**UNITED STATES**
**SECURITIES AND EXCHANGE COMMISSION**
**Washington, D.C. 20549**

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# FORM 10-K

**(Mark One)**
☒ **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**
**For the fiscal year ended December 31, 2019**
**or**
☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

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**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 No. |

| | |
|---|---|
| **7000 Shoreline Ct, Ste 100 South San Francisco, CA** | **94080** |
| Address of principal executive offices | Zip Code |

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

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

| Title of each class | Trading Symbol(s) | Name of each exchange on which registered |
|---|---|---|
| **Common Stock, $0.001 par value per share** | **FLDM** | **The Nasdaq Global Select Market** |

Securities registered pursuant to Section 12(g) of the Act:
None

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

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or 15(d) of the Exchange Act. Yes ☐ No ☒

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 ☒ 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 (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). Yes ☒ No ☐

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 | ☐ |
| Non-accelerated filer | ☐ | Smaller reporting company | ☐ |
| | | 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 Act). Yes ☐ No ☒

As of June 30, 2019, the aggregate market value of the voting and non-voting common equity held by non-affiliates of the registrant was approximately $846,923,899, 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 January 31, 2020, there were 70,445,622 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 2020, 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 2019**
**Form 10-K**
**Annual Report**

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**Special Note Regarding Forward-looking Statements and Industry Data**

This Annual Report on Form 10-K (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," "should," "will," "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.

This Form 10-K also contains estimates, projections and other information concerning our industry, our business, and the markets for certain of our products, including data regarding the estimated size of those markets. Information that is based on estimates, forecasts, projections, market research or similar methodologies is inherently subject to uncertainties and actual events or circumstances may differ materially from events and circumstances reflected in this information. Unless otherwise expressly stated, we obtained this industry, business, market, and other data from reports, research surveys, studies, and similar data prepared by market research firms and other third parties, industry, medical and general publications, government data, and similar sources.

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Fluidigm®, the Fluidigm logo, 48.Atlas™, Acculift™, Access Array™, Advanta™, Biomark™, Bringing new insights to life™, C1™, Callisto™, Cell-ID™, CyTOF®, D3™, Delta Gene™, Direct™, Digital Array™, Dynamic Array™, EP1™, EQ™, FC1™, Flex Six™, Helios™, High-Precision 96.96 Genotyping™, Hyperion™, IMC™, Imaging Mass Cytometry™, Immune Profiling Assay™, Juno™, Maxpar®, MCD™, MSL®, Nanoflex™, Open App™, Pathsetter™, Polaris™, qdPCR 37K™, Script Builder™, Script Hub™, Singular™, SNP Trace™, 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.

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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 patented 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 (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, contract research organizations and plant and animal research laboratories worldwide and we strive to increase the quality of life for all.

### Market Opportunity

We believe that the Immunome market is a large, under-penetrated multibillion dollar market opportunity. Through our work with outside consultants and internal market analysis, we believe that our potential market is approximately $3 billion, growing at a compound annual growth rate in the teens. The current markets for our products address a broad range of biological analysis approaches, including the genome, proteome, transcriptome, epigenome 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 spanning 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, high multiplex 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.

- IMC™ is a pioneering technology allowing for high multiplexed imaging to understand the composition of tissue microenvironments at a subcellular 1-micron resolution. Together with Mass Cytometry, these products provide researchers the capabilities to gain deeper insights into immune function.

  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, analysis of proteomic biomarkers, or library preparation in advance of gene sequencing.

**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 sample-to-answer workflow for comprehensive human immune profiling for use with our Helios system, that puts pre-titrated antibodies in dry format in a single tube, with automated software that provides data analysis in as few as five minutes. This assay is reproducible from site-to-site and lot-to-lot, which is important for translational and pharma/biotech research work. We have collaborated with industry partners to enable workflows and software for both the Helios and Hyperion systems. In 2019, we added seven new metal antibody labels, becoming the first company to enable 50-plex cytometry panels, launched three Imaging Mass Cytometry Panel Kits and Advanced CyTOF software, as well as Maxpar Direct Immune Profiling Assay, a sample-to-answer workflow that received the 2019 Life Science Industry Gold Award for Most Innovative New Cell Biology Product.
- 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 development as well as externally-partnered solutions to drive new applications and sample-to-answer functionality across all our platforms. In 2019, we launched the Advanta RNA-Seq NGS Library Preparation product targeting a large potential market opportunity, in line with this strategy. We also announced a collaboration with Icahn School of Medicine at Mount Sinai for a single-cell study of the human epigenome. This study is being funded by the U.S. Department of Defense.

## 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:**

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|---|---|---|
| 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 |
| Maxpar Direct Immune Profiling Assay | The assay enables comprehensive identification and characterization of 37 immune cell populations. With automated software and as little as five minutes of data analysis. The kit contains 30 pre-titrated antibodies provided in a dry single-tube format. | Mass Cytometry |
| Maxpar IMC Panel Kits for Immuno-oncology | Contains a mix of non-overlapping metal-conjugated antibodies to deeply profile tumor-infiltrating lymphocytes, immunce cell activation states or tissue architecture. These new panels can be easily mixed and matched or combined as an 18-marker panel to broadly profile immune infiltrates. | Mass Cytometry |

**Software:**

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|---|---|---|
| Advanced CyTOF Software 7.0 | Streamlines the selection and acquisition of multiple regions of interest from each slide with an enhanced user experience. Remotely annotate each ROI using bright field reference images to guide automated batch acquisition of highly multiplexed images on the Hyperion Imaging System. | Mass Cytometry |

**Microfluidics**

**Preparatory Instruments:**

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| 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:**

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|---|---|---|
| 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):**

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| LP IFCs | Library Preparation IFCs to support targeted DNA sequencing of 48 or 192 samples on NGS 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 |

**Assays and Reagents:**

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|---|---|---|
| Advanta RNA-Seq NGS Library Prep Kit | Integrated solution for automated NGS library prep. Used with The Juno system with the Advanta RNA-Seq reagents and 48.Atlas integrated fluidic circuit, supports simultaneous processing of up to 48 total RNA samples. | Library preparation for next-generation DNA sequencing |
| 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:**

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|---|---|---|
| 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 (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 44 protein targets simultaneously in a single cell for a total of more than 50 detected cellular parameters. 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 (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.

