contributed significant revenue in prior periods may decrease.
In addition, it is important that our systems be perceived as accurate and reliable by the scientific and medical research community as a whole. Historically, a significant part of our sales and marketing efforts has been directed at convincing industry leaders of the advantages of our systems and encouraging such leaders to publish or present the results of their evaluation of our system. If we are unable to continue to induce leading researchers to use our systems, or if such researchers are unable to achieve and publish or present significant experimental results using our systems, acceptance and adoption of our systems will be slowed and our ability to increase our revenue would be adversely affected.
We may experience development or manufacturing problems or delays that could limit the potential growth of our revenue or increase our losses.
We may encounter unforeseen situations in the manufacturing and assembly of our products that would result in delays or shortfalls in our production. For example, our production processes and assembly methods may have to change to accommodate any significant future expansion of our manufacturing capacity, which may increase our manufacturing costs, delay production of our products, reduce our product margin, and adversely impact our business. Conversely, if demand for our products shifts such that a manufacturing facility is operated below its capacity for an extended period, we may adjust our manufacturing operations to reduce fixed costs, which could lead to uncertainty and delays in manufacturing times and quality during any transition period.
Additionally, all of our integrated fluidic circuits (IFCs) for commercial sale are manufactured at our facility in Singapore. Production of the elastomeric block that is at the core of our IFCs is a complex process requiring advanced clean rooms, sophisticated equipment, and strict adherence to procedures. Any contamination of the clean room, equipment malfunction, or failure to strictly follow procedures can significantly reduce our yield in one or more batches. We have in the past experienced variations in yields due to such factors. A drop in yield can increase our cost to manufacture our IFCs or, in more severe cases, require us to halt the manufacture of our IFCs until the problem is resolved. Identifying and resolving the cause of a drop in yield can require substantial time and resources.
Furthermore, developing an IFC for a new application may require developing a specific production process for that type of IFC. While all of our IFCs are produced using the same basic processes, significant variations may be required to ensure adequate yield of any particular type of IFC. Developing such a process can be very time consuming, and any unexpected difficulty in doing so can delay the introduction of a product.
If our manufacturing activities are adversely impacted, or if we are otherwise unable to keep up with demand for our products by successfully manufacturing, assembling, testing, and shipping our products in a timely manner, our revenue could be impaired, market acceptance for our products could be adversely affected and our customers might instead purchase our competitors' products.
If our research and product development efforts do not result in commercially viable products within anticipated timelines, if at all, our business and results of operations will be adversely affected.
Our business is dependent on the improvement of our existing products, our development of new products to serve existing markets, and our development of new products to create new markets and applications that were previously not practical with existing systems. We intend to devote significant personnel and financial resources to research and development activities designed to advance the capabilities of our technology. We have developed design rules for the implementation of our technology that are frequently revised to reflect new insights we have gained about the technology. In addition, we have discovered that biological or chemical reactions sometimes behave differently when

implemented on our systems rather than in a standard laboratory environment. Furthermore, many such reactions take place within the confines of single cells, which have also demonstrated unexpected behavior when grown and manipulated within microfluidic environments. As a result, research and development efforts may be required to transfer certain reactions and cell handling techniques to our systems. In the past,

product development projects have been significantly delayed when we encountered unanticipated difficulties in implementing a process on our systems. We may have similar delays in the future, and we may not obtain any benefits from our research and development activities. Any delay or failure by us to develop and release new products or product enhancements would have a substantial adverse effect on our business and results of operations.

Our products could have defects or errors, which may give rise to claims against us, adversely affect market adoption of our systems, and adversely affect our business, financial condition, and results of operations.

Our systems utilize novel and complex technology and such systems may develop or contain undetected defects or errors. We cannot assure you that material performance problems, defects, or errors will not arise, and as we increase the density and integration of our systems, these risks may increase. We generally provide warranties that our systems will meet performance expectations and will be free from defects. The costs incurred in correcting any defects or errors may be substantial and could adversely affect our operating margins. For example, we have experienced a performance issue with respect to certain IFCs used in our C1 systems due to the presence of more than one cell in an IFC chamber. Although we have redesigned such C1 IFCs, we may experience additional unexpected product defects or errors that could affect our ability to adequately address these performance issues.

In manufacturing our products, including our systems, IFCs, and assays, we depend upon third parties for the supply of various components, many of which require a significant degree of technical expertise to produce. In addition, we purchase certain products from third-party suppliers for resale. If our suppliers fail to produce components to specification or provide defective products to us for resale and our quality control tests and procedures fail to detect such errors or defects, or if we or our suppliers use defective materials or workmanship in the manufacturing process, the reliability and performance of our products will be compromised.

If our products contain defects, we may experience:

- a failure to achieve market acceptance or expansion of our product sales;
- loss of customer orders and delay in order fulfillment;
- damage to our brand reputation;
- increased cost of our warranty program due to product repair or replacement;
- product recalls or replacements;
- inability to attract new customers;
- diversion of resources from our manufacturing and research and development departments into our service department; and
- legal claims against us, including product liability claims, which could be costly and time consuming to defend and result in substantial damages.

In addition, certain of our products are marketed for use with products sold by third parties. For example, certain of our systems are marketed as compatible with major next-generation DNA sequencing instruments. If such third-party products are not produced to specification, are produced in accordance with modified specifications, or are defective, they may not be compatible with our products. In such case, the reliability and performance of our products may be compromised.

The occurrence of any one or more of the foregoing could negatively affect our business, financial condition, and results of operations.

Our business depends on research and development spending levels of our customers, a reduction in which could limit our ability to sell our products and adversely affect our business.

We expect that our revenue in the foreseeable future will continue to be derived primarily from sales of our systems, IFCs, assays, and reagents to academic research institutions, translational research and medicine centers, cancer centers, clinical research laboratories biopharmaceutical, biotechnology, and agricultural biotechnology (Ag-Bio) companies, and contract research organizations worldwide. Our success will depend upon their demand for and use of our products. Accordingly, the spending policies of these customers could have a significant effect on the demand for our technology. These policies may be based on a wide variety of factors, including concerns regarding any future federal government budget sequestrations, the availability of resources to make purchases, the spending priorities among various types of equipment, policies regarding

spending during recessionary periods, and changes in the political climate. In addition, academic, governmental, and other research institutions that fund research and development activities may be subject to stringent budgetary constraints that could result in spending reductions, reduced allocations, or budget cutbacks, which could jeopardize the ability of these customers to purchase our products. Our operating results may fluctuate substantially due to reductions and delays in research and development expenditures by these customers. For example, reductions in capital and operating expenditures by these customers may result in lower than expected sales of our systems, IFCs, assays, and reagents. These reductions and delays may result from factors that are not within our control, such as:

- changes in economic conditions;
- natural disasters;
- changes in government programs that provide funding to research institutions and companies;
- changes in the regulatory environment affecting life science and Ag-Bio companies engaged in research and commercial activities;
- differences in budget cycles across various geographies and industries;
- market-driven pressures on companies to consolidate operations and reduce costs;
- mergers and acquisitions in the life science and Ag-Bio industries; and
- other factors affecting research and development spending.

Any decrease in our customers' budgets or expenditures, or in the size, scope, or frequency of capital or operating expenditures, could materially and adversely affect our operations or financial condition.

If one or more of our manufacturing facilities become unavailable or inoperable, we will be unable to continue manufacturing our instruments, IFCs, assays and/or reagents and, as a result, our business will be harmed until we are able to secure a new facility.

We manufacture our genomics analytical and preparatory instruments and IFCs for commercial sale at our facility in Singapore and our mass cytometry instruments for commercial sale at our facility in Canada. Our assays and reagents for commercial sale have been manufactured at our headquarters in the United States, however, we are consolidating our North American production activities into our Canada facility as part of our on-going efforts related to operational excellence and improving efficiencies. No other manufacturing facilities are currently available to us, particularly facilities of the size and scope of our Singapore and Canada operations. Our facilities and the equipment we use to manufacture our instruments, IFCs, assays, and reagents would be costly to replace and could require substantial lead times to repair or replace. Our facilities may be harmed or rendered inoperable by natural or man-made disasters, which may render it difficult or impossible for us to manufacture our products for some period of time. If any of our facilities become unavailable to us, we cannot provide assurances that we will be able to secure a new manufacturing facility on acceptable terms, if at all. The inability to manufacture our products, combined with our limited inventory of manufactured supplies, may result in the loss of customers or harm our reputation, and we may be unable to reestablish relationships with those customers in the future. Although we possess insurance for damage to our property and the disruption of our business, this insurance may not be sufficient to cover all of our potential losses and may not continue to be available to us on acceptable terms, or at all. If our manufacturing capabilities are impaired, we may not be able to manufacture and ship our products in a timely manner, which would adversely impact our business.

We generate a substantial portion of our revenue internationally and our international business exposes us to business, regulatory, political, operational, financial, and economic risks associated with doing business outside of the United States.

During the years 2018, 2017, and 2016, approximately 57%, 55%, and 49% respectively, of our product and service revenue was generated from sales to customers located outside of the United States. We believe that a significant percentage of our future revenue will continue to come from international sources as we expand our international operations and develop opportunities in other countries. Engaging in international business inherently involves a number of difficulties and risks, including:

- required compliance with existing and changing foreign regulatory requirements and laws that are or may be applicable to our business in the future, such as the European Union's General Data Protection Regulation and other

data privacy requirements, labor and employment regulations, anticompetition regulations, the U.K. Bribery Act of 2010 and other anticorruption laws, and the RoHS and WEEE directives, which regulate the use of certain hazardous substances in, and require the collection, reuse, and recycling of waste from, products we manufacture;

- required compliance with U.S. laws such as the Foreign Corrupt Practices Act, and other U.S. federal laws and regulations established by the office of Foreign Asset Control;
- export requirements and import or trade restrictions;
- laws and business practices favoring local companies;
- longer payment cycles and difficulties in enforcing agreements and collecting receivables through certain foreign legal systems
- changes in social, economic, and political conditions or in laws, regulations and policies governing foreign trade, manufacturing, development, and investment both domestically as well as in the other countries and jurisdictions in which we operate and into which we sell our products, including as a result of the 2016 advisory referendum approving the separation of the United Kingdom from the European Union (Brexit);
- potentially adverse tax consequences, tariffs, customs charges, bureaucratic requirements, and other trade barriers;
- difficulties and costs of staffing and managing foreign operations; and
- difficulties protecting or procuring intellectual property rights.

If one or more of these risks occurs, it could require us to dedicate significant resources to remedy, and if we are unsuccessful in finding a solution, our financial results will suffer.

We are subject to fluctuations in the exchange rate of the U.S. Dollar and foreign currencies.

A majority of our product sales are currently denominated in U.S. dollars and fluctuations in the value of the U.S. dollar relative to foreign currencies could decrease demand for our products and adversely impact our financial performance. For example, if the value of the U.S. dollar increases relative to foreign currencies, our products could become more costly to the international consumer and therefore less competitive in international markets, or if the value of the U.S. dollar decreases relative to the Singapore dollar or the Canadian dollar, it would become more costly in U.S. dollars for us to manufacture our products in Singapore and/or in Canada. Additionally, our expenses are generally denominated in the currencies of the countries in which our operations are located, which is primarily in the United States, with a portion of expenses incurred in Singapore and Canada where a significant portion of our manufacturing operations are located. Our results of operations and cash flows are, therefore, subject to fluctuations due to changes in foreign currency exchange rates. The volatility of exchange rates depends on many factors that we cannot forecast with reliable accuracy. We have experienced and will continue to experience fluctuations in our net income or loss as a result of transaction gains or losses related to revaluing certain current asset and current liability balances that are denominated in currencies other than the functional currency of the entities in which they are recorded. Fluctuations in currency exchange rates could have an adverse impact on our financial results in the future.

Any disruption or delay in the shipping or off-loading of our products, whether domestically or internationally, may have an adverse effect on our financial condition and results of operations.

We rely on shipping providers to deliver products to our customers globally. Labor, tariff, or World Trade Organization-related disputes, piracy, physical damage to shipping facilities or equipment caused by severe weather or terrorist incidents, congestion at shipping facilities, inadequate equipment to load, dock, and offload our products, energy-related tie-ups, or other factors could disrupt or delay shipping or off-loading of our products domestically and internationally. Such disruptions or delays may have an adverse effect on our financial condition and results of operations.

We are dependent on single and sole source suppliers for some of the components and materials used in our products, and the loss of any of these suppliers could harm our business.

We rely on single and sole source suppliers for certain components and materials used in our products. Additionally, several of our instruments are assembled at the facilities of contract manufacturers in Singapore. We do not have long term contracts with our suppliers of these components and materials or our assembly service providers. The loss of a single or sole source supplier of any of the following components and/or materials would require significant time and effort to locate and qualify an alternative source of supply, if at all:

- The IFCs used in our microfluidic systems are fabricated using a specialized polymer, and other specialized materials, that are available from a limited number of sources. In the past, we have encountered quality issues that have reduced our manufacturing yield or required the use of additional manufacturing processes.
- The electron multiplier detector included in the Hyperion/Helios systems and certain metal isotopes used with the Hyperion/Helios systems are purchased from sole source suppliers.
- The raw materials for our Delta Gene and SNP Type assays and Access Array target-specific primers are available from a limited number of sources.

Our reliance on single and sole source suppliers and assembly service providers also subjects us to other risks that could harm our business, including the following:

- we may be subject to increased component or assembly costs and
- we may not be able to obtain adequate supply or services in a timely manner or on commercially reasonable terms.

We have in the past experienced quality control and supply problems with some of our suppliers, such as manufacturing errors, and may again experience problems in the future. We may not be able to quickly establish additional or replacement suppliers, particularly for our single source components, or assembly service providers. Any interruption or delay in the supply of components or materials or assembly of our instruments, or our inability to obtain components, materials, or assembly services from alternate sources at acceptable prices in a timely manner, could impair our ability to meet the demand of our customers and cause them to cancel orders or switch to competitive products.

Our future success is dependent upon our ability to expand our customer base and introduce new applications.

Our customer base is primarily composed of academic research institutions, translational research and medicine centers, cancer centers, clinical research laboratories, biopharmaceutical, biotechnology, and Ag-Bio companies, and contract research organizations that perform analyses for research and commercial purposes. Our success will depend, in part, upon our ability to increase our market share among these customers, attract additional customers outside of these markets, and market new applications to existing and new customers as we develop such applications. Attracting new customers and introducing new applications require substantial time and expense. For example, it may be difficult to identify, engage, and market to customers who are unfamiliar with the current applications of our systems. Any failure to expand our existing customer base or launch new applications would adversely affect our ability to increase our revenue.

We may not be able to develop new products or enhance the capabilities of our existing systems to keep pace with rapidly changing technology and customer requirements, which could have a material adverse effect on our business, revenue, financial condition, and operating results.

Our success depends on our ability to develop new products and applications for our technology in existing and new markets, while improving the performance and cost-effectiveness of our systems. New technologies, techniques, or products could emerge that might offer better combinations of price and performance than our current or future product lines and systems. Existing markets for our products, including high-throughput genomics, single-cell genomics and mass cytometry, as well as potential markets for our products such as high-throughput DNA sequencing and molecular applications, are characterized by rapid technological change and innovation. It is critical to our success for us to anticipate changes in technology and customer requirements and to successfully introduce new, enhanced, and competitive technology to meet our customers' and prospective customers' needs on a timely and cost-effective basis. Developing and implementing new technologies will require us to incur substantial development costs and we may not have adequate resources available to be able to successfully introduce new applications of, or enhancements to, our systems. We cannot guarantee that we will be able to maintain technological advantages over emerging technologies in the future. While we typically plan improvements to our systems, we may not be able to successfully

implement these improvements. If we fail to keep pace with emerging technologies, demand for our systems will not grow and may decline, and our business, revenue, financial condition, and

operating results could suffer materially. In addition, if we introduce enhanced systems but fail to manage product transitions effectively, customers may delay or forgo purchases of our systems and our operating results may be adversely affected by product obsolescence and excess inventory. Even if we successfully implement some or all of these planned improvements, we cannot guarantee that our current and potential customers will find our enhanced systems to be an attractive alternative to existing technologies, including our current products.

Our business operations depend upon the continuing efforts of our management team and other skilled and experienced personnel, and if we are unable to retain them or to recruit and train new key executives, scientists, and technical support personnel, we may be unable to achieve our goals.

Our success depends largely on the skills, experience, and performance of key members of our management team and key scientific and technical support personnel. The loss of the services of any key member of our management team or our scientific or technical support staff might significantly delay or prevent the development of our products or achievement of other business objectives by diverting management's attention to transition matters and identification of suitable replacements, if any, and could have a material adverse effect on our business. Our research and product development efforts could also be delayed or curtailed if we are unable to attract, train, and retain highly skilled employees, particularly, senior scientists and engineers. We do not maintain fixed term employment contracts or significant key man life insurance with any of our employees.

Additionally, to expand our research and product development efforts, we need to retain and recruit key scientists skilled in areas such as molecular and cellular biology, assay development, and manufacturing. We also need highly trained technical support personnel with the necessary scientific background and ability to understand our systems at a technical level to effectively support potential new customers and the expanding needs of current customers. Competition for these people is intense and we may face challenges in retaining and recruiting such individuals if, for example, our stock price declines, reducing the retention value of equity awards, or our business or technology is no longer perceived as leading in our field. Because of the complex and technical nature of our systems and the dynamic market in which we compete, any failure to attract and retain a sufficient number of qualified employees could materially harm our ability to develop and commercialize our technology.

Our business growth strategy involves the potential for significant acquisitions, and our operating results and prospects could be harmed if we are unable to integrate future acquisitions successfully.

We may acquire other businesses to improve our product offerings or expand into new markets. Our future acquisition strategy will depend on our ability to identify, negotiate, complete, and integrate acquisitions and, if necessary, to obtain satisfactory debt or equity financing to fund those acquisitions. Mergers and acquisitions are inherently risky, and any transaction we complete may not be successful. Any merger or acquisition we may pursue would involve numerous risks, including but not limited to the following:

- difficulties in integrating and managing the operations, technologies, and products of the companies we acquire;
- diversion of our management's attention from normal daily operation of our business;
- our inability to maintain the key business relationships and the reputations of the businesses we acquire;
- our inability to retain key personnel of the acquired company;
- uncertainty of entry into markets in which we have limited or no prior experience and in which competitors have stronger market positions;
- our dependence on unfamiliar affiliates and customers of the companies we acquire;
- insufficient revenue to offset our increased expenses associated with acquisitions;
- our responsibility for the liabilities of the businesses we acquire, including those which we may not anticipate; and
- our inability to maintain internal standards, controls, procedures, and policies.

We may be unable to secure the equity or debt funding necessary to finance future acquisitions on terms that are acceptable to us. If we finance acquisitions by issuing equity or convertible debt securities, our existing stockholders will likely experience dilution, and if we finance future acquisitions with debt funding, we will incur interest expense and may have to comply with financial covenants and secure that debt obligation with our assets.

Security breaches, loss of data, cyberattacks, and other information technology failures could disrupt our operations, damage our reputation, and adversely affect our business, operations, and financial results.

We are dependent upon our data and information technology systems for the effective operation of our business and for the secure maintenance and storage of confidential data relating to our business and third-party businesses. Our information technology systems may be damaged, disrupted or shut down due to attacks by experienced programmers or hackers who may be able to penetrate our security controls and deploy computer viruses, cyberattacks, phishing schemes, or other malicious software programs, or due to employee error or malfeasance, power outages, hardware failures, telecommunication or utility failures, catastrophes or other unforeseen events, and our system redundancy and other disaster recovery planning may be ineffective or inadequate in preventing or responding to any of these circumstances. Any such compromise of our information technology systems could result in the unauthorized publication of our confidential business or proprietary information and unauthorized release of customer, supplier or employee data, any of which could expose us to a risk of legal claims or proceedings, liability under privacy or other laws, disruption of our operations and damage to our reputation, which could divert our management's attention from the operation of our business and materially and adversely affect our business, revenues and competitive position. In addition, our liability insurance may not be sufficient in type or amount to cover us against claims related to security breaches, cyberattacks and other related breaches. The cost and operational consequences of implementing further data protection measures, either as a response to specific breaches or as a result of evolving risks, could be significant. In addition, our inability to use or access our information systems at critical points in time could adversely affect the timely and efficient operation of our business. Any delayed sales, significant costs or lost customers resulting from these technology failures could adversely affect our business, operations, and financial results.

We have implemented security controls to protect our information technology infrastructure but, despite our efforts, we are not fully insulated from technology disruptions that could adversely impact us. For example, in early March 2019, we experienced a ransomware attack that infiltrated and encrypted certain of our information technology systems, including systems containing critical business data. Immediately following the attack, actions were taken to recover the compromised systems and we believe we were able to restore their operation without significant loss of business data. Based on the nature of the attack and its impact on our systems, we do not believe confidential data was lost or disclosed, but we are continuing to monitor the situation. If confidential data is later determined to have been released in the course of this event, it is possible that we could be the subject of actions by governmental authorities or claims from persons alleging they suffered damages from such a release. As of the date of this filing, we estimate the costs associated with the intrusion to be approximately $1.5 million; and are seeking to recover these costs under an applicable insurance policy. Although we believe we have now contained the disruption, we anticipate additional work and expense in the future as we continue to respond to the attack and further enhance our security processes and initiatives.

In addition to risks affecting our own systems, we could also be negatively impacted by a data breach or cyber incident happening to a third party's network and affecting us. Third parties with which we conduct business have access to certain portions of our sensitive data, including information pertaining to our customers and employees. In the event that these third parties do not adequately safeguard our data, security breaches could result and negatively impact our business, operations, and financial results.

Our efficiency and cost-savings initiatives could be disruptive to our operations and adversely affect our results of operations and financial condition, and we may not realize some or all of the anticipated benefits of these initiatives in the time frame anticipated or at all.

Since 2017, we have been implementing efficiency and cost-savings initiatives intended to stabilize our business operations and return to growth. These efficiency initiatives have included targeted workforce reductions, optimizing our facilities, and reducing excess space. Further actions such as these may be required on an ongoing basis to optimize our organization. For example, we may need to decrease or defer capital expenditures and development activities or implement further operating expense reduction measures. The implementation of these efficiency and cost-savings initiatives could impair our ability to invest in developing, marketing and selling new and existing products, be disruptive to our operations, make it difficult to attract or retain employees, result in higher than anticipated charges, divert the attention of management, result in a loss of accumulated knowledge, impact our customer and supplier relationships, and otherwise adversely affect our results of operations and financial condition.

In addition, our ability to complete our efficiency and cost-savings initiatives and achieve the anticipated benefits within the expected time frame is subject to estimates and assumptions and may vary materially from our expectations, including as a result of factors that are beyond our control. Furthermore, our efforts to grow our business and become profitable may not be successful.

To use our products, our Biomark, EP1, and Helios/CyTOF 2 systems in particular, customers typically need to purchase specialized reagents. Any interruption in the availability of these reagents for use in our products could limit our ability to market our products.

Our products, our Biomark, EP1, and Helios systems in particular, must be used in conjunction with one or more reagents designed to produce or facilitate the particular biological or chemical reaction desired by the user. Many of these reagents are highly specialized and available to the user only from a single supplier or a limited number of suppliers. Although we sell reagents for use with certain of our products, our customers may purchase these reagents directly from third-party suppliers, and we have no control over the supply of those materials. In addition, our products are designed to work with these reagents as they are currently formulated. We have no control over the formulation of reagents sold by third-party suppliers, and the performance of our products might be adversely affected if the formulation of these reagents is changed. If one or more of these reagents were to become unavailable or were reformulated, our ability to market and sell our products could be materially and adversely affected.

In addition, the use of a reagent for a particular process may be covered by one or more patents relating to the reagent itself, the use of the reagent for the particular process, the performance of that process, or the equipment required to perform the process. Typically, reagent suppliers, who are either the patent holders or their authorized licensees, sell the reagents along with a license or covenant not to sue with respect to such patents. The license accompanying the sale of a reagent often purports to restrict the purposes for which the reagent may be used. If a patent holder or authorized licensee were to assert against us or our customers that the license or covenant relating to a reagent precluded its use with our systems, our ability to sell and market our products could be materially and adversely affected. For example, our Biomark system involves real-time quantitative polymerase chain reaction (qPCR) technology. Leading suppliers of reagents for real-time qPCR reactions include Life Technologies Corporation (now part of Thermo Fisher Scientific) and Roche Diagnostics Corporation, who are our direct competitors, and their licensees. These real-time qPCR reagents are typically sold pursuant to limited licenses or covenants not to sue with respect to patents held by these companies. We do not have any contractual supply agreements for these real-time qPCR reagents, and we cannot assure you that these reagents will continue to be available to our customers for use with our systems, or that these patent holders will not seek to enforce their patents against us, our customers, or suppliers.

If we seek to be regulated as a medical device manufacturer by the U.S. Food and Drug Administration and foreign regulatory authorities, and seek approval and/or clearance for our products, the regulatory approval process would take significant time and expense and could fail to result in FDA clearance or approval for the intended uses we believe are commercially attractive. If our products were successfully approved and/or cleared, we would be subject to ongoing and extensive regulatory requirements, which would increase our costs and divert resources away from other projects. If we obtained FDA clearance or approval and we failed to comply with these requirements, our business and financial condition could be adversely impacted.

Our products are currently labeled, promoted and sold to academic research institutions, translational research and medicine centers, cancer centers, clinical research laboratories, contract research organizations, and biopharmaceutical, biotechnology, and Ag-Bio companies “for research use only” (RUO), and are not designed, or intended to be used, for clinical diagnostic tests or as medical devices as currently marketed. Before we can begin to label and market our products for use as, or in the performance of, clinical diagnostics in the United States, thereby subjecting them to FDA regulation as medical devices, we would be required to obtain premarket 510(k) clearance or premarket approval from the FDA, unless an exception applies.

We may in the future register with the FDA as a medical device manufacturer and list some of our products with the FDA pursuant to an FDA Class I listing for general purpose laboratory equipment. While this regulatory classification is exempt from certain FDA requirements, such as the need to submit a premarket notification commonly known as a 510(k), and some of the requirements of the FDA’s Quality System Regulations, or QSRs, we would be subject to ongoing FDA “general controls,” which include compliance with FDA regulations for labeling, inspections by the FDA, complaint evaluation, corrections and removals reporting, promotional restrictions, reporting adverse events or malfunctions for our products, and general prohibitions against misbranding and adulteration.

In addition, we may in the future submit 510(k) premarket notifications to the FDA to obtain FDA clearance of certain of our products on a selected basis. It is possible, in the event we elect to submit 510(k) applications for certain of our

products, that the FDA would take the position that a more burdensome premarket application, such as a premarket approval application or a de novo application is required for some of our products. If such applications were required, greater time and investment would be required to obtain FDA approval. Even if the FDA agreed that a 510(k) was appropriate, FDA clearance can be expensive and time consuming. It generally takes a significant amount of time to prepare a 510(k), including conducting appropriate testing on our products, and several months to years for the FDA to review a submission. Notwithstanding the

effort and expense, FDA clearance or approval could be denied for some or all of our products. Even if we were to seek and obtain regulatory approval or clearance, it may not be for the intended uses we believe are important or commercially attractive.

If we sought and received regulatory clearance or approval for certain of our products, we would be subject to ongoing FDA obligations and continued regulatory oversight and review, including the general controls listed above and the FDA's QSRs for our development and manufacturing operations. In addition, we would be required to obtain a new 510(k) clearance before we could introduce subsequent modifications or improvements to such products. We could also be subject to additional FDA post-marketing obligations for such products, any or all of which would increase our costs and divert resources away from other projects. If we sought and received regulatory clearance or approval and are not able to maintain regulatory compliance with applicable laws, we could be prohibited from marketing our products for use as, or in the performance of, clinical diagnostics and/or could be subject to enforcement actions, including warning letters and adverse publicity, fines, injunctions, and civil penalties; recall or seizure of products; operating restrictions; and criminal prosecution.

In addition, we could decide to seek similar regulatory clearance or approval for certain of our products in countries outside of the United States. Sales of such products outside the United States will likely be subject to foreign regulatory requirements, which can vary greatly from country to country. As a result, the time required to obtain clearances or approvals outside the United States may differ from that required to obtain FDA clearance or approval and we may not be able to obtain foreign regulatory approvals on a timely basis or at all. Clearance or approval by the FDA does not ensure approval by regulatory authorities in other countries, and approval by one foreign regulatory authority does not ensure approval by regulatory authorities in other countries or by the FDA. In Europe, we would need to comply with the Medical Device Directive 93/42 EEC and/or the In Vitro Diagnostics Directive 98/79/EC, which are required to market medical devices in the European Union. These directives have been replaced by Medical Device Regulation 2017/745 and In Vitro Diagnostic Regulation 2017/746, with official entry into force in May 26, 2017 and date of applications of May 26, 2020 and May 26, 2022 respectively. This will increase the difficulty of regulatory approvals in Europe in the future. In addition, the FDA regulates exports of medical devices. Failure to comply with these regulatory requirements or obtain and maintain required approvals, clearances and certifications could impair our ability to commercialize our products for diagnostic use outside of the United States.

Our products could become subject to regulation as medical devices by the FDA or other regulatory agencies before we have obtained regulatory clearance or approval to market our products for diagnostic purposes, which would adversely impact our ability to market and sell our products and harm our business.

As products that are currently labeled, promoted and intended "for research use only" (RUO), our products are not currently subject to regulation as medical devices by the FDA or comparable agencies of other countries. However, the FDA or comparable agencies of other countries could disagree with our conclusion that our products are currently intended for research use only or deem our current sales, marketing and promotional efforts as being inconsistent with research use only products. For example, our customers may independently elect to use our research use only labeled products in their own laboratory developed tests (LDTs) for clinical diagnostic use. The FDA has historically exercised enforcement discretion in not enforcing the medical device regulations against laboratories offering LDTs. However, on October 3, 2014, the FDA issued two draft guidance documents that set forth the FDA's proposed risk-based framework for regulating LDTs, which are designed, manufactured, and used within a single laboratory. The draft guidance documents provide the anticipated details through which the FDA would propose to establish an LDT oversight framework, including premarket review for higher-risk LDTs, such as those that have the same intended use as FDA-approved or cleared companion diagnostic tests currently on the market. In January 2017, the FDA announced that it would not issue final guidance on the oversight of LDTs and LDT manufacturers, but would seek further public discussion on an appropriate oversight approach, and give Congress an opportunity to develop a legislative solution. Any future legislative or administrative rule making or oversight of LDTs and LDT manufacturers, if and when finalized, may impact the sales of our products and how customers use our products, and may require us to change our business model in order to maintain compliance with these laws. We cannot predict how these various efforts will be resolved, how Congress or the FDA will regulate LDTs in the future, or how that regulatory system will impact our business.

Additionally, on November 25, 2013, the FDA issued Final Guidance “Distribution of In Vitro Diagnostic Products Labeled for Research Use Only.” The guidance emphasizes that the FDA will review the totality of the circumstances when it comes to evaluating whether equipment and testing components are properly labeled as RUO. The final guidance states that merely including a labeling statement that the product is for research purposes only will not necessarily render the device exempt from the FDA’s clearance, approval, and other regulatory requirements if the circumstances surrounding the distribution, marketing and promotional practices indicate that the manufacturer knows its products are, or intends for its products to be, used for clinical diagnostic purposes. These circumstances may include written or verbal sales and marketing claims or links to articles regarding a product’s performance in clinical applications and a manufacturer’s provision of technical support for clinical applications.

If the FDA modifies its approach to our products labeled and intended as RUO, or otherwise determines our products or related applications should be subject to additional regulation as in vitro diagnostic devices based upon customers' use of our products for clinical diagnostic or therapeutic purposes, before we have obtained regulatory clearance or approval to market our products for diagnostic purposes, our ability to market and sell our products could be impeded and our business, prospects, results of operations and financial condition may be adversely affected. In addition, if the FDA determines that our products labeled as RUO were intended, based on a review of the totality of circumstances, for use in clinical investigation or diagnosis, those products could be considered misbranded or adulterated under the Federal Food, Drug, and Cosmetic Act and subject to recall and/or other enforcement action.

Compliance or the failure to comply with current and future regulations affecting our products and business operations worldwide, such as environmental regulations enacted in the European Union, could cause us significant expense and adversely impact our business.

We are subject to many federal, state, local, and foreign regulations relating to various aspects of our business operations. Governmental entities at all levels are continuously enacting new regulations, and it is difficult to identify all applicable regulations and anticipate how such regulations will be implemented and enforced. We continue to evaluate the necessary steps for compliance with applicable regulations. To comply with applicable regulations, we have and will continue to incur significant expense and allocate valuable internal resources to manage compliance-related issues. In addition, such regulations could restrict our ability to expand or equip our facilities, or could require us to acquire costly equipment or to incur other significant expenses to comply with the regulations. For example, the Restriction on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Directive, or RoHS, and the Waste Electrical and Electronic Equipment Directive, or WEEE, enacted in the European Union, regulate the use of certain hazardous substances in, and require the collection, reuse, and recycling of waste from, products we manufacture. Certain of our products sold in these countries are subject to WEEE and RoHS. These and similar regulations that have been or are in the process of being enacted in other countries may require us to redesign our products, use different types of materials in certain components, or source alternative components to ensure compliance with applicable standards, and may reduce the availability of parts and components used in our products by negatively impacting our suppliers' ability to source parts and components in a timely and cost-effective manner.

Any such redesigns, required use of alternative materials, or limited availability of parts and components used in our products may detrimentally impact the performance of our products, add greater testing lead times for product introductions, reduce our product margins, or limit the markets for our products, and if we fail to comply with any present and future regulations, we could be subject to future fines, penalties, and restrictions, such as the suspension of manufacturing of our products or a prohibition on the sale of products we manufacture. Any of the foregoing could adversely affect our business, financial condition, or results of operations.

If we fail to maintain effective internal control over financial reporting in the future, the accuracy and timing of our financial reporting may be impaired, which could adversely affect our business and our stock price.

The Sarbanes-Oxley Act requires, among other things, that we maintain effective internal control over financial reporting and disclosure controls and procedures. In particular, we must perform system and process evaluation and testing of our internal control over financial reporting to allow management to report on the effectiveness of our internal control over financial reporting, as required by Section 404 of the Sarbanes-Oxley Act. Our testing may reveal deficiencies in our internal control over financial reporting that are deemed to be material weaknesses.

Our compliance with Section 404 requires that we incur substantial accounting expense and expend significant management time on compliance-related issues. We currently do not have an internal audit group, and we continue to evaluate our need for additional accounting and financial staff with appropriate public company experience and technical accounting knowledge. Moreover, if we do not comply with the requirements of Section 404, or if we or our independent registered public accounting firm identify deficiencies in our internal control over financial reporting that are deemed to be material weaknesses, the market price of our stock could decline and we could be subject to sanctions or investigations by the Nasdaq Global Select Market (Nasdaq), the SEC, or other regulatory authorities, which would require additional financial and management resources.

Impairment of our goodwill or other intangible assets could materially and adversely affect our business, operating results, and financial condition.

As of December 31, 2018, we had approximately $165.9 million of goodwill and net intangible assets, including approximately $104.1 million of goodwill and $61.8 million of net intangible assets. These assets represent a significant portion of the assets recorded on our consolidated balance sheet and relate primarily to our acquisition of DVS Sciences, Inc., or DVS,

in February 2014. In addition, if in the future we acquire additional businesses, technologies, or other intangible assets, a substantial portion of the value of such assets may be recorded as goodwill or intangible assets.

The carrying amounts of goodwill and intangible assets are affected whenever events or changes in circumstances indicate that their carrying amounts may not be recoverable. We review goodwill and indefinite lived intangible assets for impairment at least annually and more frequently under certain circumstances. Other intangible assets that are deemed to have finite useful lives will continue to be amortized over their useful lives but must be reviewed for impairment when events or changes in circumstances indicate that the carrying amount of these assets may not be recoverable. Events or changes in circumstances that could affect the likelihood that we will be required to recognize an impairment charge include declines in our stock price or market capitalization, declines in our market share or revenues, an increase in our losses, rapid changes in technology, failure to achieve the benefits of capacity increases and utilization, significant litigation arising out of an acquisition, or other matters. In particular, these or other adverse events or changes in circumstances may affect the estimated undiscounted future operating cash flows expected to be derived from our goodwill and intangible assets. Any impairment charges could have a material adverse effect on our operating results and net asset value in the quarter in which we recognize the impairment charge. We cannot provide assurances that we will not in the future be required to recognize impairment charges.

Our future capital needs are uncertain and we may need to raise additional funds in the future, which may cause dilution to stockholders or may be upon terms that are not favorable to us.

We believe that our existing cash and cash equivalents and availability under the Revolving Credit Facility will be sufficient to meet our anticipated cash requirements for at least the next 18 months. We have continued to experience losses and, if that trend continues, we may need to seek additional sources of financing. In addition, we may need to raise substantial additional capital for various purposes, including:

- expanding the commercialization of our products;
- funding our operations;
- furthering our research and development; and
- acquiring other businesses or assets and licensing technologies.

Our future funding requirements will depend on many factors, including:

- market acceptance of our products;
- the cost of our research and development activities;
- the cost of filing and prosecuting patent applications;
- the cost of defending any litigation including intellectual property, employment, contractual or other litigation;
- the cost and timing of regulatory clearances or approvals, if any;
- the cost and timing of establishing additional sales, marketing, and distribution capabilities;
- the cost and timing of establishing additional technical support capabilities;
- fluctuations in cash demands (e.g., due to interest payments or payouts under existing cash compensation plans);
- sales variability through the year-end timing of related cash collections:
- the effectiveness of our recent efficiency and cost-savings initiatives;
- the effect of competing technological and market developments; and
- the extent to which we acquire or invest in businesses, products, and technologies, although we currently have no commitments or agreements relating to any of these types of transactions.