***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 (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 (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 (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 for research use only 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 2019, 2018, or 2017.

**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, 2019, we had 187 people employed in sales, technical support, and marketing.

**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. As part of our on-going efforts related to operational excellence and improving efficiencies, we consolidated our North American production of reagents for mass cytometry activities into our Canadian facility in 2019.

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. 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. In 2019, we launched the Advanta™ RNA-Seq NGS Library Prep Kit. Designed to drive significant improvement in the RNA-seq workflow, the Advanta RNA-Seq NGS Library Prep Kit together with the Juno™ system delivers an integrated solution for automated, cost-efficient NGS library prep.

In 2019, we launched the Maxpar Direct Immune Profiling Assay, a sample-to-answer workflow for comprehensive human immune profiling for use with our Helios system, that puts pre-titrated antibodies in dry format in a single tube, with automated software that provides data analysis in as few as five minutes. This assay is reproducible from site-to-site and lot-to-lot, which is important for translational and pharma/biotech research work. We have collaborated with industry partners to enable workflows and software for both the Helios and Hyperion systems. Also in 2019, we added seven new metal antibody labels, becoming the first company to enable 50-plex cytometry panels, and launched three Imaging Mass Cytometry Panel Kits as well as CyTOF7.0, an advanced CyTOF software.

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 $31.6 million, $30.0 million and $30.8 million in 2019, 2018, and 2017 respectively. As of December 31, 2019, 123 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.

## 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, 2019, we owned or licensed over 520 patents and we had approximately 158 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 (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), now 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 Inc.) and its subsidiary Applied Biosystems, LLC (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 (the Original License Agreement) between Fluidigm Canada Inc. (Fluidigm Canada), and PerkinElmer Health Sciences, Inc. (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 (ICP) -based mass cytometry, including the analysis of elemental tagged materials in connection therewith (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 advisers.

**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 (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 (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. More recently, the FDA has issued warning letters to genomics labs for illegally marketing genetic tests that claim to predict patients’ responses to specific medications, noting that the FDA has not created a legal “carve-out” for LDTs and retains discretion to take action when appropriate, such as when certain genomic tests raise significant public health concerns. As laboratories and manufacturers develop more complex genetic tests and diagnostic software, the FDA may increase its regulation of LDTs. 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 equaled $73.9 million, or 63% of our total revenue, in 2019, compared to $64.8 million, or 57% of our total revenue, in 2018, and $56.1 million, or 55% of our total revenue, in 2017. 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 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, 2019, we had 566 employees, of which 123 work in research and development, 134 work in general and administrative, 122 work in manufacturing, and 187 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, until March 13, 2020, and thereafter will be located at Two Tower Place, 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 (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.

We intend to use our website, www.fluidigm.com as a means of disclosing material non-public information and for complying with our disclosure obligations under SEC Regulation FD. Such disclosures will be included on our website under “About Us > Investors.” Accordingly, investors should monitor the “Investors” section of our website, in addition to following our press releases, SEC filings, and public conference calls and webcasts.

## 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 2017 compared to 2016, but increased year-over-year in 2018 compared to 2017. Our revenue continued to increase year-over-year in 2019 compared to 2018, 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 $64.8 million, $59.0 million, and $60.5 million during the years 2019, 2018, and 2017, respectively. As of December 31, 2019, we had an accumulated deficit of $623.6 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 and protein expression analysis, SNP genotyping, quantitative polymerase chain reaction (qPCR), digital PCR, flow cytometry, cell imaging, and additional applications using well established laboratory techniques, as well as newer technologies such as bead encoded arrays, microfluidics, next generation DNA sequencing, microdroplets, spatial protein expression, 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.

We consider Illumina, Inc., Agilent Technologies, Inc., Thermo Fisher Scientific Inc. (Thermo), Bio-Rad Laboratories, Inc., NanoString Technologies, Inc. (NanoString), and Agena Bioscience, Inc. to be our principal competitors in the microfluidics space. We believe that Cytek Biosciences, Inc. and Becton, Dickinson and Company are currently our principal competitors in the mass cytometry markets, and that IonPath Inc., Akoya Biosciences, Inc., and NanoString are our principal competitors in imaging mass cytometry. While the aforementioned principal competitors are the largest and most prevalent in their representative technology areas, the combined markets in which we compete have an additional 10 to 20 smaller competitors with competing approaches and technologies that we routinely face in selling situations.

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 plant and animal research 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 plant and animal research 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 plant and animal research 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, assays, and reagents for commercial sale at our facility in Canada. 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.