To the extent we draw on our $15.0 million revolving senior credit facility (the “2018 Facility”) or otherwise incur additional indebtedness, the risks described above could increase. Further, if we increase our indebtedness, our actual cash requirements in the future may be greater than expected. Our cash flow from operations may not be sufficient to repay all of the outstanding debt as it becomes due, and we cannot assure you that we will be able to obtain additional funds on acceptable terms, or at all. If we raise additional funds by issuing equity securities, our stockholders may experience dilution. Debt financing in addition to the 2018 Facility, if available, may involve covenants restricting our operations or our ability to incur additional debt. Any additional debt or equity financing that we raise may contain terms that are not favorable to us or our stockholders. If we raise additional funds through collaboration and licensing arrangements with third parties, it may be necessary to relinquish some rights to our technologies or our products, or grant licenses on terms that are not favorable to us. If we do not have or are unable to raise adequate funds, we may have to liquidate some or all of our assets, delay development or commercialization of our products, or license to third

parties the rights to commercialize products or technologies that we

would otherwise seek to commercialize. We also may have to reduce marketing, customer support, research and development, or other resources devoted to our products, or cease operations. Any of these factors could harm our operating results.

If we fail to comply with the covenants and other obligations under our credit facility, the lenders may be able to accelerate amounts owed under the facilities and may foreclose upon the assets securing our obligations.

In August 2018, we entered into the Revolving Credit Facility. The Revolving Credit Facility provides for secured revolving loans in an aggregate amount of up to $15.0 million. The Revolving Credit Facility is secured by substantially all of our assets, other than intellectual property. The Revolving Credit Facility contains customary affirmative and negative covenants which, unless waived by the bank, limit our ability to, among other things, incur additional indebtedness, grant liens, make investments, repurchase stock, pay dividends, transfer assets, enter into affiliate transactions, undergo a change of control, or engage in merger and acquisition activity, including merging or consolidating with a third party. If we fail to comply with the covenants and our other obligations under the 2018 Facility, the lenders would be able to accelerate the required repayment of amounts due under the 2018 Credit Agreement and, if they are not repaid, could foreclose upon the assets securing our obligations under the 2018 Facility.

We are subject to risks related to taxation in multiple jurisdictions and if taxing authorities disagree with our interpretations of existing tax laws or regulations, our effective income tax rate could be adversely affected and we could have additional tax liability.

We are subject to income taxes in both the United States and certain foreign jurisdictions. Significant judgments based on interpretations of existing tax laws or regulations are required in determining the provision for income taxes. For example, we have made certain interpretations of existing tax laws or regulations based upon the operations of our business internationally and we have implemented intercompany agreements based upon these interpretations and related transfer pricing analyses. If the U.S. Internal Revenue Service or other taxing authorities disagree with the positions, our effective income tax rate could be adversely affected and we could have additional tax liability, including interest and penalties. We recently completed a review of our European corporate structure and tax positions and, based upon our existing business operations, we restructured our European intercompany transactions, which increased our income tax liability. From time to time, we may review our corporate structure and tax positions in other international jurisdictions and such review may result in additional changes to how we structure our international business operations, which may adversely impact our effective income tax rate. Our effective income tax rate could also be adversely affected by changes in the mix of earnings in tax jurisdictions with different statutory tax rates, changes in the valuation of deferred tax assets and liabilities, changes in existing tax laws or tax rates, changes in the level of non-deductible expenses (including share-based compensation), changes in our future levels of research and development spending, mergers and acquisitions, or the result of examinations by various tax authorities. Legislation commonly referred to as the 2017 Tax Cuts and Jobs Act was enacted in the United States on December 22, 2017 and introduced a number of changes to U.S. federal income tax, the consequences to us of which have not yet been fully determined and which could have material impact on the value of our deferred tax assets, could result in significant one-time charges in the current or future taxable years, and could increase our future U.S. tax expense. Payment of additional amounts as a result of changes in applicable tax law or upon final adjudication of any disputes could have a material impact on our results of operations and financial position.

Our ability to use net operating loss carryforwards to offset future taxable income for U.S. federal income tax purposes and other tax benefits may be limited.

Section 382 of the Internal Revenue Code of 1986, as amended, referred to as the “Code,” imposes an annual limitation on the amount of taxable income that may be offset if a corporation experiences an “ownership change” as defined in Section 382 of the Code. An ownership change occurs when a company’s “five-percent shareholders” (as defined in Section 382 of the Code) collectively increase their ownership in the company by more than 50 percentage points (by value) over a rolling three-year period. Additionally, various states have similar limitations on the use of state net operating losses, referred to as our NOLs, following an ownership change.

If we experience an ownership change, our ability to use our NOLs, any loss or deduction attributable to a “net unrealized built-in loss” and other tax attributes, which we refer to as tax benefits, could be substantially limited, and the timing of the usage of the tax benefits could be substantially delayed, which could significantly impair the value of

the tax benefits. There is no assurance that we will be able to fully utilize the tax benefits and we could be required to record an additional valuation allowance related to the amount of the tax benefits that may not be realized, which could adversely impact our results of operations.

We believe that these tax benefits are a valuable asset for us. However, legislation commonly known as the 2017 Tax Cuts and Jobs Act includes a decrease in the U.S. federal corporate income tax rate from 35% to 21%, and our tax benefits were

revalued at the newly enacted rate. We do not expect this to have a material impact on our financial statements because we currently maintain a full valuation allowance on our U.S. deferred tax assets; however, this reduction in the U.S. federal corporate income tax rate results in a corresponding reduction in the value of our tax benefits. On November 21, 2016, our board of directors approved a tax benefit preservation plan, or Tax Benefit Preservation Plan, in an effort to protect our tax benefits during the effective period of the tax benefit preservation plan. Our board of directors elected to let the Tax Benefit Preservation Plan expire in August 2017 based on its determination, in consultation with our management and tax advisors, that our NOLs were not at material risk of limitation based on an ownership change pursuant to Section 382. Our board of directors will continue to monitor our NOLs, however, and could elect to adopt a similar plan if it believes a potential risk exists that our NOLs could be limited. Any future tax benefit preservation plan could make it more difficult for a third party to acquire, or could discourage a third party from acquiring, us or a large block of our common stock.

Adverse conditions in the global economy and disruption of financial markets may significantly harm our revenue, profitability, and results of operations.

The global credit and financial markets have in recent years experienced volatility and disruptions, including diminished liquidity and credit availability, increased concerns about inflation and deflation, and the downgrade of U.S. debt and exposure risks on other sovereign debts, decreased consumer confidence, lower economic growth, volatile energy costs, increased unemployment rates, and uncertainty about economic stability. In addition, certain geopolitical events, including the prolonged shutdown of the United States government and the ongoing negotiation of the United Kingdom's withdrawal from the European Union, have caused significant economic, market, political and regulatory uncertainty in some of our markets. Volatility and disruption of financial markets could limit our customers' ability to obtain adequate financing or credit to purchase and pay for our products in a timely manner or to maintain operations, which could result in a decrease in sales volume that could harm our results of operations. General concerns about the fundamental soundness of domestic and international economies may also cause our customers to reduce their purchases. Changes in governmental banking, monetary, and fiscal policies to address liquidity and increase credit availability may not be effective. Significant government investment and allocation of resources to assist the economic recovery of sectors which do not include our customers may reduce the resources available for government grants and related funding for life science, Ag-Bio, and clinical research and development. Continuation or further deterioration of these financial and macroeconomic conditions could significantly harm our sales, profitability, and results of operations.

If we are unable to expand our direct sales and marketing force or distribution capabilities to adequately address our customers' needs, our business may be adversely affected.

We may not be able to market, sell, and, distribute our products effectively enough to support our planned growth. We sell our products primarily through our own sales force and through distributors in certain territories. Our future sales will depend in large part on our ability to continue to develop and substantially expand our direct sales force and to increase the scope of our marketing efforts. Our products are technically complex and used for highly specialized applications. As a result, we believe it is necessary to continue to develop a direct sales force that includes people with specific scientific backgrounds and expertise, and a marketing group with technical sophistication. Competition for such employees is intense. In addition, we have experienced significant changes in our sales organization in recent quarters due to reorganizations and changes in leadership. We may not be able to attract and retain personnel or be able to build an efficient and effective sales and marketing force, which would negatively impact sales of our products and reduce our revenue and profitability.

In addition, we may continue to enlist one or more sales representatives and distributors to assist with sales, distribution, and customer support globally or in certain regions of the world. If we do seek to enter into such arrangements, we may not be successful in attracting desirable sales representatives and distributors, or we may not be able to enter into such arrangements on favorable terms. If our sales and marketing efforts, or those of any third-party sales representatives and distributors, are not successful, our technologies and products may not gain market acceptance, which would materially and adversely impact our business operations.

If we seek to implement a company-wide implementation of an enterprise resource planning, or ERP, system, such implementation could adversely affect our business and results of operations or the effectiveness of internal control over financial reporting.

We have considered implementing a company-wide ERP system to handle the business and financial processes within our operations and corporate functions. ERP implementations are complex and time-consuming projects that involve substantial expenditures on system software and implementation activities that can continue for several years. ERP implementations also require transformation of business and financial processes in order to reap the benefits of the ERP system. If we decide to implement a company-wide ERP system, our business and results of operations could be adversely affected if we experience operating problems and/or cost overruns during the ERP implementation process, or if the ERP system and the associated

process changes do not give rise to the benefits that we expect. If we do not effectively implement the ERP system as planned or if the system does not operate as intended, our business, results of operations, and internal controls over financial reporting could be adversely affected.

Changes in accounting principles, or interpretations thereof, could have a significant impact on our financial position and results of operations.

We prepare our consolidated financial statements in accordance with accounting principles generally accepted in the United States of America, referred to as U.S. GAAP. These principles are subject to interpretation by the SEC and various bodies formed to interpret and create appropriate accounting principles. A change in these principles can have a significant effect on our reported results and may even retroactively affect previously reported transactions. Additionally, the adoption of new or revised accounting principles may require that we make significant changes to our systems, processes and controls.

For example, the U.S.-based Financial Accounting Standards Board, referred to as FASB, is currently working together with the International Accounting Standards Board, referred to IASB, on several projects to further align accounting principles and facilitate more comparable financial reporting between companies who are required to follow U.S. GAAP under SEC regulations and those who are required to follow International Financial Reporting Standards outside of the United States. These efforts by the FASB and IASB may result in different accounting principles under U.S. GAAP that may result in materially different financial results for us in areas including, but not limited to, principles for recognizing revenue and lease accounting. Additionally, significant changes to U.S. GAAP resulting from the FASB's and IASB's efforts may require that we change how we process, analyze and report financial information and that we change financial reporting controls. Additionally, the FASB issued new guidance (ASU 2014-09) *Revenue from Contracts with Customers (Topic 606)* which supersedes nearly all existing U.S. GAAP revenue recognition guidance. The new guidance was effective for our fiscal year 2018. We adopted ASU 2014-09 in the first quarter of 2018 using the modified retrospective method. Under the modified retrospective method, periods prior to the adoption of ASU 2014-09 are not restated and the cumulative effect of initially applying the new standard is reflected in the opening balance of retained earnings as of January 1, 2018. To date, the adoption has not had a material impact on our consolidated financial statements. Additional disclosures are required for significant differences between the reported results under the new standard and those that would have been reported under the legacy standard, which required us to make certain changes to our business processes and controls to support revenue recognition and disclosure under the new standard.

The FASB also issued Accounting Standards Update (ASU) 2016-02, *Leases (Topic 842)*. The core principle is that lessees should recognize the assets and liabilities arising from leases on the balance sheet. Under the new standard, lessees will be required to recognize lease assets and liabilities for all leases, with certain exceptions, on their balance sheets. We will adopt ASU 2016-02 as of January 1, 2019. We continue to evaluate the initial cumulative effect of the new standard as well as on our ongoing financial reporting. We continue to identify the appropriate changes to our business processes, systems, and controls to support the new lease standards and the required disclosures under the new standard.

It is not clear if or when these potential changes in accounting principles may become effective, whether we have the proper systems and controls in place to accommodate such changes and the impact that any such changes may have on our financial position and results of operations.

We have a significant amount of outstanding indebtedness, and our financial condition and results of operations could be adversely affected if we do not efficiently manage our liabilities.

We have significant outstanding convertible debt, and may be required to repay, refinance or restructure a portion of such debt before 2021. As of December 31, 2018, we had outstanding $150.00 million aggregate principal amount of our 2018 Notes and $51.3 million aggregate principal amount of our 2014 Notes. Subsequent to December 31, 2018, all of the 2018 Notes have since been converted into shares of our common stock pursuant to conversion notices received from the holders of such 2018 Notes and in connection with the Issuer's Conversion Option and no 2018 Notes remain outstanding. Please see the section entitled "Recent Developments" in Part II, Item 7 of this Form 10-K for more information on the conversion of the 2018 Notes.

The 2014 Notes will mature on February 1, 2034, unless earlier converted, redeemed, or repurchased in accordance with the terms of the 2014 Notes. Holders of the 2014 Notes may require us to repurchase all or a portion of their

2014 Notes on each of February 6, 2021, February 6, 2024, and February 6, 2029 at a repurchase price in cash equal to 100% of the principal amount of the Notes plus accrued and unpaid interest. If we undergo a fundamental change, as defined in the terms of each of the applicable series of Notes, holders of the 2014 Notes may require us to repurchase the 2014 Notes in whole or in part for cash at a repurchase price equal to 100% of the principal amount of the 2014 Notes plus accrued and unpaid interest. If we refinance the debt owed under the 2014 Notes, we may issue additional convertible notes or other debt, which could include additional company obligations and represent more dilution to existing stockholders and noteholders.

This significant amount of debt has important risks to us and our investors, including:

- requiring a portion of our cash flow from operations to make interest payments on this debt;
- increasing our vulnerability to general adverse economic and industry conditions;
- reducing the cash flow available to fund capital expenditures and other corporate purposes and to grow our business;
- limiting our flexibility in planning for, or reacting to, changes in our business and the industry; and
- limiting our ability to borrow additional funds as needed or take advantage of business opportunities as they arise.

In addition, to the extent we draw on our Revolving Credit Facility or otherwise incur additional indebtedness, the risks described above could increase. Further, if we increase our indebtedness, our actual cash requirements in the future may be greater than expected. Our cash flow from operations may not be sufficient to repay all of the outstanding debt as it becomes due, and we may not be able to borrow money, sell assets or otherwise raise funds on acceptable terms, or at all, to refinance our debt.

Risks Related to Intellectual Property

Our ability to protect our intellectual property and proprietary technology through patents and other means is uncertain.

Our commercial success depends in part on our ability to protect our intellectual property and proprietary technologies. We rely on patent protection, where appropriate and available, as well as a combination of copyright, trade secret, and trademark laws, and nondisclosure, confidentiality, and other contractual restrictions to protect our proprietary technology. However, these legal means afford only limited protection and may not adequately protect our rights or permit us to gain or keep any competitive advantage. We apply for patents covering our products and technologies and uses thereof, as we deem appropriate. However, we may fail to apply for patents on important products and technologies in a timely fashion or at all. Our pending U.S. and foreign patent applications may not issue as patents or may not issue in a form that will be sufficient to protect our proprietary technology and gain or keep our competitive advantage. Any patents we have obtained or do obtain may be subject to re-examination, reissue, opposition, or other administrative proceeding, or may be challenged in litigation, and such challenges could result in a determination that the patent is invalid or unenforceable. In addition, competitors may be able to design alternative methods or devices that avoid infringement of our patents. Both the patent application process and the process of managing patent disputes can be time consuming and expensive.

Furthermore, the laws of some foreign countries may not protect our intellectual property rights to the same extent as do the laws of the United States, and many companies have encountered significant problems in protecting and defending such rights in foreign jurisdictions. Proceedings to enforce our patent rights in foreign jurisdictions could result in substantial cost and divert our efforts and attention from other aspects of our business. Changes in either the patent laws or in interpretations of patent laws in the United States or other countries may diminish the value of our intellectual property. We cannot predict the breadth of claims that may be allowed or enforced in our patents or in third-party patents. For example:

- We might not have been the first to make the inventions covered by each of our pending patent applications;
- We might not have been the first to file patent applications for these inventions;
- The patents of others may have an adverse effect on our business; and
- Others may independently develop similar or alternative products and technologies or duplicate any of our products and technologies.

To the extent our intellectual property, including licensed intellectual property, offers inadequate protection, or is found to be invalid or unenforceable, our competitive position and our business could be adversely affected.

We may be involved in lawsuits to protect or enforce our patents and proprietary rights, to determine the scope, coverage and validity of others' proprietary rights, or to defend against third party claims of intellectual property infringement, any of which could be time-intensive and costly and may adversely impact our business or stock price.

Litigation may be necessary for us to enforce our patent and proprietary rights, determine the scope, coverage, and validity of others' proprietary rights, and/or defend against third party claims of intellectual property infringement against us as well as against our suppliers, distributors, customers, and other entities with whom we do business. Litigation could result in substantial legal fees and could adversely affect the scope of our patent protection. The outcome of any litigation or other proceeding is inherently uncertain and might not be favorable to us, and we might not be able to obtain licenses to technology that we require. Even if such licenses are obtainable, they may not be available at a reasonable cost. We could therefore incur substantial costs related to royalty payments for licenses obtained from third parties, which could negatively affect our product margins or financial position. Further, we could encounter delays in product introductions, or interruptions in product sales, as we develop alternative methods or products.

As we move into new markets and applications for our products, incumbent participants in such markets may assert their patents and other proprietary rights against us as a means of impeding our entry into such markets or as a means to extract substantial license and royalty payments from us. Our commercial success may depend in part on our non-infringement of the patents or proprietary rights of third parties. Numerous significant intellectual property issues have been litigated, and will likely continue to be litigated, between existing and new participants in our existing and targeted markets. For example, some of our products provide for the testing and analysis of genetic material, and patent rights relating to genetic materials remain a developing area of patent law. A recent U.S. Supreme Court decision held, among other things, that claims to isolated genomic DNA occurring in nature are not patent eligible, while claims relating to synthetic DNA may be patent eligible. We expect the ruling will result in additional litigation in our industry. In addition, third parties may assert that we are employing their proprietary technology without authorization, and if they are successful in making such claims, we may be forced to enter into license agreements, pay additional royalties or license fees, or enter into settlements that include monetary obligations or restrictions on our business.

Our customers have been sued for various claims of intellectual property infringement in the past, and we expect that our customers will be involved in additional litigation in the future. In particular, our customers may become subject to lawsuits claiming that their use of our products infringes third-party patent rights, and we could become subject to claims that we contributed to or induced our customer's infringement. In addition, our agreements with some of our suppliers, distributors, customers, and other entities with whom we do business may require us to defend or indemnify these parties to the extent they become involved in infringement claims against us, including the claims described above. We could also voluntarily agree to defend or indemnify third parties in instances where we are not obligated to do so if we determine it would be important to our business relationships. If we are required or agree to defend or indemnify any of these third parties in connection with any infringement claims, we could incur significant costs and expenses that could adversely affect our business, operating results, or financial condition.

We may be subject to damages resulting from claims that we or our employees have wrongfully used or disclosed alleged trade secrets of our employees' former employers or other institutions or third parties with whom such employees may have been previously affiliated.

Many of our employees were previously employed at universities or other life science or Ag-Bio companies, including our competitors or potential competitors. In the future, we may become subject to claims that our employees, or we, have inadvertently or otherwise used or disclosed trade secrets or other proprietary information of their former employers or other third parties or institutions with whom our employees may have been previously affiliated. Litigation may be necessary to defend against these claims. For example, we were a defendant in litigation brought against us and one of our non-executive employees by Thermo Fisher Scientific Inc. (Thermo) alleging, among other claims, misappropriation of proprietary information and breach of contractual and fiduciary obligations. While we resolved our dispute with Thermo in July 2017, if we fail in defending against similar claims brought in the future we could be subject to injunctive relief against us. A loss of key research personnel work product could hamper or prevent our ability to commercialize certain potential products or a loss of or inability to hire key marketing, sales or

research and development personnel could adversely affect our future product development, sales and revenues, any of which could severely harm our business. Even if we are successful in defending against any similar claims brought in the future, litigation could result in substantial costs and be a distraction to management.

We depend on certain technologies that are licensed to us. We do not control these technologies and any loss of our rights to them could prevent us from selling our products, which would have an adverse effect on our business.

We rely on licenses in order to be able to use various proprietary technologies that are material to our business, including our core IFC, multi-layer soft lithography, and mass cytometry technologies. In some cases, we do not control the prosecution, maintenance, or filing of the patents to which we hold licenses, or the enforcement of these patents against third parties. Additionally, our business and product development plans anticipate and may substantially depend on future in-license agreements with additional third parties, some of which are currently in the early discussion phase. For example, Fluidigm Canada Inc., or Fluidigm Canada, an Ontario corporation and wholly-owned subsidiary of Fluidigm Sciences, was party to an interim license agreement, now expired, with Nodality, Inc., or Nodality, under which Nodality granted Fluidigm Canada a worldwide, non-exclusive, research use only, royalty bearing license to certain cytometric reagents, instruments, and other products. While we were able to secure a license under a new license agreement with Nodality, we cannot provide assurances that we will always be able to obtain suitable license rights to technologies or intellectual property of other third parties on acceptable terms, if at all.

In-licensed intellectual property rights that are fundamental to the business being operated present numerous risks and limitations. For example, all or a portion of the license rights granted may be limited for research use only, and in the event we attempt to expand into diagnostic applications, we would be required to negotiate additional rights, which may not be available to us on commercially reasonable terms, if at all.

Our rights to use the technology we license are also subject to the negotiation and continuation of those licenses. Certain of our licenses contain provisions that allow the licensor to terminate the license upon specific conditions. Our rights under the licenses are subject to our continued compliance with the terms of the license, including the payment of royalties due under the license. Because of the complexity of our products and the patents we have licensed, determining the scope of the license and related royalty obligation can be difficult and can lead to disputes between us and the licensor. An unfavorable resolution of such a dispute could lead to an increase in the royalties payable pursuant to the license. If a licensor believed we were not paying the royalties due under the license or were otherwise not in compliance with the terms of the license, the licensor might attempt to revoke the license. If such an attempt were successful and the license is terminated, we might be barred from marketing, producing, and selling some or all of our products, which would have an adverse effect on our business. Potential disputes between us and one of our existing licensors concerning the terms or conditions of the applicable license agreement could result, among other risks, in substantial management distraction; increased expenses associated with litigation or efforts to resolve disputes; substantial customer uncertainty concerning the direction of our product lines; potential infringement claims against us and/or our customers, which could include efforts by a licensor to enjoin sales of our products; customer requests for indemnification by us; and, in the event of an adverse determination, our inability to operate our business as currently operated. Termination of material license agreements could prevent us from manufacturing and selling our products unless we can negotiate new license terms or develop or acquire alternative intellectual property rights that cover or enable similar functionality. Any of these factors would be expected to have a material adverse effect on our business, operating results, and financial condition and could result in a substantial decline in our stock price.

We are subject to certain manufacturing restrictions related to licensed technologies that were developed with the financial assistance of U.S. governmental grants.

We are subject to certain U.S. government regulations because we have licensed technologies that were developed with U.S. government grants. In accordance with these regulations, these licenses provide that products embodying the technologies are subject to domestic manufacturing requirements. If this domestic manufacturing requirement is not met, the government agency that funded the relevant grant is entitled to exercise specified rights, referred to as "march-in rights," which if exercised would allow the government agency to require the licensors or us to grant a non-exclusive, partially exclusive, or exclusive license in any field of use to a third party designated by such agency. All of our microfluidic systems revenue is dependent upon the availability of our IFCs, which incorporate technology developed with U.S. government grants. Our genomics instruments, including microfluidic systems, and IFCs are manufactured at our facility in Singapore. The federal regulations allow the funding government agency to grant, at the request of the licensors of such technology, a waiver of the domestic manufacturing requirement. Waivers may be

requested prior to any government notification. We have assisted the licensors of these technologies with the analysis of the domestic manufacturing requirement, and, in December 2008, the sole licensor subject to the requirement applied for a waiver of the domestic manufacturing requirement with respect to the relevant patents licensed to us by this licensor. In July 2009, the funding government agency granted the requested waiver of the domestic manufacturing requirement for a three-year period commencing in July 2009. In June 2012, the licensor requested a continued waiver of the domestic manufacturing requirement with respect to the relevant patents, but the government agency has not yet taken any action in response to this request. If the government agency does not grant the requested waiver or the government fails to grant additional waivers of such requirement that may be sought in the future, then the U.S. government could exercise its march-in

rights with respect to the relevant patents licensed to us. In addition, the license agreement under which the relevant patents are licensed to us contains provisions that obligate us to comply with this domestic manufacturing requirement. We are not currently manufacturing instruments and IFCs in the United States that incorporate the relevant licensed technology. If our lack of compliance with this provision constituted a material breach of the license agreement, the license of the relevant patents could be terminated or we could be compelled to relocate our manufacturing of microfluidic systems and IFCs to the United States to avoid or cure a material breach of the license agreement. Any of the exercise of march-in rights, the termination of our license of the relevant patents or the relocation of our manufacturing of microfluidic systems and IFCs to the United States could materially adversely affect our business, operations and financial condition.

We are subject to certain obligations and restrictions relating to technologies developed in cooperation with Canadian government agencies.

Some of our Canadian research and development is funded in part through government grants and by government agencies. The intellectual property developed through these projects is subject to rights and restrictions in favor of government agencies and Canadians generally. In most cases the government agency retains the right to use intellectual property developed through the project for non-commercial purposes and to publish the results of research conducted in connection with the project. This may increase the risk of public disclosure of information relating to our intellectual property, including confidential information, and may reduce its competitive advantage in commercializing intellectual property developed through these projects. In certain projects, we have also agreed to use commercially reasonable efforts to commercialize intellectual property in Canada, or more specifically in the province of Ontario, for the economic benefit of Canada and the province of Ontario. These restrictions will limit our choice of business and manufacturing locations, business partners and corporate structure and may, in certain circumstances, restrict our ability to achieve maximum profitability and cost efficiency from the intellectual property generated by these projects. In one instance, a dispute with the applicable government funded entity may require mediation, which could lead to unanticipated delays in our commercialization efforts to that project. One of our Canadian government funded projects is also subject to certain limited “march-in” rights in favor of the government of the Province of Ontario, under which we may be required to grant a license to our intellectual property, including background intellectual property developed outside the scope of the project, to a responsible applicant on reasonable terms in circumstances where the government determines that such a license is necessary in order to alleviate emergency or extraordinary health or safety needs or for public use. In addition, we must provide reasonable assistance to the government in obtaining similar licenses from third parties required in connection with the use of its intellectual property. Instances in which the government of the Province of Ontario has exercised similar “march-in” rights are rare; however, the exercise of such rights could materially adversely affect our business, operations and financial condition.

Risks Related to Our Common Stock

Our stock price may fluctuate significantly, particularly if holders of substantial amounts of our stock attempt to sell, and holders may have difficulty selling their shares based on current trading volumes of our stock. In addition, numerous other factors could result in substantial volatility in the trading price of our stock.

Our stock is currently traded on Nasdaq, but we can provide no assurance that we will be able to maintain an active trading market on Nasdaq or any other exchange in the future. The trading volume of our stock tends to be low relative to our total outstanding shares, and we have several stockholders who hold substantial blocks of our stock. As of December 31, 2018, we had 49,338,473 shares of common stock outstanding, and stockholders holding at least 5% of our stock, individually or with affiliated persons or entities, collectively beneficially owned or controlled approximately 46.6%of such shares and one stockholder beneficially owned 25.3% of our outstanding common stock. Sales of large numbers of shares by any of our large stockholders could adversely affect our trading price, particularly given our relatively small historic trading volumes. If stockholders holding shares of our common stock sell, indicate an intention to sell, or if it is perceived that they will sell, substantial amounts of their common stock in the public market, the trading price of our common stock could decline. Moreover, if there is no active trading market or if the volume of trading is limited, holders of our common stock may have difficulty selling their shares. In addition, the concentration of ownership of our outstanding common stock (approximately 46.6% held by our top three stockholders) means that a relatively small number of stockholders have significant control over the outcomes of stockholder voting.

In addition, the trading price of our common stock may be highly volatile and could be subject to wide fluctuations in response to various factors, some of which are beyond our control. These factors include:

- actual or anticipated quarterly variation in our results of operations or the results of our competitors;

- announcements or communications by us or our competitors relating to, among other things, new commercial products, technological advances, significant contracts, commercial relationships, capital commitments, acquisitions or sales of businesses, and/or misperceptions in or speculation by the market regarding such announcements or communications;
- issuance of new or changed securities analysts' reports or recommendations for our stock;
- developments or disputes concerning our intellectual property or other proprietary rights;
- commencement of, or our involvement in, litigation;
- market conditions in the life science, Ag-Bio, and CRO sectors;
- failure to complete significant sales;
- manufacturing disruptions that could occur if we were unable to successfully expand our production in our current or an alternative facility;
- any future sales of our common stock or other securities in connection with raising additional capital or otherwise;
- any major change to the composition of our board of directors or management; and
- general economic conditions and slow or negative growth of our markets.

The stock market in general, and market prices for the securities of technology-based companies like ours in particular, have from time to time experienced volatility that often has been unrelated to the operating performance of the underlying companies. These broad market and industry fluctuations may adversely affect the market price of our common stock regardless of our operating performance. In several recent situations where the market price of a stock has been volatile, holders of that stock have instituted securities class action litigation against the company that issued the stock. If any of our stockholders were to bring a lawsuit against us, the defense and disposition of the lawsuit could be costly and divert the time and attention of our management and harm our operating results.

If securities or industry analysts publish unfavorable research about our business or cease to cover our business, our stock price and/or trading volume could decline.

The trading market for our common stock may rely, in part, on the research and reports that equity research analysts publish about us and our business. We do not have any control of the analysts or the content and opinions included in their reports. The price of our stock could decline if one or more equity research analysts downgrade our stock or issue other unfavorable commentary or research. If one or more equity research analysts ceases coverage of our company or fails to publish reports on us regularly, demand for our stock could decrease, which in turn could cause our stock price or trading volume to decline.

Anti-takeover provisions in our charter documents and under Delaware law could make an acquisition of us, which may be beneficial to our stockholders, more difficult and may prevent attempts by our stockholders to replace or remove our current management and limit the market price of our common stock.

Provisions in our certificate of incorporation and bylaws may have the effect of delaying or preventing a change of control or changes in our management, including provisions that:

- authorize our board of directors to issue, without further action by the stockholders, up to 10,000,000 shares of undesignated preferred stock;
- require that any action to be taken by our stockholders be effected at a duly called annual or special meeting and not by written consent;
- specify that special meetings of our stockholders can be called only by our board of directors, the chairman of the board, the chief executive officer or the president;
- establish an advance notice procedure for stockholder approvals to be brought before an annual meeting of our stockholders, including proposed nominations of persons for election to our board of directors;

- establish that our board of directors is divided into three classes, Class I, Class II, and Class III, with each class serving staggered three-year terms;
- provide that our directors may be removed only for cause;
- provide that vacancies on our board of directors may be filled only by a majority of directors then in office, even though less than a quorum;
- specify that no stockholder is permitted to cumulate votes at any election of directors; and
- require a super-majority of votes to amend certain of the above-mentioned provisions.

These provisions may frustrate or prevent any attempts by our stockholders to replace or remove our current management by making it more difficult for stockholders to replace members of our board of directors, which is responsible for appointing the members of our management. In addition, because we are incorporated in Delaware, we are governed by the provisions of Section 203 of the Delaware General Corporation Law, which limits the ability of stockholders owning in excess of 15% of our outstanding voting stock to merge or combine with us.

We have never paid cash dividends on our capital stock, and we do not anticipate paying any cash dividends in the foreseeable future.

We have paid no cash dividends on any of our classes of capital stock to date and currently intend to retain our future earnings to fund the development and growth of our business. In addition, we cannot pay any cash dividends on any of our classes of common stock without approval from the lender under our 2018 Credit Facility, and may become subject to covenants under future debt arrangements that place restrictions on our ability to pay dividends. As a result, capital appreciation, if any, of our common stock will be stockholders' sole source of gain for the foreseeable future.

Risks Related to Our Outstanding Convertible Notes

Our outstanding convertible notes are effectively subordinated to our secured debt and any liabilities of our subsidiaries.

Our outstanding 2014 Notes rank:

- senior in right of payment to any of our indebtedness that is expressly subordinated in right of payment to the 2014 Notes;
- equal in right of payment to all of our liabilities that are not so subordinated;
- effectively junior in right of payment to any of our secured indebtedness, including, but not limited to, any indebtedness under the Revolving Credit Facility, to the extent of the value of the assets securing such indebtedness; and
- structurally junior to all indebtedness and other liabilities (including trade payables) of our subsidiaries.

In February 2014, we completed the offering of our 2014 Notes with an aggregate outstanding principal amount of $201.3 million. In March 2018, we completed an exchange of $150.0 million in aggregate principal amount of our 2014 Notes for $150.0 million in aggregate principal amount of our 2018 Notes, leaving approximately $51.3 million in aggregate principal amount of 2014 Notes outstanding. Subsequent to December 31, 2018, all of the 2018 Notes have since been converted into shares of our common stock pursuant to conversion notices received from the holders of such 2018 Notes and in connection with the Issuer's Conversion Option and no 2018 Notes remain outstanding. Please see the section entitled "Recent Developments" in Part II, Item 7 of this Form 10-K for more information on the conversion of the 2018 Notes. In the event of our bankruptcy, liquidation, reorganization, or other winding up, our assets that secure debt ranks senior in right of payment to 2014 Notes will be available to pay obligations on the 2014 Notes only after the secured debt, including but not limited to, any indebtedness under the Revolving Credit Facility, has been repaid in full from these assets, and the assets of our subsidiaries will be available to pay obligations on the 2014 Notes only after all claims senior to the 2014 Notes have been repaid in full. There may not be sufficient assets remaining to pay amounts due on any or all of the 2014 Notes then outstanding. The indenture governing the 2014 Notes does not prohibit us from incurring additional senior debt or secured debt, nor does it prohibit our subsidiaries from incurring additional liabilities.

The 2014 Notes are our obligations only and some of our operations are conducted through, and a portion of our consolidated assets are held by, our subsidiaries.

The 2014 Notes are our obligations exclusively and are not guaranteed by any of our operating subsidiaries. A portion of our consolidated assets is held by our subsidiaries. Accordingly, our ability to service our debt, including the 2014 Notes, depends in part on the results of operations of our subsidiaries and upon the ability of such subsidiaries to provide us with cash, whether in the form of dividends, loans, or otherwise, to pay amounts due on our obligations, including the 2014 Notes. Our subsidiaries are separate and distinct legal entities and have no obligation, contingent or otherwise, to make payments on the 2014 Notes or to make any funds available for that purpose. In addition, dividends, loans, or other distributions to us from such subsidiaries may be subject to contractual and other restrictions and are subject to other business and tax considerations.

Recent and future regulatory actions and other events may adversely affect the trading price and liquidity of the 2014 Notes.

We expect that many investors in, and potential purchasers of, the 2014 Notes will employ, or seek to employ, a convertible arbitrage strategy with respect to the 2014 Notes. Investors would typically implement such a strategy by selling short the common stock underlying the 2014 Notes and dynamically adjusting their short position while continuing to hold the 2014 Notes. Investors may also implement this type of strategy by entering into swaps on our common stock in lieu of or in addition to short selling the common stock. As a result, any specific rules regulating equity swaps or short selling of securities or other governmental action that interferes with the ability of market participants to effect short sales or equity swaps with respect to our common stock could adversely affect the ability of investors in, or potential purchasers of, the 2014 Notes to conduct the convertible arbitrage strategy that we believe they will employ, or seek to employ, with respect to the 2014 Notes. This could, in turn, adversely affect the trading price and liquidity of the 2014 Notes.

The SEC and other regulatory and self-regulatory authorities have implemented various rules and taken certain actions, and may in the future adopt additional rules and take other actions, that may impact those engaging in short selling activity involving equity securities (including our common stock). Such rules and actions include Rule 201 of SEC Regulation SHO, the adoption by the Financial Industry Regulatory Authority, Inc. and the national securities exchanges of a “Limit Up-Limit Down” program, the imposition of market-wide circuit breakers that halt trading of securities for certain periods following specific market declines, and the implementation of certain regulatory reforms required by the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. Although the direction and magnitude of the effect that Regulation SHO, FINRA, securities exchange rule changes, and implementation of the Dodd-Frank Act may have on the trading price and the liquidity of the 2014 Notes will depend on a variety of factors, many of which cannot be determined at the date of this report, past regulatory actions (such as certain emergency orders issued by the SEC in 2008 prohibiting short sales of stock of certain financial services companies) have had a significant impact on the trading prices and liquidity of convertible debt instruments. Any governmental or regulatory action that restricts the ability of investors in, or potential purchasers of, the 2014 Notes to effect short sales of our common stock, borrow our common stock, or enter into swaps on our common stock or increases the costs of implementing an arbitrage strategy could adversely affect the trading price and the liquidity of the 2014 Notes.

Volatility in the market price and trading volume of our common stock could adversely impact the trading price of the 2014 Notes.

The stock market in recent years has experienced significant price and volume fluctuations that have often been unrelated to the operating performance of companies. The market price of our common stock could fluctuate significantly for many reasons, including in response to the risks described in this report, or for reasons unrelated to our operations, such as reports by industry analysts, investor perceptions or negative announcements by our customers, competitors or suppliers regarding their own performance, as well as industry conditions and general financial, economic and political instability. The market price of our common stock could also decline as a result of sales of a large number of shares of our common stock in the market, particularly sales by our directors, executive officers, employees, and significant stockholders, and the perception that these sales could occur may also depress the market price of our common stock. A decrease in the market price of our common stock would likely adversely impact the trading price of the 2014 Notes. The market price of our common stock could also be affected by possible sales of our common stock by investors who view the 2014 Notes as a more attractive means of equity participation in

us and by hedging or arbitrage trading activity that we expect to develop involving our common stock. This trading activity could, in turn, affect the trading price of the 2014 Notes.