**Disruption of our manufacturing facilities or other operations, or in the operations of our customers or business partners, due to earthquake, flood, other natural catastrophic events, health epidemics, or terrorism could result in cancellation of orders, delays in deliveries or other business activities, or loss of customers and could seriously harm our business.**

We have significant manufacturing operations in Singapore and Canada and operations in the United States. In addition, our business is international in nature, with our sales, service and administrative personnel and our customers located in numerous countries throughout the world. Operations at our manufacturing facilities and our subcontractors, as well as our other operations and those of our customers, are subject to disruption for a variety of reasons, including work stoppages, acts of war, terrorism, health epidemics (including the outbreak caused by the novel coronavirus COVID-19), fire, earthquake, volcanic eruptions, energy shortages, flooding or other natural disasters. Such disruption could cause delays in, among other things, shipments of products to our customers, our ability to perform services requested by our customers, or the installation of our products at customer sites. We cannot provide any assurance that alternate means of conducting our operations (whether through alternate production capacity or service providers or otherwise) would be available if a major disruption were to occur or that, if such alternate means were available, they could be obtained on favorable terms.

**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 2019, 2018, and 2017, approximately 63%, 57%, and 55% 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 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 plant and animal research 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 our management team and 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 person life insurance with any of our employees.

Additionally, to expand our research and product development efforts, we need to retain and recruit 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 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. If, however, confidential data is later determined to have been released in the course of this or any future 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. Although we believe we have contained the disruption from the March 2019 attack, we anticipate additional work and expense in the future as we continue to enhance our security processes and initiatives in response to ever-evolving information security threats.

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 implemented 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 further 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, Helios/CyTOF 2, and Hyperion 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, Helios, and Hyperion 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) 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 elect to label and promote any of our products as medical devices, we would be required to obtain prior approval or clearance by the FDA, which 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.**

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 plant and animal research companies as RUO, and are not designed, or intended to be used, for clinical diagnostic tests or as medical devices as currently marketed. If we elect 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 (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 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. In Europe, we would need to comply with the new Medical Device Regulation 2017/745 and In Vitro Diagnostic Regulation 2017/746, which became effective May 26, 2017, with application dates 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 even if we do not elect to seek 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 as 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. More recently, the FDA has issued warning letters to certain genomics labs for illegally marketing genetic tests that claim to predict patients’ responses to specific medications, noting that the FDA has not created a legal “carve-out” for LDTs and retains discretion to take action when appropriate, such as when certain genomic tests raise significant public health concerns. As manufacturers develop more complex genetic tests and diagnostic software, the FDA may increase its regulation of LDTs. 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 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, 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, the FDA could consider our products to be 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 (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 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, 2019, we had approximately $153.2 million of goodwill and net intangible assets, including approximately $104.1 million of goodwill and $49.1 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. (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. In the fourth quarter of 2019, we concluded that certain of our patents and licenses were impaired and reduced the applicable carrying value to zero, recognizing a charge of $0.4 million, which is reflected in accumulated amortization.

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 our $15.0 million revolving senior credit facility (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 or principal payments or payouts under existing cash compensation plans);
- variability in sales and 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 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 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 Revolving Credit 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 Revolving 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, which 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 Revolving Credit 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 Revolving Credit 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. From time to time, we may review our corporate structure and tax positions in the various international jurisdictions in which we operate and such review may result in 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. 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 (the Code), imposes an annual limitation on the amount of taxable income that may be offset by net operating loss carryforwards (NOLs) if a corporation experiences an “ownership change.” As provided in Section 382 of the Code, an “ownership change” occurs when a company’s “five-percent shareholders” collectively increase their ownership in the company by more than 50 percentage points (by value) over a rolling three-year period. Various states also have limitations on the use of state NOLs following an ownership change.

Future changes in our stock ownership, some of which are outside our control, could result in an ownership change under Section 382 of the Code. If we experience an ownership change, our ability to use our NOLs or other tax benefits could be substantially limited, which could significantly impair their value.  There is no assurance that we will be able to fully utilize our NOLs or other tax benefits, which could adversely impact our results of operations.

We believe that these tax benefits are a valuable asset for us and we monitor our stock ownership to determine whether our NOLs are at material risk of limitation based on an ownership change pursuant to Section 382. If our board of directors determines a potential risk exists that our NOLs could be limited, it could elect to adopt a tax benefit preservation plan in an effort to protect our tax benefits. Adoption of a 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 United States government’s adoption and expansion of trade restrictions and 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, plant and animal research, 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 enterprise resource planning (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 (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 (FASB) is currently working together with the International Accounting Standards Board (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 accumulated deficit 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)* (ASU 2016-02). 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 adopted ASU 2016-02 as of January 1, 2019. The adoption of this standard had a material impact on our consolidated financial statements. We continue to identify the appropriate changes to our business processes, systems, and controls to support the new lease standard and the required disclosures under the new standard.

It is not clear if or when 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. As of December 31, 2019, we had outstanding $1.1 million aggregate principal amount of our 2.75% Senior Convertible Notes due 2034 (2014 Notes) and $55.0 million aggregate principal amount of our 5.25% convertible senior notes due 2024 (2019 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. The 2019 Notes will mature on December 1, 2024, unless earlier converted, or repurchased in accordance with the terms of the 2019 Notes. If we undergo a fundamental change (as defined in the terms of the indenture governing either the 2014 Notes or the 2019 Notes (collectively, the Convertible Notes)), holders of the applicable series of Convertible Notes may require us to repurchase such Convertible Notes in whole or in part for cash at a repurchase price equal to 100% of the principal amount of the applicable series of Convertible Notes plus accrued and unpaid interest. If we refinance the debt owed under the 2014 Notes or 2019 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 plant and animal research 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 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, 2019, we had 69,956,397 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 46.3% of such shares and one stockholder beneficially owned approximately 9.8% 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 46.3% held by our top six 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, plant and animal research, and CRO sectors;
- failure to complete significant sales;
- manufacturing disruptions that could occur if we are 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 Revolving 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.