We have incurred additional debt and may still incur substantially more debt or take other actions which would intensify the risks discussed above.

We are not restricted under the terms of the indenture governing the 2014 Notes from incurring additional debt, securing existing or future debt, recapitalizing our debt, or taking a number of other actions that are not limited by the terms of the indenture governing the 2014 Notes that could have the effect of diminishing our ability to make payments on the 2014 Notes when due. Any failure by us or any of our significant subsidiaries to make any payment at maturity of indebtedness for borrowed money in excess of $15.0 million or the acceleration of any such indebtedness in excess of $15.0 million would, subject to the terms of the indenture governing the 2014 Notes, constitute a default under the indenture. If the repayment of the related indebtedness were to be accelerated after any applicable notice or grace periods, we may not have sufficient funds to repay the 2014 Notes when required.

In August 2018, we entered into the Revolving Credit Facility with Silicon Valley Bank, which matures on August 2, 2020. Amounts drawn under the Revolving Credit Facility will be used for working capital and general corporate purposes. While we currently have no outstanding debt under the Revolving Credit Facility, we may incur up to $15.0 million of secured debt pursuant to the Revolving Credit Facility. See Note 6 to the Consolidated Financial Statements included in this Form 10-K for more information about the Revolving Credit Facility.

We may not have the ability to raise the funds necessary to repurchase the 2014 Notes upon specified dates or upon a fundamental change, and our future debt may contain limitations on our ability to repurchase the 2014 Notes.

Holders of the 2014 Notes have the right to require us to repurchase all or a portion of their 2014 Notes on certain dates or upon the occurrence of a fundamental change at a repurchase price equal to, for the 2014 Notes, 100% of the principal amount of the 2014 Notes to be repurchased plus accrued and unpaid interest, if any. We may not have enough available cash or be able to obtain financing at the time we are required to make repurchases of 2014 Notes surrendered therefor.

In addition, our ability to repurchase the 2014 Notes may be limited by law, regulatory authority, or agreements governing our future indebtedness. Our failure to repurchase the 2014 Notes at a time when the repurchase is required by the indenture would constitute a default under the indenture. A default under the indenture or the fundamental change itself could also lead to a default under agreements governing our future indebtedness. If the repayment of the related indebtedness were to be accelerated after any applicable notice or grace periods, we may not have sufficient funds to repay the indebtedness and repurchase the 2014 Notes when required.

Holders of 2014 Notes are not entitled to any rights with respect to our common stock, but they are subject to all changes made with respect to them to the extent our conversion obligation includes shares of our common stock.

Holders of 2014 Notes are not entitled to any rights with respect to our common stock (including, without limitation, voting rights and rights to receive any dividends or other distributions on our common stock) prior to the conversion date with respect to any 2014 Notes they surrender for conversion, but they are subject to all changes affecting our common stock. For example, if an amendment is proposed to our certificate of incorporation or bylaws requiring stockholder approval and the record date for determining the stockholders of record entitled to vote on the amendment occurs prior to the conversion date with respect to any 2014 Notes surrendered for conversion, then the holder surrendering such 2014 Notes will not be entitled to vote on the amendment, although such holder will nevertheless be subject to any changes affecting our common stock.

We have made only limited covenants in the indenture governing the 2014 Notes, and these limited covenants may not protect a noteholder's investment.

The indenture governing the 2014 Notes does not:

- require us to maintain any financial ratios or specific levels of net worth, revenues, income, cash flows, or liquidity and, accordingly, does not protect holders of the 2014 Notes in the event that we experience adverse changes in our financial condition or results of operations;
- limit our subsidiaries' ability to guarantee or incur indebtedness that would rank structurally senior to the 2014 Notes;
- limit our ability to incur additional indebtedness, including secured indebtedness;
- restrict our subsidiaries' ability to issue securities that would be senior to our equity interests in our subsidiaries and therefore would be structurally senior to the 2014 Notes;

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- restrict our ability to repurchase our securities;
- restrict our ability to pledge our assets or those of our subsidiaries; or
- restrict our ability to make investments or pay dividends or make other payments in respect of our common stock or our other indebtedness.

Furthermore, the indenture governing the 2014 Notes contains only limited protections in the event of a change of control. We could engage in many types of transactions, such as acquisitions, refinancings, or certain recapitalizations, that could substantially affect our capital structure and the value of the 2014 Notes and our common stock but may not constitute a "fundamental change" that permits holders to require us to repurchase their 2014 Notes or a "make-whole fundamental change" that permits holders to convert their 2014 Notes at an increased conversion rate. For these reasons, the limited covenants in the indenture governing the 2014 Notes may not protect a noteholder's investment in the 2014 Notes.

The increase in the conversion rate for 2014 Notes converted in connection with a make-whole fundamental change or provisional redemption may not adequately compensate noteholders for any lost value of the 2014 Notes as a result of such transaction or redemption.

If (i) a make-whole fundamental change occurs prior to February 6, 2021, or (ii) upon our issuance of a notice of provisional redemption, under certain circumstances, we will increase the conversion rate by a number of additional shares of our common stock for the 2014 Notes converted in connection with such events. The increase in the conversion rate for the 2014 Notes converted in connection with such events may not adequately compensate noteholders for any lost value of the 2014 Notes as a result of such transaction or redemption. In addition, if the price of our common stock in the transaction is greater than $180.00 per share or less than $39.96 per share (in each case, subject to adjustment), no additional shares will be added to the conversion rate for the 2014 Notes. Moreover, in no event will the conversion rate per $1,000 principal amount of 2014 Notes as a result of this adjustment exceed 25.0250 shares of common stock, subject to adjustment.

Our obligation to increase the conversion rate for 2014 Notes converted in connection with such events could be considered a penalty, in which case the enforceability thereof would be subject to general principles of reasonableness and equitable remedies.

The conversion rate of the 2014 Notes may not be adjusted for all dilutive events.

The conversion rate of the 2014 Notes is subject to adjustment for certain events, including, but not limited to, the issuance of certain stock dividends on our common stock, the issuance of certain rights or warrants, subdivisions, combinations, distributions of capital stock, indebtedness, or assets, cash dividends and certain issuer tender or exchange offers. However, the conversion rate will not be adjusted for other events, such as a third-party tender or exchange offer or an issuance of common stock for cash, that may adversely affect the trading price of the 2014 Notes or our common stock. An event that adversely affects the value of the 2014 Notes may occur, and that event may not result in an adjustment to the conversion rate.

Some significant restructuring transactions may not constitute a fundamental change, in which case we would not be obligated to offer to repurchase the 2014 Notes.

Upon the occurrence of a fundamental change, a holder of 2014 Notes has the right to require us to repurchase the 2014 Notes. However, the fundamental change provisions will not afford protection to holders of 2014 Notes in the event of other transactions that could adversely affect the 2014 Notes. For example, transactions such as leveraged recapitalizations, refinancings, restructurings, or acquisitions initiated by us may not constitute a fundamental change requiring us to repurchase the 2014 Notes. In the event of any such transaction, the holders would not have the right to require us to repurchase the 2014 Notes, even though each of these transactions could increase the amount of our indebtedness, or otherwise adversely affect our capital structure or any credit ratings, thereby adversely affecting the holders of 2014 Notes.

In addition, absent the occurrence of a fundamental change or a make-whole fundamental change as described under changes in the composition of our board of directors will not provide holders with the right to require us to repurchase the 2014 Notes or to an increase in the conversion rate upon conversion.

We cannot assure noteholders that an active trading market will develop or be maintained for the 2014 Notes.

We do not intend to apply to list our outstanding 2014 Notes on any securities exchange or to arrange for quotation on any automated dealer quotation system. In addition, the liquidity of the trading market in the 2014 Notes and the

market price quoted for the 2014 Notes may be adversely affected by changes in the overall market for this type of security and by changes

in our financial performance or prospects or in the prospects for companies in our industry generally. As a result, we cannot assure noteholders that an active trading market will develop or be maintained for the 2014 Notes. If an active trading market does not develop or is not maintained, the market price and liquidity of the 2014 Notes may be adversely affected. In that case, noteholders may not be able to sell the 2014 Notes at a particular time or at a favorable price.

Any adverse rating of the 2014 Notes may cause their trading price to fall.

We do not intend to seek a rating on the 2014 Notes. However, if a rating service were to rate the 2014 Notes and if such rating service were to lower its rating on the 2014 Notes below the rating initially assigned to the 2014 Notes or otherwise announces its intention to put the 2014 Notes on credit watch, the trading price of the 2014 Notes could decline.

Holders of 2014 Notes may be subject to tax if we make or fail to make certain adjustments to the conversion rate of the 2014 Notes even though they do not receive a corresponding cash distribution.

The conversion rate of the 2014 Notes is subject to adjustment in certain circumstances, including the payment of cash dividends. If the conversion rate is adjusted as a result of a distribution that is taxable to our common stockholders, such as a cash dividend, a noteholder may be deemed to have received a dividend subject to U.S. federal income tax without the receipt of any cash. In addition, a failure to adjust (or to adjust adequately) the conversion rate after an event that increases a noteholder's proportionate interest in us could be treated as a deemed taxable dividend to you. If a make-whole fundamental change occurs prior to February 6, 2021 or upon our issuance of a notice of provisional redemption, under some circumstances, we will increase the conversion rate for the 2014 Notes converted in connection with the make-whole fundamental change or provisional redemption. Such increase may also be treated as a distribution subject to U.S. federal income tax as a dividend. For a non-U.S. holder, any deemed dividend would be subject to U.S. federal withholding tax at a 30% rate, or such lower rate as may be specified by an applicable treaty, which may be set off against subsequent payments on the 2014 Notes.

Any conversions of the 2014 Notes will dilute the ownership interest of our existing stockholders, including holders who had previously converted their notes.

Any conversion of some or all of the 2014 Notes will dilute the ownership interests of our existing stockholders. The initial conversion price under the 2014 Notes is approximately $55.94. As a result, each of the outstanding 2014 Notes is initially convertible into 17.8750 shares of our common stock per $1,000 principal amount. Issuances of shares of common stock upon conversion of our 2014 Notes could depress the market price of our common stock and impair our ability to raise capital through the sale of additional equity securities. In addition, the existence of the 2014 Notes may encourage short selling by market participants because the conversion of the 2014 Notes could depress the price of our common stock.

ITEM 1B. UNRESOLVED STAFF COMMENTS

None.

ITEM 2. PROPERTIES

We lease approximately 74,100 square feet of office and laboratory space at our headquarters in South San Francisco, California under a lease that expires in April 2020. Additionally, we lease office, laboratory and manufacturing space in Singapore of approximately 50,000 square feet and in Ontario, Canada of approximately 44,500 square feet under leases that expire in June 2022 and March 2026, respectively. As of December 31, 2018, we also leased office space in Japan, China, and France, with various expiration dates through February 2026. In addition, we believe that our properties are in good condition and are adequate and suitable for their purposes.

ITEM 3. LEGAL PROCEEDINGS

In the normal course of business, we are from time to time involved in legal proceedings or potential legal proceedings, including matters involving employment, intellectual property, or others. Although the results of

litigation and claims cannot be predicted with certainty, we currently believe that the final outcome of any currently pending matters would not have a material adverse effect on our business, operating results, financial condition, or cash flows. Regardless of the outcome, litigation can have an adverse impact on us because of defense and settlement costs, diversion of management resources, and other factors.

ITEM 4. MINE SAFETY DISCLOSURES

Not applicable.

PART II

ITEM 5. MARKET FOR REGISTRANT'S COMMON EQUITY, RELATED STOCKHOLDER MATTERS AND ISSUER PURCHASES OF EQUITY SECURITIES

Market for Our Common Stock; Dividends

Our common stock began trading on the Nasdaq Global Select Market under the symbol "FLDM" on February 10, 2011. We had 86 stockholders of record as of March 13, 2019; however, because many of our outstanding shares are held by brokers or other institutions on behalf of stockholders, we are unable to estimate the total number of beneficial owners represented by the holders of record.

We have never declared or paid cash dividends on our common stock and do not expect to pay dividends on our common stock for the foreseeable future. Instead, we anticipate that all of our earnings in the foreseeable future will be used for the operation and growth of our business.

Stock Performance Graph

The following performance graph shall not be deemed "soliciting material" or to be "filed" with the Securities and Exchange Commission for purposes of Section 18 of the Securities Exchange Act of 1934, as amended, or the Exchange Act, or otherwise subject to the liabilities under that Section, and shall not be deemed to be incorporated by reference into any filing of Fluidigm Corporation under the Securities Act or the Exchange Act.

The following graph compares, from December 31, 2013 through December 31, 2018, the cumulative total return for our common stock, the Nasdaq Composite Total Return Index, and the Nasdaq US Benchmark Medical Equipment Index, assuming in each case an initial investment of $100 and reinvestment of all dividends. Such returns are based on historical results and are not intended to suggest future performance.

Sales of Unregistered Securities

None.

Issuer Purchases of Equity Securities

We did not repurchase any shares of our common stock during the year ended December 31, 2018.

ITEM 6. SELECTED FINANCIAL DATA

The following selected financial data should be read in conjunction with the consolidated financial statements and related notes thereto appearing elsewhere in this Form 10-K. We have derived the consolidated statement of operations data for the years ended December 31, 2018, 2017, and 2016, and consolidated balance sheet data as of December 31, 2018, and December 31, 2017 from audited consolidated financial statements included elsewhere in this Form 10-K. The consolidated statement of operations data for the years ended December 31, 2015, and 2014, and the consolidated balance sheet data as of December 31, 2016, December 31, 2015, and December 31, 2014 were derived from audited consolidated financial statements that are not included in this Form 10-K.

	2018	2017	2016	2015	2014
	(in thousands, except per share amounts)				
Consolidated Statement of Operations Data:					
Total revenue	$112,964	$101,937	$104,446	$114,712	$116,456
Loss from operations	(48,164)	(58,360)	(73,190)	(50,155)	(51,836)
Net loss	(59,013)	(60,535)	(75,985)	(53,315)	(52,830)
Net loss per share, basic and diluted	(1.49)	(1.84)	(2.62)	(1.86)	(1.90)

	2018	2017	2016	2015	2014
	(in thousands)				
Consolidated Balance Sheet Data:					
Cash, cash equivalents, and short and long-term investments	$95,401	$63,136	$59,430	$101,465	$142,800
Working capital (1)	100,988	71,565	76,334	123,433	133,440
Total assets (2)	303,647	287,351	306,395	370,050	406,506
Total long-term debt (2)	172,058	195,238	194,951	194,673	194,402
Total stockholders' equity	72,116	30,935	53,233	114,901	150,419

(1) Working capital excludes deferred revenue.

(2) $1.0 million and $1.1 million of debt issuance costs for Convertible notes were previously included in Total assets reclassified to Total long-term debt as a deduction in December 31, 2015 and December 31, 2014, respectively.

ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS

The following discussion and analysis should be read together with our consolidated financial statements and the notes to those statements included elsewhere in this Form 10-K. This discussion contains forward-looking statements based on our current expectations, assumptions, estimates and projections about Fluidigm and our industry. These forward-looking statements involve risks and uncertainties. Our actual results could differ materially from those indicated in these forward-looking statements as a result of certain factors, as more fully described in "Risk factors" in Item 1A of this Form 10-K, in this Item 7, and elsewhere in this Form 10-K. Except as may be required by law, we undertake no obligation to update publicly any forward-looking statements for any reason, even if new information becomes available or other events occur in the future.

Overview

Fluidigm is a global company that improves life through comprehensive health insight. Our innovative technologies and multi-omic tools are used by researchers to reveal meaningful insights in health and disease, identify biomarkers to inform decisions and accelerate the development of more effective therapies. We create, manufacture, and market innovative technologies and life science tools, including preparatory and analytical instruments for Mass Cytometry, PCR, Library Prep, Single Cell Genomics, and consumables, including IFCs, assays, and reagents.

Our focus is on the most pressing needs in translational and clinical research, including cancer, immunology and immunotherapy. We use proprietary CyTOF® and microfluidics technologies to develop innovative end-to-end solutions that have the flexibility required to meet the needs of translational research and the robustness to support high-impact clinical research studies. We sell our products to leading academic, government, pharmaceutical, biotechnology and plant and animal research laboratories worldwide.

We distribute our systems through our direct sales force and support organizations located in North America, Europe, and Asia-Pacific, and through distributors or sales agents in several European, Latin American, Middle Eastern, and Asia-Pacific countries. Our manufacturing operations are located in Singapore and Canada. Our facility in Singapore manufactures our genomics instruments, which are assembled by our contract manufacturer located within our in Singapore facility. All of our IFCs for commercial sale and some IFCs for our research and development purposes are also fabricated at our Singapore facility. Our mass cytometry instruments for commercial sale, as well as for internal research and development purposes, are manufactured at our facility in Canada. We also manufacture assays and reagents at our facilities in the United States. We also manufacture assays and reagents at our facilities in the United States. As part of our on-going efforts related to operational excellence and improving efficiencies, we are consolidating our North American production activities into our Canadian facility.

Our total revenue was $113.0 million in 2018, $101.9 million in 2017, and $104.4 million in 2016. We have incurred significant net losses since our inception in 1999 and, as of December 31, 2018, our accumulated deficit was $558.9 million.

At the end of 2016, we began reallocating our resources based on revenue contribution and growth expectations across our target markets, including a reorganization of our sales team and commercial leadership. We implemented certain operational efficiencies and cost-savings initiatives beginning in the first quarter of 2017 intended to align our resources with our product strategy, reduce our operating expenses, and manage our cash flows. In 2017 and 2018, we have grown our revenues, increased gross margins, reduced operating expenses, streamlined our manufacturing operations, and rationalized our headcount and facilities. These activities have resulted in lower net losses, improving from $76.0 million in 2016 to $59.0 million in 2018. We have also strengthened our balance sheet through the issuance of common stock and refinancing our convertible debt. In August 2017, we sold 9.1 million shares of common stock for aggregate net proceeds of approximately $28.8 million; in December 2018, we sold approximately 9.4 million shares of common stock for aggregate net proceeds of $59.1 million. In March 2018, we refinanced $150 million of our convertible debt which effectively extended the maturity of the debt while providing us with additional financing flexibility. These transactions are described in Note 6 and Note 8 of our audited 2018 consolidated financial statements.