**Any conversions of the 2014 Notes or 2019 Notes will dilute the ownership interest of our existing stockholders and may otherwise depress the price of our common stock.**

Any conversion of some or all of the 2014 Notes or 2019 Notes will dilute the ownership interests of our existing stockholders. Any sales in the public market of our common stock issuable upon such conversion could also adversely affect prevailing market prices of our common stock. In addition, holders of the 2014 Notes or 2019 Notes may hedge their position in such Convertible Notes by entering into short positions with respect to the underlying common stock. As a result, any anticipated conversion of the 2014 Notes or 2019 Notes could depress the market price of our common stock and impair our ability to raise capital through the sale of additional equity securities.

**ITEM 1B. UNRESOLVED STAFF COMMENTS**

None.

**ITEM 2. PROPERTIES**

We lease approximately 69,000 square feet of office and laboratory space at our headquarters in South San Francisco, California under a lease that expires in March 2020. It will be replaced by a new operating lease for approximately 78,000 square feet in the same area. The term of the new lease, which is expected to commence when the old lease expires, is approximately 10 years. Additionally, we lease office, laboratory and manufacturing space in Singapore of approximately 40,000 square feet that expires in June 2022, and in Ontario, Canada approximately 44,500 square feet under a lease that expires in March 2026 and a second lease that was entered into during 2019 for approximately 19,000 square feet, which expires in March 2027. As of December 31, 2019, 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. Refer to Note 7 of our consolidated financial statements for additional information about leased properties in this Form 10-K.

## 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.

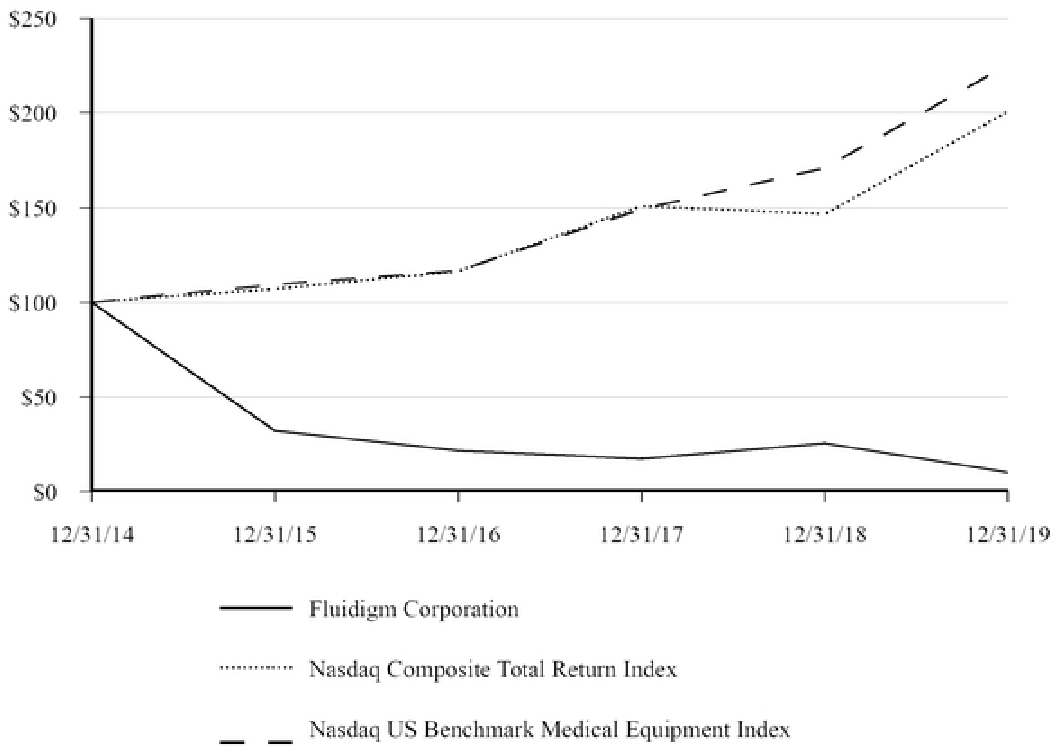
We had 87 stockholders of record as of January 31, 2020; however, because many of our outstanding shares are held by brokers or other institutions on behalf of stockholders, we are unable to estimate the total number of beneficial owners represented by the holders of record.

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 SEC 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, 2014 through December 31, 2019, 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, 2019.

**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, 2019, 2018, and 2017, and consolidated balance sheet data as of December 31, 2019, and December 31, 2018 from audited consolidated financial statements included elsewhere in this Form 10-K. The consolidated statement of operations data for the years ended December 31, 2016, and 2015, and the consolidated balance sheet data as of December 31, 2017, December 31, 2016, and December 31, 2015 were derived from audited consolidated financial statements that are not included in this Form 10-K.