Recent Developments

From January 9, 2019 through February 27, 2019, we received notices from holders of the 2018 Notes electing to voluntarily convert approximately $138.1 million in aggregate principal amount pursuant to the terms of the Second Supplemental Indenture dated March 6, 2018, between us and U.S. Bank National Association (Trustee) to the Indenture dated as of February 14, 2014, between us and the Trustee. As a result of such voluntary conversions, we have elected to fully satisfy our conversion obligations by delivering approximately 17.9 million shares of our common stock to such holders and have retired approximately $138.1 million of the 2018 Notes. On February 27, 2019, we notified the Trustee of our intention to

exercise our Issuer's Conversion Option pursuant to the terms of the Second Supplemental Indenture with respect to the remaining approximately $11.9 million in aggregate principal amount of 2018 Notes. These bonds were converted into approximately 1.5 million shares of our common stock and the bonds retired in March 2019.
In early March 2019, we experienced a ransomware attack that infiltrated and encrypted certain of our information technology systems, including systems containing critical business data. Immediately following the attack, actions were taken to recover the compromised systems and we believe we were able to restore their operation without significant loss of business data. Based on the nature of the attack and its impact on our systems, we do not believe confidential data was lost or disclosed, but we are continuing to monitor the situation. If confidential data is later determined to have been released in the course of this event, it is possible that we could be the subject of actions by governmental authorities or claims from persons alleging they suffered damages from such a release. As of the date of this filing, we estimate the costs associated with the intrusion to be approximately $1.5 million and are seeking to recover these costs under an applicable insurance policy. Although we believe we have now contained the disruption, we anticipate additional work and expense in the future as we continue to respond to the attack and further enhance our security processes and initiatives.

Critical Accounting Policies, Significant Judgments and Estimates

Our consolidated financial statements and the related notes included elsewhere in this Form 10-K are prepared in accordance with accounting principles generally accepted in the United States. The preparation of these consolidated financial statements requires us to make estimates and assumptions that affect the reported amounts of assets, liabilities, revenue, costs, and expenses and related disclosures. We base our estimates on historical experience and on various other assumptions that we believe to be reasonable under the circumstances. Changes in accounting estimates may occur from period to period. Accordingly, actual results could differ significantly from the estimates made by our management. We evaluate our estimates and assumptions on an ongoing basis. To the extent that there are material differences between these estimates and actual results, our future financial statement presentation, financial condition, results of operations, and cash flows will be affected.

We believe that the following critical accounting policies involve a greater degree of judgment and complexity than our other accounting policies. Accordingly, these are the policies we believe are the most critical to understanding and evaluating of our audited 2018 consolidated financial statements.

Revenue Recognition

We generate revenue primarily from sales of our products and services. Our product revenue consists of sales of our mass cytometry, high-throughput genomics and single-cell genomics instruments and consumables, including IFCs, assays, and other reagents. Our service revenue consists of post-warranty service contracts, preventive maintenance plans, repairs, installation, training and other specialized product support services. We also receive revenue from our license agreements with third parties. Revenue is reported net of any sales, use and value-added taxes we collect from customers as required by government authorities.

We recognize revenue based on the amount of consideration we expect to receive in exchange for the goods and services we transfer to the customer. Our commercial arrangements typically include multiple distinct products and services, and we allocate revenue to these performance obligations based on their relative standalone selling prices. Standalone selling prices (SSPs) are generally determined using observable data from recent transactions. In cases where sufficient data is not available, we estimate a product's SSP using a cost plus a margin approach or by applying a discount to the product's list price.

Product Revenue

We recognize product revenue at the point in time when control of the goods passes to the customer and we have an enforceable right to payment. This generally occurs either when the product is shipped from one of our facilities or when it arrives at the customer's facility, based on the contractual terms. Customers generally do not have a unilateral right to return products after delivery. Invoices are generally issued at shipment and become due in 30 to 60 days.

Service Revenue

We recognize revenue from repairs, installation, training and other specialized product support services at the point in time the work is completed. Installation and training services are generally billed in advance of service. Repairs and other services are generally billed at the point the work is completed.

Revenue associated with instrument service contracts is recognized on a straight-line basis over the life of the agreement, which is generally one to three years. We believe this approach is appropriate for service contracts because we provide services on demand throughout the term of the agreement. Invoices are generally issued in advance of service on a monthly, quarterly, annual or multi-year basis. Payments made in advance of service are reported on our consolidated balance sheet as deferred revenue.

Contract Costs

Incremental sales commission costs incurred to obtain instrument service contracts are capitalized and amortized to selling, general and administrative expense over the life of the contract, which is generally one to three years. As a practical expedient, we expense sales commissions associated with product support services that are delivered in less than one year as they are incurred. Sales commissions associated with the sale of products are expensed as they are incurred.

Product Warranties

We generally provide a one-year warranty on our instruments. We accrue for estimated warranty obligations at the time of product shipment. We periodically review our warranty liability and record adjustments based on the terms of warranties provided to customers, and historical and anticipated warranty claim experience. This expense is recorded as a component of cost of product revenue in the consolidated statements of operations.

Significant Judgments

Applying the revenue recognition practices discussed above often requires significant judgment. Judgment is required when identifying performance obligations, estimating SSP and allocating purchase consideration in multi-element arrangements and estimating the future amount of our warranty obligations. Significant judgment is also required when interpreting commercial terms and determining when control of goods and services passes to the customer. Any material changes created by errors in judgment could have a material effect on our operating results and overall financial condition.

Goodwill, Intangible Assets and Other Long-Lived Assets

Goodwill, which has an indefinite useful life, represents the excess of cost over fair value of net assets acquired. Our intangible assets include developed technology, patents and licenses. The cost of identifiable intangible assets with finite lives is generally amortized on a straight-line basis over the assets' respective estimated useful lives.

Goodwill and intangible assets with indefinite lives are not subject to amortization, but are tested for impairment on an annual basis during the fourth quarter or whenever events or changes in circumstances indicate the carrying amount of these assets may not be recoverable. We first conduct an assessment of qualitative factors to determine whether it is more likely than not that the fair value of our reporting unit is less than its carrying amount. If we determine that it is more likely than not that the fair value of our reporting unit is less than its carrying amount, we then conduct a two-step test for impairment of goodwill. In the first step, we compare the fair value of our reporting unit to its carrying value. If the fair value of our reporting unit exceeds its carrying value, goodwill is not considered impaired and no further analysis is required. If the carrying value of the reporting unit exceeds its fair value, then the second step of the impairment test must be performed in order to determine the implied fair value of the goodwill. If the carrying value of the goodwill exceeds its implied fair value, then an impairment loss equal to the difference would be recorded.

We evaluate our long-lived assets, including finite-lived intangibles, for indicators of possible impairment when events or changes in circumstances indicate the carrying amount of an asset may not be recoverable. If any indicators of impairment exist, we assess the recoverability of the affected long-lived assets by determining whether the carrying value of the asset can be recovered through undiscounted future operating cash flows. If impairment is indicated, we estimate the asset's fair value using future discounted cash flows associated with the use of the asset and adjust the carrying value of the asset accordingly. We did not recognize any impairment of long-lived assets for any of the periods presented herein.

Convertible Notes

In February 2014, we closed an underwritten public offering $201.3 million aggregate principal amount of our 2.75% Senior Convertible Notes due 2034 (2014 Notes). In March 2018, we entered into separate privately negotiated transactions with certain holders of our 2014 Notes to exchange $150.0 million in aggregate principal amount of the 2014 Notes for our new 2.75% Exchange Convertible Senior Notes due 2034 (2018 Notes). Following the exchange, approximately $51.3 million in

aggregate principal amount of the 2014 Notes remained outstanding in addition to $150.0 million in aggregate principal amount of the 2018 Notes.

As the 2018 Notes are convertible, at our election, into cash, shares of our common stock, or a combination of cash and shares of our common stock, we accounted for the 2018 Notes under the cash conversion guidance in ASC 470, whereby the embedded conversion option in the 2018 Notes was separated and accounted for in equity. The embedded conversion option value was calculated as the difference between (i) the total fair value of the 2018 Notes and (ii) the fair value of a similar debt instrument excluding the embedded conversion option. We determined an embedded conversion option value of $29.3 million, which was recorded in additional paid-in-capital and reduced the carrying value of the 2018 Notes. The resulting discount on the 2018 Notes will be amortized over the expected term of the 2018 Notes, using the effective interest method through the first note holder put date of February 6, 2023.

For both the 2014 Notes and 2018 Notes, offering-related costs, including underwriting costs, were capitalized as debt issuance costs, recorded as an offset to the carrying value of the related Notes, and are amortized over the expected term of the related Notes using the effective interest method.

Stock-Based Compensation

Our board of directors sets the terms, conditions, and restrictions related to our Employee Stock Purchase Plan (ESPP) and the grant of stock options, Restricted Share Units (RSUs) and performance-based awards under our various stock-based plans. Our board of directors determines the number of awards to grant and sets the vesting criteria. For performance-based share awards, our board of directors sets the performance objectives and other vesting provisions in determining the number of shares or value of performance units and performance shares that will be paid out. Such payout will be a function of the extent to which performance objectives or other vesting provisions have been achieved.

We recognize compensation costs for all stock-based awards, including stock options, RSUs, and stock purchased under our ESPP, based on the grant date fair value of the award. We recognize stock-based compensation expense on a straight-line basis over the requisite service periods for non-performance-based awards. For performance-based stock awards, stock-based compensation expense is recognized over the requisite service period when the achievement of each individual performance goal becomes probable.

Stock-based compensation cost for restricted stock units granted to employees is measured based on the closing fair market value of our common stock on the date of grant. The fair value of options and stock purchases under ESPP on the grant date is estimated using the Black-Scholes option-pricing model, which requires the use of certain subjective assumptions, including expected term, volatility, risk-free interest rate and the fair value of our common stock. These assumptions generally require significant judgment. We determine the expected volatility based on our historical stock price volatility generally commensurate with the estimated expected term of the stock awards. The expected term of an award is based on historical forfeiture experience, exercise activity, and the terms and conditions of the stock awards. The risk-free interest rate is based on the U.S. Treasury yield in effect at the time of grant for zero coupon U.S. Treasury notes with maturities approximately equal to each grant’s expected term. We account for forfeitures as they occur.

Income Taxes

We use the asset and liability method to account for income taxes. Deferred tax assets and liabilities are recognized for the future tax consequences attributable to differences between the financial statement carrying amounts of existing assets and liabilities and their respective tax bases. Deferred tax assets and liabilities are measured using enacted tax rates expected to apply to taxable income in the years in which those temporary differences are expected to be

recovered or settled. Significant management judgment is required in determining our provision for income taxes, our deferred tax assets and liabilities, and any valuation allowance recorded against our deferred tax assets. Our provision for income taxes generally consists of tax expense/benefit related to current period earnings/losses.

As part of the process of preparing our consolidated financial statements, we continuously monitor the circumstances impacting the expected realization of our deferred tax assets for each jurisdiction. We consider all available evidence, including historical operating results in each jurisdiction, expectations and risks associated with estimates of future taxable income, and ongoing prudent and feasible tax planning strategies in assessing the need for a valuation allowance. To the extent a deferred tax asset cannot be recognized, a valuation allowance is established to reduce our deferred tax assets to the amount that is more likely than not to be realized. These deferred tax assets primarily consist of net operating loss carryforwards, research and development tax credits, and stock-based compensation. We intend to maintain such valuation allowance until sufficient evidence exists to support its reduction. Our deferred tax liabilities primarily consist of book and tax basis differences in fixed

assets and acquired identifiable intangible assets. We make estimates and judgments about our future taxable income that are based on assumptions that are consistent with our plans and estimates. Should the actual amounts differ from our estimates, the amount of our valuation allowance could be materially impacted. Changes in these estimates may result in significant increases or decreases to our tax provision in a period in which such estimates are changed, which in turn would affect net income or loss.

We recognize the financial statement effects of a tax position when it is more likely than not, based on the technical merits, that the position will be sustained upon examination. Any interest and penalties related to uncertain tax positions are reflected in the income tax provision.

The Tax Cuts and Jobs Act (the Tax Act) was enacted in December 2017. The Tax Act introduced a broad range of tax reform measures that significantly changed the federal income tax laws. At December 31, 2017, we recorded the provisional income tax effects of the Tax Act in accordance with ASU No. 2018-05, Income Taxes (Topic 740). Due to our having recorded a full valuation allowance against its U.S. federal and state deferred tax assets, there was no net impact on our tax provision as a result of the remeasurement of U.S. deferred taxes using the relevant tax rate at which we expect them to reverse. The one-time transition tax on post-1986 foreign unremitted earnings did not have a material impact to our effective tax rate as a result of our generating net foreign deficit earnings. In accordance with Staff Accounting Bulletin (SAB No. 118, we completed the accounting related to tax reform in the fourth quarter of 2018 and no material adjustments to the provisional tax expense were required. We continue to monitor supplemental legislation and technical interpretations of the tax law that may cause the final impact from the Tax Act to differ from the amounts previously recorded.

At December 31, 2017, we changed our permanent reinvestment assertion and will not permanently reinvest our foreign earnings outside the United States. The cash generated from some of our foreign subsidiaries may be used domestically to fund operations. Any domestic, foreign withholding tax and state taxes that may be due upon future repatriation of earnings is not expected to be significant.

Inventory Valuation

Inventories are stated at the lower of cost (on a first-in, first-out basis) or net realizable value. Inventory costs include direct materials, direct labor, and normal manufacturing overhead. Finished goods that are used for research and development are expensed as consumed or depreciated over their period of use. We regularly review inventory for excess and obsolete products and components. Provisions for slow-moving, excess, and obsolete inventories are recorded when required to reduce inventory values to their estimated net realizable values based on product life cycle, development plans, product expiration, and quality issues.

Recent Accounting Changes and Accounting Pronouncements

Adoption of New Accounting Guidance
In May 2014, the FASB issued ASU 2014-09 Revenue from Contracts with Customers (Topic 606). Topic 606 and its related amendments supersede Revenue Recognition (Topic 605), issued in June 2010, and provide principles for recognizing revenue for goods and services in a manner consistent with the transfer of control of those goods and services to the customer.

We adopted Topic 606 on January 1, 2018, using the modified retrospective method applied to those contracts with unrecognized revenue on the adoption date. We recognized the effect of applying the new revenue standard by recording a cumulative catch-up adjustment that reduced the accumulated deficit component of stockholders' equity by $0.4 million and increased current assets by $0.2 million and non-current assets by $0.2 million. The adjustment

capitalized certain sales commission costs that were incurred to obtain instrument service contracts. Under Topic 605, we accounted for these incremental contract acquisition costs by recognizing them as expense at the point the contract was awarded. Under Topic 606, the costs are capitalized and amortized to expense over the life of the contract, which is generally one to three years. The comparative information for periods prior to January 1, 2018, has not been restated and continues to be reported in accordance with Topic 605.

The following table summarizes the cumulative effect of adopting Topic 606 on amounts previously reported in our consolidated balance sheet at December 31, 2017 (in thousands):

	Balance at December 31, 2017	Topic 606 Transition Adjustments	Balance at January 1, 2018
Prepaid expenses and other current assets	$1,528	$ 153	$1,681
Total current assets	$94,801	$ 153	$94,954
Other non-current assets	$7,541	$ 205	$7,746
Total assets	$287,351	$ 358	$287,709
Accumulated deficit	$(500,196)	$ 358	$(499,838)
Total stockholders' equity	$30,935	$ 358	$31,293
Total liabilities and stockholders' equity	$287,351	$ 358	$287,709

The following table summarizes the impacts on our consolidated statement of operations of adopting Topic 606 compared to Topic 605 for the twelve months ended December 31, 2018 (in thousands):

	As Reported	Balance Without Adoption of Topic 606	Effect of Change
	Twelve Months Ended December 31, 2018		
Selling, general and administrative	$79,783	$79,859	$(76)
Total costs and expenses	$161,128	$161,204	$(76)
Loss from operations	$(48,164)	$(48,240)	$76
Loss before income taxes	$(61,420)	$(61,496)	$76
Net loss	$(59,013)	$(59,089)	$76

The following table summarizes the impacts on our consolidated balance sheet of adopting Topic 606 compared to Topic 605 at December 31, 2018 (in thousands):

	As Reported	Balance Without Adoption of Topic 606	Effect of Change
		December 31, 2018	
Prepaid expenses and other current assets	$2,051	$1,884	$ 167
Total current assets	$127,106	$126,939	$ 167
Other non-current assets	$6,208	$5,941	$ 267
Total assets	$303,647	$303,213	$ 434
Stockholders' equity	$72,116	$71,682	$ 434
Total liabilities and stockholders' equity	$303,647	$303,213	$ 434

In March 2018, the FASB issued ASU No. 2018-05, Income Taxes (Topic 740): Amendments to SEC Paragraphs Pursuant to SEC Staff Accounting Bulletin No. 118. This ASU allows SEC reporting companies to record provisional amounts in earnings for the year ended December 31, 2017, due to the complexities involved in accounting for the enactment of the Tax Act. We recognized the estimated income tax effects of the Tax Act in its 2017 Consolidated Financial Statements in accordance with SEC Staff Accounting Bulletin No. 118. In accordance with SAB No. 118, we completed the accounting related to tax reform in the fourth quarter of 2018 and no material adjustments to the provisional tax expense were required. Refer to Note 10 of the consolidated financial statements in the Form 10-K for the fiscal year ended December 31, 2018 for further information regarding the provisional amounts recorded by the Company.

In August 2016, the FASB issued ASU 2016-15 Statement of Cash Flows (Topic 230): Classification of Certain Cash Receipts and Cash Payments. The ASU addresses eight specific cash flow issues and their presentation within the statement of cash flows. We adopted this ASU in the first quarter of 2018. The adoption of this ASU did not have a material impact on our consolidated financial statements.

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In November 2016, the FASB issued ASU 2016-18 Statement of Cash Flows (Topic 230): Restricted Cash, a consensus of the FASB's Emerging Issues Task Force, which amended the presentation of restricted cash within the statement of cash flows. The new guidance requires restricted cash be included within cash and cash equivalents on the statement of cash flows. We adopted this ASU in the first quarter of 2018. The adoption of this ASU did not have a material impact on our consolidated financial statements.

Recent Accounting Pronouncements

In August 2018, the FASB issued ASU 2018-15 Intangibles—Goodwill and Other—Internal-Use Software (Subtopic 350-40) which establishes new guidance on the accounting for costs incurred to implement a cloud computing arrangement that is considered a service arrangement. The new guidance requires the capitalization of such costs, aligning it with the accounting for costs associated with developing or obtaining internal-use software. The new guidance is effective for fiscal years beginning after December 15, 2019. We are currently evaluating the impact of adoption on its consolidated financial statements.

In February 2016, the FASB established Topic 842, Leases, by issuing Accounting Standards Update (ASU) No. 2016-02, which requires lessees to recognize leases on-balance sheet and disclose key information about leasing arrangements. Topic 842 was subsequently amended by ASU No. 2018-01, Land Easement Practical Expedient for Transition to Topic 842; ASU No. 2018-10, Codification Improvements to Topic 842, Leases; and ASU No. 2018-11, Targeted Improvements. The new standard establishes a right-of-use (ROU) model that requires a lessee to recognize a ROU asset and lease liability on the balance sheet for all leases with a term longer than 12 months. Leases will be classified as finance or operating; the classification will impact the expense recognition in the income statement.