| | 2019 | 2018 | 2017 | 2016 | 2015 |
|---|---|---|---|---|---|
| | (in thousands, except per share amounts) | | | | |
| **Consolidated Statement of Operations Data:** | | | | | |
| Total revenue | $ 117,243 | $ 112,964 | $ 101,937 | $ 104,446 | $ 114,712 |
| Loss from operations | (51,839) | (48,164) | (58,360) | (73,190) | (50,155) |
| Net loss | (64,790) | (59,013) | (60,535) | (75,985) | (53,315) |
| Net loss per share, basic and diluted | (0.97) | (1.49) | (1.84) | (2.62) | (1.86) |

| | 2019 | 2018 | 2017 | 2016 | 2015 |
|---|---|---|---|---|---|
| | (in thousands) | | | | |
| **Consolidated Balance Sheet Data:** | | | | | |
| Cash, cash equivalents, and short and long-term investments | $ 58,639 | $ 95,401 | $ 63,136 | $ 59,430 | $ 101,465 |
| Working capital (1) | 74,003 | 100,988 | 71,565 | 76,334 | 123,433 |
| Total assets (2) | 264,812 | 303,647 | 287,351 | 306,395 | 370,050 |
| Total long-term debt (2) | 53,821 | 172,058 | 195,238 | 194,951 | 194,673 |
| Total stockholders’ equity | 153,612 | 72,116 | 30,935 | 53,233 | 114,901 |

(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.

## 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 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.

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 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 Canada.

Our total revenue was $117.2 million in 2019, $113.0 million in 2018, and $101.9 million in 2017. We have incurred significant net losses since our inception in 1999 and, as of December 31, 2019, our accumulated deficit was $623.6 million.

### Recent Developments

In November 2019, we closed a private placement to qualified institutional buyers pursuant to Rule 144A under the Securities Act of $55.0 million aggregate principal amount of our 2019 Notes. Net proceeds of the 2019 Notes issuance were $52.7 million, after deductions for commissions and other debt issuance costs. $51.8 million of the proceeds was used to retire $50.2 million aggregate principal amount of our 2014 Notes. Pursuant to the indenture governing the 2014 Notes, holders of the 2014 Notes have the right, subject to certain conditions specified in such indenture, to require the Company to purchase their 2014 Notes beginning in February 2021. The private placement of the 2019 Notes and concurrent repurchase of a portion of the 2014 Notes had the effect of refinancing a portion of the Company's outstanding debt under the 2014 Notes to December 2024.

The 2019 Notes bear interest at 5.25% per annum, payable semiannually on June 1 and December 1 of each year, beginning on June 1, 2020. The 2019 Notes will mature on December 1, 2024, unless earlier repurchased or converted pursuant to their terms. The 2019 Notes will be convertible at the option of the holder at any point prior to the close of business on the second scheduled trading day preceding the maturity date. The initial conversion rate of the 2019 Notes is 344.8276 shares of the Company's common stock per $1,000 principal amount of 2019 Notes (which is equivalent to an initial conversion price of approximately $2.90 per share). The conversion rate will be subject to adjustment upon the occurrence of certain specified events but will not be adjusted for any accrued and unpaid interest.

The 2019 Notes will also be convertible at our option upon certain conditions in accordance with the terms of the indenture governing the 2019 Notes. On or after December 1, 2021 to December 1, 2022, if the price of the Company's common stock has equaled or exceeded 150% of the Conversion Price (as defined in the indenture, currently $2.90, subject to adjustment) for a specified number of days (Issuer's Conversion Option), we may, at our option, elect to convert the 2019 Notes in whole but not in part into shares of the Company's common stock, determined in accordance with the terms of the indenture. On or after December 1, 2022, if the price of the Company's common stock has equaled or exceeded 130% of the

Conversion Price then in effect for a specified number of days, we may, at our option, elect to convert the 2019 Notes in whole but not in part into shares of the Company's common stock, determined in accordance with the terms of the indenture. This transaction is described in more detail in Note 6 of our consolidated financial statements.

In 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. We were able to recover the majority of the costs associated with the intrusion under an applicable insurance policy. Although we believe we have contained the disruption from the March 2019 attack, we anticipate additional work and expense in the future as we continue to enhance our security processes and initiatives in response to ever-evolving information security threats.

**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 2019 consolidated financial statements.

***Revenue Recognition***

We adopted ASC 606 Revenue from Contracts with Customers on January 1, 2018 and all the related amendments using the modified retrospective method. The Company recognized the cumulative effect of initially applying the new revenue standard as an adjustment to the opening balance of accumulated deficit as of January 1, 2018. The comparative information for 2017 has not been recast and continues to be reported under the accounting standards in effect for that period.

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 grants from various entities to perform research and development activities over contractually defined periods. Revenue is reported net of any sales, use and value-added taxes, which 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, maintenance, 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. To date, capitalized contract costs have been immaterial.

### 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. Events or changes in circumstances that could affect the likelihood that we will be required to recognize an impairment charge include, but are not limited to, declines in our stock price or market capitalization, declines in our market share or revenues, and 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. 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.

In evaluating our goodwill and intangible assets with indefinite lives for indications of impairment, 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 did not recognize any impairment of goodwill for any of the periods presented herein.

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. In the fourth quarter of 2019, we recognized an impairment charge of $0.4 million on patents and licenses that are not used in any current products and are not expected to be used in future product offerings.

***Convertible Notes***

In February 2014, we closed an underwritten public offering of $201.3 million aggregate principal amount of our 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 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, together with $150.0 million in aggregate principal amount of the 2018 Notes.

As the 2018 Notes were 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 was 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. In the first quarter of 2019, the 2018 Notes were converted into approximately 19.5 million shares of common stock and the 2018 Notes were retired. We recorded a loss of $9.0 million on the retirement of the 2018 Notes. This amount represents the difference between the fair value of the bonds converted and the carrying value of the bonds at the time of conversion, including unamortized premiums, discounts and debt issuance costs. We have determined the fair value of the 2018 Notes using valuation techniques that require us to make assumptions related to the implied discount rate.

In November 2019, we closed a private placement to qualified institutional buyers pursuant to Rule 144A under the Securities Act of $55.0 million aggregate principal amount of our 2019 Notes. The majority of the issuance proceeds were used to retire approximately $50.2 million of aggregate principal amount of our 2014 Notes, leaving approximately $1.1 million of aggregate principal amount of our 2014 Notes outstanding. We recorded a loss of $3.0 million on the extinguishment of the 2014 Notes. This amount represents the difference between the fair value of the 2019 Notes used to extinguish the debt and the carrying value of the 2014 Notes, including unamortized debt issuance costs.

As the 2019 Notes do not provide for a cash conversion feature, the 2019 Notes are recorded as debt in their entirety in accordance with ASC 470. For the 2014, 2018 and 2019 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 (PSUs) under our various stock-based plans. Our board of directors determines the number of awards to grant and sets the vesting criteria. For PSUs, 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 RSUs, fair value is measured based on the closing fair market value of our common stock on the date of grant. For PSUs with a market condition, we used a Monte Carlo simulation pricing model to incorporate the market condition effects at our grant date. For PSUs with performance conditions, stock-based compensation expense is recognized over the requisite service period when the achievement of each individual performance goal becomes probable.

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 primarily consists of foreign tax expense/benefit.

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 and research and development tax credits. 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.

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 February 2016, the FASB established Topic 842, Leases, by issuing Accounting Standards Update (ASU) No. 2016-02, which requires lessees to recognize operating leases on the 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 are 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 (i) its effective date or (ii) the beginning of the earliest comparative period presented in the financial statements as its date of initial application. We adopted the new standard on January 1, 2019 and used the effective date of the standard as our date of initial application. Consequently, previously presented financial information has not been updated, and the disclosures required under the new standard have not been provided for dates and periods before January 1, 2019. For dates and periods prior to January 1, 2019, the original disclosures under ASC 840 are disclosed.

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

On adoption of the new standard, we recognized $9.2 million of lease liabilities, based on the present value of the current minimum lease payments, discounted using our collateralized incremental borrowing rate, with corresponding ROU assets of $7.4 million. The difference between the initial lease liability and ROU asset is attributable to deferred rent. There was no impact to accumulated deficit from the adoption of ASC 842.

The new standard also provides certain accounting elections for an entity's ongoing accounting. We elected the short-term lease recognition exemption for all leases that qualify. This means that, for those leases that qualify, we will not recognize ROU assets or lease liabilities for leases with an initial lease term of one year or less. We also elected to not separate lease and nonlease components for our building leases. The nonlease components are generally variable in nature and are expected to represent most of our variable lease costs. Variable costs are expensed as incurred. We have taken a portfolio approach for our vehicle leases by country. We determine whether an arrangement is a lease, or contains a lease, at inception.

*Recent Accounting Pronouncements*

In November 2019, the FASB issued ASU 2019-12 Income Taxes (Topic 740)-Simplifying the Accounting for Income Taxes. The amendments in this update improve consistent application of and simplifies GAAP for Topic 740 by clarifying and amending existing guidance including intra-period allocation, reporting tax law changes and losses in interim periods, state and local taxes not fully based on income and recognition of deferred tax liability related to certain transactions. There is also new guidance related to consolidated group reporting and tax impacts resulting from business combinations. The new guidance is effective for fiscal years beginning after December 15, 2020. We are currently evaluating the impact of adoption on our consolidated financial statements.

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. The adoption of the new guidance is not expected to have a significant impact on our financial results.

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 years beginning January 1, 2020, with early adoption permitted. The adoption of the new guidance is not expected to have a significant impact on our financial results.

The FASB issued two ASUs related to financial instruments - credit losses. The ASUs issued were: (i) in June 2016, ASU 2016-13, Financial Instruments-Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments, and (ii) in November 2018, ASU 2018-19-Codification Improvements to Topic 326, Financial Instruments-Credit Losses. ASU 2016-13 is intended to improve financial reporting by requiring more timely recording of credit losses on loans and other financial instruments held by financial institutions and other organizations. ASU 2018-19 clarifies that receivables arising from operating leases are not within the scope of the credit losses standard, but rather, should be accounted for in accordance with the leasing standard. These ASUs are effective for fiscal years beginning after December 15, 2019, and interim periods within those years, with early adoption permitted. The modified retrospective method is required upon adoption. The adoption of the new guidance is not expected to have a significant impact on our financial results.

**Results of Operations**

The following table presents our historical consolidated statements of operations data for the years ended December 31, 2019, 2018, and 2017, and as a percentage of total revenue for the respective years (in thousands):

| | Year Ended December 31, | | | | | |
|---|---|---|---|---|---|---|
| | 2019 | | 2018 | | 2017 | |
| Revenue: | | | | | | |
| Total revenue | $ 117,243 | 100 % | $ 112,964 | 100 % | $ 101,937 | 100 % |
| Cost of sales: | | | | | | |
| Total cost of sales | 52,964 | 45 | 51,315 | 45 | 49,955 | 49 |
| Gross profit | 64,279 | 55 | 61,649 | 55 | 51,982 | 51 |
| Operating expenses: | | | | | | |
| Research and development | 31,640 | 27 | 30,030 | 27 | 30,826 | 30 |
| Selling, general and administrative | 84,478 | 72 | 79,783 | 71 | 79,516 | 78 |
| Total operating expenses | 116,118 | 99 | 109,813 | 98 | 110,342 | 108 |
| Loss from operations | (51,839) | (44) | (48,164) | (43) | (58,360) | (57) |
| Interest expense | (4,279) | (4) | (13,893) | (12) | (5,824) | (6) |
| Loss from extinguishment of debt | (12,020) | (10) | — | — | — | — |
| Other income, net | 1,433 | 1 | 637 | 1 | 385 | 1 |
| Loss before income taxes | (66,705) | (57) | (61,420) | (54) | (63,799) | (62) |
| Income tax benefit | 1,915 | 2 | 2,407 | 2 | 3,264 | 3 |
| Net loss | $ (64,790) | (55)% | $ (59,013) | (52)% | $ (60,535) | (59)% |