A Modified Retrospective Transition approach is required, applying the new standard to all leases existing at the date of initial application. An entity may choose to use either (1) its effective date or (2) the beginning of the earliest comparative period presented in the financial statements as its date of initial application. We expect to adopt the new standard on January 1, 2019 and use the effective date as our date of initial application. Consequently, financial information will not be updated, and the disclosures required under the new standard will not be provided for dates and periods before January 1, 2019. For dates and periods prior to January 1, 2019, the original disclosures under ASC 840 will be disclosed.

The new standard provides several optional practical expedients upon transition. We expect to elect the 'package of practical expedients', which permits us not to reassess under the new standard our prior conclusions about lease identification, lease classification, and initial direct costs. We do not expect to elect the use-of-hindsight or the practical expedient pertaining to land easements; the latter not being applicable to us.

We expect that this standard will have a material effect on our financial statements. While we continue to assess all the effects of adoption, we currently believe the most significant effects relate to the recognition of new ROU assets and lease liabilities on our balance sheet for our building, vehicle and equipment leases. On adoption, we currently expect to recognize $8.0 million to $11.0 million of additional operating liabilities, based on the present value of the remaining fixed rental payments under current leasing standards for existing operating leases, with corresponding ROU assets of approximately $6.0 million to $9.0 million. The difference between the initial lease liability and right of use asset is attributable to deferred rent. We do not expect any impact on retained earnings from the adoption of ASC 842.

The new standard also provides certain accounting elections for an entity's ongoing accounting. We currently expect to elect the short-term lease recognition exemption for all leases that qualify. This means, for those leases that qualify, we will not recognize ROU assets or lease liabilities. We also currently expect to elect to not separate lease and

nonlease components for our building leases and to take a portfolio approach for our vehicle leases by country.

In January 2017, the FASB issued ASU 2017-04, Intangibles - Goodwill and Other (Topic 350): Simplifying the Test for Goodwill Impairment. The ASU eliminates the requirement for an entity to calculate the implied fair value of goodwill to measure a goodwill impairment charge. Instead, an entity performs its annual, or interim, goodwill impairment testing by comparing the fair value of a reporting unit with its carrying amount and recording an impairment charge for the amount by which the carrying amount exceeds the fair value. The ASU will be effective for annual and interim goodwill impairment testing performed for our fiscal year beginning January 1, 2020, with early adoption permitted. We are currently evaluating the effect that the updated standard will have on our consolidated financial statements.

Results of Operations

The following table presents our historical consolidated statements of operations data for the years ended December 31, 2018, 2017, and 2016, and as a percentage of total revenue for the respective years (in thousands):

	Year Ended December 31,					
	2018		2017		2016	
Revenue:						
Total revenue	$112,964	100 %	$101,937	100 %	$104,446	100 %
Cost of sales:						
Cost of product revenue	44,861	39	45,039	44	41,110	39
Cost of service revenue	6,454	6	4,916	5	4,899	5
Total cost of sales	51,315	45	49,955	49	46,009	44
Gross profit	61,649	55 %	51,982	51 %	58,437	56 %
Operating expenses:						
Research and development	30,030	27	30,826	30	38,415	37
Selling, general and administrative	79,783	71	79,516	78	93,212	89
Total operating expenses	109,813	98	110,342	108	131,627	126
Loss from operations	(48,164)	(43)	(58,360)	(57)	(73,190)	(70)
Interest expense	(13,893)	(12)	(5,824)	(6)	(5,820)	(6)
Other income (expense), net	637	1	385	1	(1,167)	(1)
Loss before income taxes	(61,420)	(54)	(63,799)	(62)	(80,177)	(77)
Benefit from income taxes	2,407	2	3,264	3	4,192	4
Net loss	$(59,013)	(52)%	$(60,535)	(59)%	$(75,985)	(73)%

Revenue

We generate revenue primarily from sales of our products and services, and license agreements. Our product revenue consists of sales of instruments and consumables. Consumable revenues are largely driven by the size of our installed base of instruments and the annual level of pull-through per instrument. Service revenue is linked to our sales of instruments as our service revenue consists of post-warranty service contracts, preventive maintenance plans, instrument parts, installation and training. Our license revenue is generated primarily in the United States and relates to licensing our technology to third-parties.

We sell our instruments to leading academic research institutions, translational research and medicine centers, cancer centers, clinical research laboratories, and biopharmaceutical, biotechnology, contract research organizations, and Ag-Bio companies. No single customer represented more than 10% of our total revenue for 2018, 2017, or 2016. Revenue from our five largest customers was 17%, 14% and 15% of total revenue in 2018, 2017, and 2016, respectively.

The following table presents our revenue by source for the years ended December 31, 2018, 2017, and 2016, and as a percentage of total revenue for the respective years (in thousands):

	Year Ended December 31,						Change	
	2018		2017		2016		2018	2017
Revenue:								
Instruments	$45,491	40 %	$42,505	42 %	$46,834	45 %	7 %	(9)%
Consumables	48,159	43	41,894	41	42,169	40	15 %	(1)%
Product revenue	93,650	83 %	84,399	83 %	89,003	85 %	11 %	(5)%
Service revenue	19,314	17	17,348	17	15,205	15	11 %	14 %
License revenue	—	—	190	—	238	—	(100)%	(20)%
Total revenue	$112,964	100%	$101,937	100%	$104,446	100%	11 %	(2)%

The following table presents our total revenue by geographic area of our customers and as a percentage of total revenue for each year presented (in thousands):

	Year Ended December 31,						Change	
	2018		2017		2016		2018	2017
Americas	$51,172	46 %	$49,290	48 %	$56,229	54 %	4 %	(12)%
EMEA	36,617	32	32,642	32	29,739	28	12%	10 %
Asia-Pacific	25,175	22	20,005	20	18,478	18	26%	8 %
Total revenue	$112,964	100%	$101,937	100%	$104,446	100%	11%	(2)%

The Americas revenue includes revenue generated in the United States of $48.1 million, $45.8 million, and $52.6 million for 2018, 2017 and 2016, respectively.

Total Revenue

Total revenue increased by $11.0 million or 11%, to $113.0 million for 2018 compared to $101.9 million for 2017, primarily due to increased sales of our mass cytometry instruments and related service revenues, mass cytometry consumables, and microfluidics consumables. Revenue grew in 2018 compared to the prior year across all regions for both products and services. The significant growth in the Asia-Pacific region primarily reflects mass cytometry instrument and consumables growth in Japan and China. Changes in foreign currency exchange rates had a minimal impact on revenue in 2018.

Total revenue decreased by $2.5 million, or 2%, to $101.9 million for 2017 compared to $104.4 million for 2016. The revenue decrease was predominantly in the United States, partially offset by increases in Europe and Asia-Pacific. The decrease in the United States was mainly attributable to lower instrument sales, particularly our single-cell systems, partially offset by an increase in service revenue. The increases in Europe and Asia-Pacific were primarily driven by higher mass cytometry product sales, partially offset by a decrease in sales of our single-cell products.

Product Revenue

Product revenue increased by $9.3 million, or 11%, to $93.7 million for 2018 from $84.4 million in 2017. Instrument sales increased $3.0 million, or 7% in 2018 compared to 2017, due to higher mass cytometry instrument sales in the Americas and Asia-Pacific from higher unit volumes and average selling prices, partially offset by softer microfluidic instrument sales in both regions. Instrument sales in EMEA declined in 2018 compared to 2017, with softer mass

cytometry instrument sales partially offset by higher microfluidic instrument sales.

Consumables sales increased $6.3 million, or 15% in 2018 compared to 2017, due to unit volume growth in both mass cytometry and microfluidic consumables, which comprise the bulk of our microfluidics business. Asia-Pacific and EMEA experienced strong growth in both mass cytometry and microfluidics consumables year-over-year. Total consumables sales in the Americas were essentially flat in 2018 versus 2017, with growth in mass cytometry offset by declines in microfluidics.

Product revenue decreased by $4.6 million, or 5%, to $84.4 million for 2017 compared to $89.0 million for 2016. Instrument revenue decreased by $4.3 million, or 9%, to $42.5 million for 2017 compared to 2016, predominately due to lower unit sales of our microfluidics instruments and particularly our C1 systems, partially offset by higher unit sales of our mass cytometry instruments. Consumables revenue decreased by $0.3 million, or 1%, to $41.9 million for 2017 compared to 2016, largely attributable to decreased unit sales of single-cell consumables and lower average selling prices for most consumables, partially offset by increased unit sales of mass cytometry reagents.

We expect the average selling prices of our products to fluctuate over time based on market conditions, product mix, and currency fluctuations.

Service Revenue

Service revenue increased by $2.0 million, or 11%, to $19.3 million for 2018 compared to 2017. Service revenue increased by $2.1 million, or 14%, to $17.3 million for 2017 compared to 2016. The increases in both 2018 and 2017 were primarily due to an increase in instruments under post-warranty service contracts as a result of growth in mass cytometry instruments. Revenue from post-warranty service contracts generally lags changes our instrument revenue by one year.

Cost of Product and Service Revenue

Cost of product revenue includes manufacturing costs incurred in the production process, including component materials, labor and overhead, installation, packaging, and delivery costs. In addition, cost of product revenue includes amortization of developed technology and intangibles, royalty costs for licensed technologies included in our products, warranty, provisions for slow-moving and obsolete inventory, and stock-based compensation expense. Cost of service revenue includes direct labor hours, overhead and instrument parts. While margins vary between product and service offerings, in general, instruments have the lowest profit margin, while margins on consumables tend to be higher than instrument margins. Service margins tend to be between the instrument and consumable margins.

The following table presents our cost of product and service revenue, total cost of sales, product and service margin, and gross margin for each year presented (in thousands):

	Year Ended December 31,		
	2018	2017	2016
Cost of product revenue	$44,861	$45,039	$41,110
Cost of service revenue	6,454	4,916	4,899
Total cost of sales	$51,315	$49,955	$46,009
Product margin	52.1 %	46.6 %	53.8 %
Service margin	66.6 %	71.7 %	67.8 %
Gross margin	54.6 %	51.0 %	55.9 %

Product margin increased 5.5 percentage points in 2018 compared to 2017. The year-over-year increase in product margin was due to favorable manufacturing capacity utilization and product mix, coupled with the impact of fixed amortization on a higher revenue base in 2018.

Product margin decreased 7.0 percentage points in 2017 compared to 2016, primarily driven by increased microfluidic unit product costs from lower production volumes, higher excess and obsolete inventory expense and, to a lesser extent, lower average selling prices across most of the products, and the impact of fixed amortization on a lower revenue base in 2017. Favorable product mix partially offsets these negative factors.

Service margin decreased 5.1 percentage points during 2018 compared to 2017. Service margin decreased primarily due to product mix, with a greater percentage of service revenue coming from servicing mass cytometry products than microfluidics products. Service costs tend to be higher for mass cytometry instruments compared to microfluidic instruments as the servicing is more labor-intensive.

Service margin increased 3.9 percentage points during 2017 compared to 2016, mainly due to lower labor costs driven by product mix.

Operating Expenses

The following table presents our operating expenses for each year presented (in thousands):

	Year Ended December 31,			2018 vs. 2017 change	2017 vs. 2016 change
	2018	2017	2016		
Research and development	$30,030	$30,826	$38,415	(3)%	(20)%
Selling, general and administrative	79,783	79,516	93,212	— %	(15)%
Total operating expenses	$109,813	$110,342	$131,627	— %	(16)%

Research and Development

Research and development expense consists primarily of personnel and independent contractor costs, prototype and material expenses and other allocated facilities, and information technology expenses. We have made substantial investments in research and development since our inception. Our research and development efforts have focused primarily on enhancing our technologies and supporting development and commercialization of new and existing products and services.

Research and development expense decreased by $0.8 million, or 3%, to $30.0 million for 2018 compared to $30.8 million for 2017, as a result of the lower severance and employee-related expenses.

Research and development expense decreased by $7.6 million, or 20%, to $30.8 million for 2017. The decrease in research and development expense for 2017 was primarily attributable to our cost-savings initiatives, which included headcount and compensation savings of $3.6 million. In addition, product materials and supplies costs decreased by $3.1 million mainly due to fewer projects in 2017 driven by our strategic realignment and focus.

We believe that our continued investment in research and development is essential to our long-term competitive position and that these expenses may increase in future periods.

Selling, General and Administrative

Selling, general and administrative expense consists primarily of personnel costs for our sales, marketing and administrative employees, facilities, depreciation and professional services, such as legal and accounting services.

Selling, general and administrative expense increased by $0.3 million, or 0%, to $79.8 million for 2018 compared to $79.5 million for 2017. The increase in 2018 was primarily due to higher headcount-related costs.

Selling, general and administrative expense decreased by $13.7 million or 15% to $79.5 million for 2017 compared to $93.2 million for 2016. This decrease for 2017 was primarily due to our cost-savings initiatives, which included infrastructure and facilities savings of $3.4 million. In addition, we had lower net legal expenses of $6.2 million mainly attributable to settlements in 2017 of previously pending litigations, a decrease in outside services of $1.5 million, a decrease in travel expenses of $1.2 million and a decrease in recruiting costs of $1.1 million.

Interest Expense and Other Income (Expense), Net

The following table presents these items for each year presented (in thousands):

	Year Ended December 31,			2018 vs. 2017 change	2017 vs. 2016 change
	2018	2017	2016		
Interest expense	$(13,893)	$(5,824)	$(5,820)	(139)%	— %
Other income (expense), net	637	385	(1,167)	(65)%	133 %
Total	$(13,256)	$(5,439)	$(6,987)	(144)%	22 %

As noted above in Critical Accounting Policies, in March 2018, we entered into privately negotiated transactions with certain holders of our 2014 Notes to exchange $150.0 million in aggregate principal amount of the 2014 Notes for $150.0 million in aggregate principal amount of our new 2.75% Exchange Convertible Senior Notes due 2034. As the 2018 Notes are convertible, at our election, into cash, shares of our common stock, or a combination of cash and shares of our common stock. we accounted for the 2018 Notes under the cash conversion guidance in ASC 470. Because of this conversion option, along with a redemption premium, the net effective interest rate for the 2018 Notes is higher than the 2014 Notes. The effective interest rate on the 2014 Notes and the 2018 Notes is approximately 3.0% and 12.3%, respectively. The majority of the difference in effective interest rates is due to non-cash amortization of debt discounts. With the higher effective interest rate, interest expense increased in 2018 as compared to 2017 and 2016.

Other income, net, of $0.6 million for 2018 is primarily attributable to $0.6 million of interest income. Other income, net, of $0.4 million for 2017 includes $0.3 million of interest income. Other expense, net, of $1.2 million for 2016 was mainly associated with losses of $1.5 million from revaluation of certain foreign currency denominated assets and liabilities, partially offset by $0.3 million of interest income.

Benefit from Income Taxes

We recorded a tax benefit of $2.4 million, or an effective tax rate benefit of 3.9%, for the year ended December 31, 2018. The tax benefit was principally due to the amortization of our acquisition-related deferred tax liability, partially offset by net income tax expense from our foreign operations and unrecognized tax benefits.

We recorded a tax benefit of $3.3 million, or an effective tax rate benefit of 5.1%, for the year ended December 31, 2017. This tax benefit was primarily attributable to amortization of our acquisition-related deferred tax liability.

We recorded a tax benefit of $4.2 million, or an effective tax rate benefit of 5.2% for the year ended December 31, 2016. The tax benefit was principally due to the amortization of our acquisition-related deferred tax liability, partially offset by net income tax expense from our foreign operations and unrecognized tax benefits.

Liquidity and Capital Resources

Sources of Liquidity

As of December 31, 2018, our principal sources of liquidity consisted of $95.4 million of cash and cash equivalents.

The following table presents our cash flow summary for each year presented (in thousands):

	Year Ended December 31,		
	2018	2017	2016
Cash flow summary:			
Net cash used in operating activities	$(25,201)	$(24,098)	$(39,138)
Net cash provided by investing activities	4,719	17,658	45,102
Net cash provided by financing activities	57,660	28,997	116
Net increase in cash and cash equivalents	37,345	23,011	5,928

Net Cash Used in Operating Activities

We derive cash flows from operations primarily from cash collected from the sale of our products and services, and license agreements. Our cash flows from operating activities are also significantly influenced by our use of cash for operating expenses and working capital to support the business. We have historically experienced negative cash flows from operating activities as we have expanded our business and built our infrastructure domestically and internationally.

Net cash used in operating activities in 2018 was $25.2 million and consisted of net loss of $59.0 million less non-cash adjustments of $36.3 million, and a net increase in assets and liabilities of $2.5 million. Non-cash items primarily included amortization of developed technology of $11.2 million, stock-based compensation expense of $11.0 million, amortization of debt discounts and issuance costs of $8.4 million and depreciation and amortization of $5.4 million. The net increase in assets

and liabilities was primarily due to lower accrued liabilities for retention bonuses, which were paid in November 2018 in the form of stock.

Net cash used in operating activities in 2017 was $24.1 million and consisted of net loss of $60.5 million less non-cash adjustments of $27.2 million, and a net reduction in assets and liabilities of $9.2 million. Non-cash items primarily included amortization of developed technology of $11.2 million, stock-based compensation expense of $9.1 million, and depreciation and amortization of $7.4 million. The net change in assets and liabilities was primarily driven by a decrease in inventory, an increase in deferred revenue, an increase in other liabilities and a decrease in prepaid expenses and other current assets.

Net cash used in operating activities in 2016 was $39.1 million and consisted of net loss of $76.0 million less non-cash adjustments of $32.1 million, and a net decrease in assets and liabilities of $4.7 million. Non-cash items primarily included stock-based compensation expense of $13.9 million, amortization of developed technology of $11.2 million, and depreciation and amortization of $6.7 million. The net change in assets and liabilities was primarily driven by a decrease in accounts receivable, offset by an increase in inventory and a decrease in accounts payable.

Net Cash Provided by Investing Activities

Our primary investing activities consist of purchases, sales, and maturities of our short-term investments and to a much lesser extent, capital expenditures for manufacturing, laboratory, computer equipment and software to support our infrastructure and work force. We expect to continue to incur costs for capital expenditures for demonstration units and loaner equipment to support our sales and service efforts, and computer equipment and software to support our business operations. However, we may choose to decrease or defer certain capital expenditures and development activities, while further optimizing our organization.

Net cash provided by investing activities in 2018 was $4.7 million, which included proceeds from sales and maturities of investments of $6.5 million, offset by purchases of investments of $1.5 million and capital expenditures of $0.4 million to support our commercial and manufacturing operations.

Net cash provided by investing activities in 2017 was $17.7 million, which included proceeds from sales and maturities of investments of $25.6 million, offset by purchases of investments of $6.3 million and capital expenditures of $1.6 million to support our commercial and manufacturing operations.

Net cash provided by investing activities in 2016 was $45.1 million, which included proceeds from sales and maturities of investments of $86.4 million and proceeds from the sale of investment in Verinata of $2.3 million, offset by purchases of investments of $38.6 million and capital expenditures of $5.1 million to support our commercial and manufacturing operations.