***Revenue***

We generate revenue primarily from sales of our products and services, and from grant 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. We also receive grants from various entities to perform research and development activities over contractually defined periods. Our license revenue is generated primarily in the United States and relates to licensing our technology to third-parties.

We sell our products to leading academic, government, pharmaceutical, biotechnology and plant and animal research laboratories worldwide.

No single customer represented more than 10% of our total revenue for 2019, 2018, or 2017. Revenue from our five largest customers was 17% of total revenue both for 2019 and 2018, and 14% for 2017, respectively.

The following table presents our revenue by source for the years ended December 31, 2019, 2018, and 2017, and as a percentage of total revenue for the respective years (in thousands):

| | Year Ended December 31, | | | | | | Change | |
|---|---|---|---|---|---|---|---|---|
| | 2019 | | 2018 | | 2017 | | 2019 | 2018 |
| Revenue: | | | | | | | | |
| Instruments | $ 50,004 | 43% | $ 45,491 | 40% | $ 42,505 | 42% | 10 % | 7 % |
| Consumables | 45,412 | 39 | 48,159 | 43 | 41,894 | 41 | (6)% | 15 % |
| Product revenue | 95,416 | 82% | 93,650 | 83% | 84,399 | 83% | 2 % | 11 % |
| Service revenue | 21,277 | 18 | 19,314 | 17 | 17,348 | 17 | 10 % | 11 % |
| Grant revenue | 550 | — | — | — | — | — | NA | — % |
| License revenue | — | — | — | — | 190 | — | NA | (100)% |
| Total revenue | $ 117,243 | 100% | $ 112,964 | 100% | $ 101,937 | 100% | 4 % | 11 % |

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 | |
|---|---|---|---|---|---|---|---|---|
| | 2019 | | 2018 | | 2017 | | 2019 | 2018 |
| Americas | $ 47,016 | 40% | $ 51,172 | 46% | $ 49,290 | 48% | (8)% | 4% |
| EMEA | 40,024 | 34 | 36,617 | 32 | 32,642 | 32 | 9 % | 12% |
| Asia-Pacific | 30,203 | 26 | 25,175 | 22 | 20,005 | 20 | 20 % | 26% |
| Total revenue | $117,243 | 100% | $112,964 | 100% | $101,937 | 100% | 4 % | 11% |

The Americas revenue includes revenue generated in the United States of $43.4 million, $48.1 million, and $45.8 million for 2019, 2018 and 2017, respectively. Asia-Pacific revenue includes sales to customers in China of $15.4 million, $14.0 million and $11.1 million for 2019, 2018 and 2017, respectively. Except for China, no other foreign country or jurisdiction had sales in excess of 10% of our total revenue during the years 2019, 2018 and 2017.

The following section includes management discussion and analysis for the fiscal year ended December 31, 2019. Refer to Part I Item 7 of the Annual Report on Form 10-K for the fiscal year ended December 31, 2018, filed with the SEC on March 18, 2019, for a discussion of the comparative results for 2018 and 2017, which discussion of comparative results is incorporated by reference into this Form 10-K.

***Total Revenue***

Total revenue increased by $4.3 million or 4%, to $117.2 million for 2019 compared to $113.0 million for 2018, primarily attributable to increases in mass cytometry instruments, consumables and service revenue, partially offset by lower microfluidics revenue.

Americas revenues declined by 8%, due to lower instrument and consumables product revenues, partially offset by higher service and grant revenues. EMEA revenues grew 9%, driven primarily by higher instrument sales. Unfavorable foreign exchange rates had a negative 3% point impact on EMEA revenue growth. The 20% increase in Asia-Pacific revenues is due to increases in instrument sales and service revenue, partially offset by lower consumables revenue. On a company-wide basis, weaker foreign exchange rates negatively impacted revenues by less than 1% for 2019 compared to 2018.

***Product Revenue***

Product revenue increased by $1.8 million, or 2%, to $95.4 million for 2019 from $93.7 million in 2018 due to higher sales volumes of mass cytometry instruments and consumables, partially offset by lower average selling prices of mass cytometry instruments and lower revenues from microfluidics products.

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 10%, to $21.3 million for 2019 compared to 2018, primarily due to higher revenues from service agreements and product maintenance fees on mass cytometry products. Revenue from post-warranty service contracts are generally recognized in the year following instrument purchases.

***Cost of Revenue, Gross Profit and Gross Margin***

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. Our cost of product revenue and related product margin may fluctuate depending on the capacity utilization of our manufacturing facilities in response to market conditions and the demand for our products.

Cost of service revenue includes direct labor hours, overhead, and instrument parts. Our cost of service revenue and related service margin may fluctuate depending on the variability in material and labor costs of servicing instruments.