Net Cash Provided by Financing Activities

We generated cash from financing activities of $57.7 million during 2018. Approximately $59.5 million was generated from a public offering of our common stock. The remainder reflects the proceeds from stock option exercises and ESPP purchases, offset by debt and equity issuance costs and payments of taxes for the net settlement of equity awards. We generated cash from financing activities of $29.0 million during 2017, primarily due to a public equity offering. In 2016, we generated cash of $0.1 million, primarily from proceeds received in connection with the exercise of options for our common stock.

Capital Resources

At December 31, 2018 and December 31, 2017, our working capital, excluding deferred revenues, was $101.0 million and $71.6 million, respectively, including cash and cash equivalents of $95.4 million and $58.1 million, respectively, and short-term investments of $0.0 million and $5.1 million, respectively.

In February 2014, we closed an underwritten public offering of $201.3 million in aggregate principal amount of our 2.75% Senior Convertible Notes due 2034 (2014 Notes). In March 2018, we entered into privately negotiated transactions with certain holders of our 2014 Notes to exchange $150.0 million in aggregate principal amount of the 2014 Notes for $150.0 million in aggregate principal amount of our new 2.75% Exchange Convertible Senior Notes due 2034 (2018 Notes). Following the exchange transactions, approximately $51.3 million in aggregate principal amount of 2014 Notes remained outstanding. Our board of directors determined that the private exchange transactions were in our best interest and in the best interest of our stockholders following substantial review with management and our financial advisors concerning the amount of our outstanding indebtedness relative to the market capitalization of our common stock and, in particular, obligations under the

indenture for the 2014 Notes that could require us to repurchase the 2014 Notes beginning in 2021 at a repurchase price equal to the aggregate principal amount of the 2014 Notes (approximately $201.3 million prior to the exchange). The principal differences between the 2014 Notes and the 2018 Notes are the following:

- The date on which we may be first required to repurchase the 2018 Notes has been extended to February 2023, compared to February 2021 under the 2014 Notes. In addition, while the applicable cash repurchase price for the 2014 Notes is 100% of the outstanding principal amount, the cash repurchase price for the 2018 Notes is based on a formula that would result in the 2018 Notes being redeemed for up to an amount equal to 120% of the original principal amount, plus, in each case, accrued and unpaid interest.

- The initial conversion price under the 2018 Notes is approximately $7.88, as compared to approximately $55.94 under the 2014 Notes. As a result, each of the outstanding 2018 Notes is initially convertible into 126.9438 shares of our common stock per $1,000 principal amount, while the 2014 Notes are initially convertible into 17.8750 shares of our common stock per $1,000 principal amount.

- Under the supplemental indenture for the 2018 Notes, we may at any time cause the then-outstanding 2018 Notes to be converted into shares of our common stock at the then-applicable 2018 Note conversion price if the volume weighted average price of our common stock is at least 110% of the applicable 2018 Note conversion price on each applicable trading day over a period specified in the supplement indenture for the 2018 Notes. Under the indenture for the 2014 Notes, we may only redeem the 2014 Notes for cash under certain circumstances during the period from February 6, 2018, through February 6, 2021.

- Under certain circumstances such as a “fundamental change” (as defined in the applicable indenture) that occurs prior to (i) February 6, 2021, in the case of the 2014 Notes and (ii) February 6, 2023, in the case of the 2018 Notes, holders of the Notes are entitled to a “make-whole” premium that will result in an increase in the applicable conversion rate. Under the terms of the 2018 Notes (but not the 2014 Notes), holders will be entitled to receive additional shares reflecting the economic equivalent of approximately two years of additional coupon payments, subject to certain limitations, in connection with a voluntary conversion by the noteholder prior to our exercise of our early conversion option.

The foregoing summaries of the 2014 Notes, the 2018 Notes, and the exchange transactions completed in March 2018 are not complete and are qualified in their entirety by the applicable indentures, forms of global notes, and other agreements and documents filed with the Securities and Exchange Commission with respect to the 2018 Notes and the exchange, and investors should refer to the text of the Second Supplemental Indenture, dated March 6, 2018, between Fluidigm Corporation and U.S. Bank National Association and the Form of Global Note included in the Second Supplemental Indenture, which are incorporated by reference as Exhibits 4.6 and 4.7, respectively, in our Annual Report on Form 10-K for the year ended December 31, 2017. With respect to the 2014 Notes, of which approximately $51.3 million in aggregate principal amount remains outstanding, investors should refer to the text of the Indenture, dated as of February 4, 2014, by and between Fluidigm Corporation and U.S. Bank National Association, the First Supplemental Indenture, dated as of February 4, 2014, by and between Fluidigm Corporation and U.S. Bank National Association, and the Form of Global Note included in the First Supplemental Indenture which are incorporated by reference as Exhibits 4.2, 4.3 and 4.4, respectively, in our Annual Report on Form 10-K for the year ended December 31, 2017.

On August 2, 2018, we entered into a Revolving Credit Facility with Silicon Valley Bank, which matures on August 2, 2020. Amounts drawn under the Revolving Credit Facility will be used for working capital and general corporate purposes. As of December 31, 2018, total availability under the Revolving Credit Facility was $12.3 million. We currently have no outstanding debt under the Revolving Credit Facility, and we are in compliance with all the terms and conditions of the loan agreement governing the Revolving Credit Facility. See Note 6 to the Consolidated

Financial Statements included in this Form 10-K for more information about the Revolving Credit Facility.

In early 2017, we implemented a retention incentive plan that provided for payment of cash bonuses in January 2019 to plan participants who were employees at the time the plan was implemented and who remained with Fluidigm through January 1, 2019. In September 2018, certain plan participants were permitted to elect to surrender their right to receive all or a portion of the cash bonus in exchange for fully vested restricted stock units issued under our 2011 Equity Incentive Plan. Among other reasons, our compensation committee adopted the exchange program to encourage employee stock ownership and to effectively manage cash resources. Participants opted to exchange approximately $2.4 million of cash bonus payments for approximately 380,000 fully vested RSUs issued in November 2018. The cash bonus payments payable in January 2019 for plan participants that remain employed with Fluidigm through January 1, 2019 is approximately $3.3 million.

We believe our existing cash, cash equivalents, and investments will be sufficient to meet our working capital and capital expenditure needs for at least the next 18 months. However, we may experience lower than expected cash generated from operating activities or greater than expected capital expenditures, cost of revenue, or operating expenses, and we may need to raise additional capital to fund our operations, further our research and development activities, or acquire or invest in a business. Our future funding requirements will depend on many factors, including market acceptance of our products, the cost of our research and development activities, the cost of filing and prosecuting patent applications, the cost associated with litigation or disputes relating to intellectual property rights or otherwise, the cost and timing of regulatory clearances or approvals, if any, the cost and timing of establishing additional sales, marketing, and distribution capabilities, the cost and timing of establishing additional technical support capabilities, and the effect of competing technological and market developments. In the future, we may acquire businesses or technologies from third parties, and we may decide to raise additional capital through debt or equity financing to the extent we believe this is necessary to successfully complete these acquisitions.

If we require additional funds in the future, we may not be able to obtain such funds on acceptable terms, or at all. If we raise additional funds by issuing equity securities, our stockholders could experience dilution. Debt financing, if available, may involve covenants restricting our operations or our ability to incur additional debt. Any additional debt or equity financing that we raise may contain terms that are not favorable to us or our stockholders. If we do not have, or are not able to obtain, sufficient funds, we may have to delay development or commercialization of our products or license to third parties the rights to commercialize products or technologies that we would otherwise seek to commercialize. We also may have to reduce marketing, customer support, research and development, or other resources devoted to our products.

Off-Balance Sheet Arrangements

Since our inception, we have not had any off-balance sheet arrangements as defined in Item 303(a)(4) of the Securities and Exchange Commission's Regulation S-K.

Contractual Obligations and Commitments

The following summarizes our contractual obligations as of December 31, 2018 (in thousands):

	Payments Due by Period				
	Total	Less than 1 Year	1-3 Years	3-5 Years	Thereafter
Long term debt obligations	$271,725	$5,534	$11,069	$189,074	$66,048
Operating lease obligations, net	9,578	3,664	3,294	1,379	1,241
Purchase obligations	1,596	1,596	—	—	—
Total	$282,899	$10,794	$14,363	$190,453	$67,289

Debt obligations include the principal amount of the Notes and interest payments to be made under the Notes. Although the Notes mature in 2034, they can be converted into cash and shares of our common stock prior to maturity if certain conditions are met. See Note 6 to our consolidated financial statements for additional information regarding the terms of the Notes.

Our operating lease obligations, net of sublease income, relate to leases for our current headquarters and leases for manufacturing and office space for our foreign subsidiaries. Purchase obligations consist of contractual and legally binding commitments to purchase goods and services.

We lease facilities and equipment under non-cancelable lease agreements expiring at various times through 2026. Our lease payments are expensed on a straight-line basis over the life of the leases. Rental expense under operating leases, net of amortization of lease incentive, totaled $5.0 million, $4.7 million, $6.3 million for 2018, 2017, and 2016, respectively.

We have entered into several license and patent agreements. Under these agreements, we pay annual license maintenance fees, non-refundable license issuance fees, and royalties as a percentage of net sales for the sale or sublicense of products using the licensed technology. Future payments related to these license agreements have not been included in the contractual obligations table above as the period of time over which the future license payments will be required to be made, and the amount of such payments, are indeterminable. We do not expect the license payments to be material in any particular year.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

Market risk represents the risk of loss that may impact our financial position due to adverse changes in financial market prices and rates. Our market risk exposure is primarily a result of fluctuations in foreign currency exchange rates and interest rates. We do not hold or issue financial instruments for trading purposes.

Foreign Currency Exchange Risk

As we expand internationally our results of operations and cash flows will become increasingly subject to fluctuations due to changes in foreign currency exchange rates. Our revenue is generally denominated in the local currency of the contracting party. Historically, the majority of our revenue has been denominated in U.S. dollars. Our expenses are generally denominated in the currencies in which our operations are located, which is primarily in the United States, with a portion of expenses incurred in Singapore and Canada where our manufacturing facilities are located. Our results of operations and cash flows are, therefore, subject to fluctuations due to changes in foreign currency exchange rates. The volatility of exchange rates depends on many factors that we cannot forecast with reliable accuracy. We have experienced and will continue to experience fluctuations in our net income or loss as a result of transaction gains or losses related to revaluing certain current asset and current liability balances that are denominated in currencies other than the functional currency of the entities in which they are recorded. For the years ended December 31, 2018 and 2017, we experienced foreign currency losses of $0.0 million and $0.1 million, respectively. To date, we have not entered into any foreign currency hedging contracts although we may do so in the future. As our international operations grow, we will continue to reassess our approach to manage our risk relating to fluctuations in currency rates. If foreign currency exchange rates had changed by 10% during the periods presented, it would not have had a material impact on our financial position or results of operations.

Interest Rate Sensitivity

We had cash and cash equivalents of $95.4 million at December 31, 2018. These amounts were held primarily in cash on deposit with banks and money market funds which are short-term. We had no investments at December 31, 2018. Cash and cash equivalents and investments are held for working capital purposes. We believe that we do not have any material exposure to changes in the fair value of our money market portfolio as a result of changes in interest rates. Declines in interest rates, however, will reduce future investment income. If overall interest rates had decreased by 10% during the periods presented, our interest income would not have been materially affected.

Fair Value of Financial Instruments

We do not have material exposure to market risk with respect to investments. We do not use derivative financial instruments for speculative or trading purposes. We may adopt specific hedging strategies in the future.

ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA
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Report of Independent Registered Public Accounting Firm

To the Board of Directors and
Stockholders of Fluidigm Corporation

Opinions on the Financial Statements and Internal Control over Financial Reporting

We have audited the accompanying consolidated balance sheets of Fluidigm Corporation and its subsidiaries (the "Company") as of December 31, 2018 and 2017, and the related consolidated statements of operations, of comprehensive loss, of stockholders' equity, and of cash flows for each of the three years in the period ended December 31, 2018, including the related notes and financial statement schedule listed in the accompanying index (collectively referred to as the "consolidated financial statements"). We also have audited the Company's internal control over financial reporting as of December 31, 2018, based on criteria established in Internal Control - Integrated Framework (2013) issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO).

In our opinion, the consolidated financial statements referred to above present fairly, in all material respects, the financial position of the Company as of December 31, 2018 and 2017, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2018 in conformity with accounting principles generally accepted in the United States of America. Also in our opinion, the Company maintained, in all material respects, effective internal control over financial reporting as of December 31, 2018, based on criteria established in *Internal Control - Integrated Framework* (2013) issued by the COSO.

Change in Accounting Principle

As discussed in Note 2 to the consolidated financial statements, the Company changed the manner in which it accounts for revenues from contracts with customers in 2018.

Basis for Opinions

The Company's management is responsible for these consolidated financial statements, for maintaining effective internal control over financial reporting, and for its assessment of the effectiveness of internal control over financial reporting, included in Management's Report on Internal Control Over Financial Reporting. Our responsibility is to express opinions on the Company's consolidated financial statements and on the Company's internal control over financial reporting based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) (PCAOB) and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audits to obtain reasonable assurance about whether the consolidated financial statements are free of material misstatement, whether due to error or fraud, and whether effective internal control over financial reporting was maintained in all material respects.

Our audits of the consolidated financial statements included performing procedures to assess the risks of material misstatement of the consolidated financial statements, whether due to error or fraud, and performing procedures that

respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the consolidated financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the consolidated financial statements. Our audit of internal control over financial reporting included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, and testing and evaluating the design and operating effectiveness of internal control based on the assessed risk. Our audits also included performing such other procedures as we considered necessary in the circumstances. We believe that our audits provide a reasonable basis for our opinions.

Definition and Limitations of Internal Control over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (i) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (ii) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (iii) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

/s/ PricewaterhouseCoopers LLP

San Jose, California
March 18, 2019

We have served as the Company's auditor since 2015.

FLUIDIGM CORPORATION
CONSOLIDATED BALANCE SHEETS
(In thousands, except per share amounts)

	December 31, 2018	2017
ASSETS		
Current assets:		
Cash and cash equivalents	$95,401	$58,056
Short-term investments	—	5,080
Accounts receivable (net of allowances of $126 and $391, at December 31, 2018 and 2017, respectively)	16,651	15,049
Inventories	13,003	15,088
Prepaid expenses and other current assets	2,051	1,528
Total current assets	127,106	94,801
Property and equipment, net	8,825	12,301
Other non-current assets	6,208	7,541
Developed technology, net	57,400	68,600
Goodwill	104,108	104,108
Total assets	$303,647	$287,351
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current liabilities:		
Accounts payable	$4,027	$4,211
Accrued compensation and related benefits	14,470	10,535
Other accrued liabilities	7,621	8,490
Deferred revenue, current	11,464	10,238
Total current liabilities	37,582	33,474
Convertible notes, net	172,058	195,238
Deferred tax liability	13,714	16,919
Deferred revenue, non-current	6,327	4,960
Other non-current liabilities	1,850	5,825
Total liabilities	231,531	256,416
Commitments and contingencies		
Stockholders' equity:		
Preferred stock, $0.001 par value, 10,000 shares authorized, no shares issued and outstanding at either December 31, 2018 or 2017	—	—
Common stock: $0.001 par value, 200,000 shares authorized at December 31, 2018 and 2017; 49,338 and 38,787 shares issued and outstanding at December 31, 2018 and 2017, respectively	49	39
Additional paid-in capital	631,605	531,666
Accumulated other comprehensive loss	(687)	(574)
Accumulated deficit	(558,851)	(500,196)
Total stockholders' equity	72,116	30,935
Total liabilities and stockholders' equity	$303,647	$287,351

See accompanying notes

FLUIDIGM CORPORATION
CONSOLIDATED STATEMENTS OF OPERATIONS
(In thousands, except per share amounts)

	Year Ended December 31,		
	2018	2017	2016
Revenue:			
Product revenue	$93,650	$84,399	$89,003
Service revenue	19,314	17,348	15,205
License revenue	—	190	238
Total revenue	112,964	101,937	104,446
Cost of sales:			
Cost of product revenue	44,861	45,039	41,110
Cost of service revenue	6,454	4,916	4,899
Total cost of sales	51,315	49,955	46,009
Gross profit	61,649	51,982	58,437
Operating expenses:			
Research and development	30,030	30,826	38,415
Selling, general and administrative	79,783	79,516	93,212
Total operating expenses	109,813	110,342	131,627
Loss from operations	(48,164)	(58,360)	(73,190)
Interest expense	(13,893)	(5,824)	(5,820)
Other income (expense), net	637	385	(1,167)
Loss before income taxes	(61,420)	(63,799)	(80,177)
Benefit from income taxes	2,407	3,264	4,192
Net loss	(59,013)	(60,535)	(75,985)
Net loss per share, basic and diluted	$(1.49)	$(1.84)	$(2.62)
Shares used in computing net loss per share, basic and diluted	39,652	32,980	29,008

See accompanying notes

FLUIDIGM CORPORATION
CONSOLIDATED STATEMENTS OF COMPREHENSIVE LOSS
(In thousands)

	Year Ended December 31,		
	2018	2017	2016
Net loss	$(59,013)	$(60,535)	$(75,985)
Other comprehensive income (loss), net of tax			
Foreign currency translation adjustment	(112)	183	314
Unrealized gain (loss) on available-for-sale securities, net	(1)	3	70
Other comprehensive income (loss)	(113)	186	384
Comprehensive loss	$(59,126)	$(60,349)	$(75,601)

See accompanying notes

FLUIDIGM CORPORATION
CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY
(in thousands)

	Common Stock		Additional Paid-in Capital	Accumulated Other Comprehensive (Loss)/Income	Accumulated Deficit	Total Stockholders' Equity
	Shares	Amount				
Balance at December 31, 2015	28,844	$ 29	$ 479,508	$ (1,144)	$ (363,492)	$ 114,901
Issuance of restricted stock, net of shares withheld for taxes, and other	307	—	(152)	—	—	(152)
Issuance of common stock from option exercises	57	—	227	—	—	227
Stock-based compensation expense	—	—	13,858	—	—	13,858
Net loss	—	—	—	—	(75,985)	(75,985)
Other comprehensive income	—	—	—	384	—	384
Balance at December 31, 2016	29,208	$ 29	$ 493,441	$ (760)	$ (439,477)	$ 53,233
At-the-market offering	9,091	9	28,793	—	—	28,802
Issuance of restricted stock, net of shares withheld for taxes, and other	413	1	(166)	—	—	(165)
Issuance of common stock from option exercises	25	—	100	—	—	100
Issuance of common stock under ESPP	50	—	222	—	—	222
Cumulative-effect of new accounting standard for Topic 718 Stock Compensation	—	—	184	—	(184)	—
Stock-based compensation expense	—	—	9,092	—	—	9,092
Net loss	—	—	—	—	(60,535)	(60,535)
Other comprehensive income	—	—	—	186	—	186
Balance at December 31, 2017	38,787	$ 39	$			