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

| | Year Ended December 31, | | | 2019 vs. 2018 change | 2018 vs. 2017 change |
|---|---|---|---|---|---|
| | 2019 | 2018 | 2017 | | |
| Cost of product revenue | $ 45,461 | $ 44,861 | $ 45,039 | 1% | — % |
| Cost of service revenue | 7,503 | 6,454 | 4,916 | 16% | 31 % |
| Total cost of revenue | $ 52,964 | $ 51,315 | $ 49,955 | 3% | 3 % |
| | | | | | |
| Gross profit | $ 64,279 | $ 61,649 | $ 51,982 | 4% | 19 % |
| Gross margin | 54.8% | 54.6% | 51.0% | 0.2 ppts | 3.6 ppts. |

Gross margin increased by 0.2 percentage points during 2019 compared to 2018. Higher capacity utilization, as well as the impact of spreading fixed depreciation and amortization over a higher revenue base, contributed to the improvement in gross margin, partially offset by higher inventory reserves, unfavorable product mix and lower average selling price on mass cytometry products.

Gross margin increased by 3.6 percentage points during 2018 compared to 2017. The year-over-year increase in gross 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.

***Operating Expenses***

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

| | Year Ended December 31, | | | 2019 vs. 2018 change | 2018 vs. 2017 change |
|---|---|---|---|---|---|
| | 2019 | 2018 | 2017 | | |
| Research and development | $ 31,640 | $ 30,030 | $ 30,826 | 5% | (3)% |
| Selling, general and administrative | 84,478 | 79,783 | 79,516 | 6% | — % |
| Total operating expenses | $ 116,118 | $ 109,813 | $ 110,342 | 6% | — % |

***Research and Development***

Research and development expense consists primarily of compensation-related costs, product development 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 increased by $1.6 million, or 5%, to $31.6 million for 2019 compared to $30.0 million for 2018. Increases included $1.7 million of new product development costs and a $0.4 million of an impairment loss related to a patent. The impact of higher headcount was largely offset by lower incentive compensation accruals.

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 and marketing, business development, finance, legal, human resources, and general management, as well as professional services, such as legal and accounting services.

Selling, general and administrative expense increased by $4.7 million, or 6%, to $84.5 million for 2019 compared to $79.8 million for 2018. Business development costs increased $1.7 million, along with a $1.4 million increase in advertising and promotional costs. We also incurred $1.3 million of severance and other costs associated with transferring certain operations from South San Francisco to Markham, Ontario. Compensation-related costs increased $0.5 million in total, reflecting an 8% increase in headcount, including several senior executives. These compensation-related cost increases were largely offset by lower accruals for incentive compensation and the absence of retention bonus expense which was recorded in 2018.

***Interest Expense, Loss on Extinguishment of Debt and Other Income, Net***

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

| | Year Ended December 31, 2019 | 2018 | 2017 | 2019 vs. 2018 change | 2018 vs. 2017 change |
|---|---|---|---|---|---|
| Interest expense | $ (4,279) | $ (13,893) | $ (5,824) | 69 % | (139)% |
| Loss on extinguishment of debt | (12,020) | — | — | NM | NM |
| Other income, net | 1,433 | 637 | 385 | (125)% | (65)% |
| Total | $ (14,866) | $ (13,256) | $ (5,439) | (12)% | (144)% |

In February 2014, we closed an underwritten public offering of $201.3 million aggregate principal amount of our 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 2018 Notes. Following the exchange, approximately $51.3 million in aggregate principal amount of the 2014 Notes remained outstanding, together with $150.0 million in aggregate principal amount of the 2018 Notes.

In the first quarter of 2019, the 2018 Notes were converted into approximately 19.5 million shares of common stock and the 2018 Notes were retired. The decrease in interest expense in 2019 as compared to 2018 is primarily due to the retirement of this debt. We recognized a loss of $9.0 million on the conversion of 2018 Notes, which is included in loss on extinguishment of debt. This amount represents the difference between the fair value of the bonds converted and the carrying value of the bonds at the time of conversion.

On November 22, 2019, we closed a private placement to qualified institutional buyers pursuant to Rule 144A under the Securities Act of $55.0 million aggregate principal amount of our 2019 Notes. $51.8 million of the net proceeds were used to retire $50.2 million in aggregate principal amount of our 2014 Notes. Pursuant to the Indenture governing the 2014 Notes, holders of the 2014 Notes have the right, subject to certain conditions specified in such indenture, to require the Company to purchase their 2014 Notes beginning in February 2021. The private placement of the 2019 Notes, and concurrent repurchase of a portion of the 2014 Notes, had the effect of refinancing a portion of the Company's debt under the 2014 Notes until 2024 (i.e., the maturity date of the 2019 Notes). We recognized a loss of $3.0 million on the extinguishment of the 2014 Notes, which is also included in loss on extinguishment of debt. This amount represents the difference between the fair value of the 2019 Notes used to extinguish the debt and the carrying value of the 2014 Notes.

Other income, net primarily consists of interest income and gains or losses on foreign exchange. Other income, net, of $1.4 million for 2019 is primarily attributable to $1.3 million of interest income, and $0.1 million of foreign exchange gains.

### *Income Tax Benefit*

Our tax provision is generally driven by three components: (i) tax provision from our foreign operations, (ii) tax benefits from the amortization of acquisition-related intangible assets, and (iii) discrete items, such as changes in valuation allowances or adjustments upon finalization of tax returns. Depending on the relative value of these components, we can have either a tax benefit or expense for any given period.

We recorded a tax benefit of $1.9 million, or an effective tax rate benefit of 2.9%, for the year ended December 31, 2019. The tax benefit was principally due to the amortization of our acquisition-related deferred tax liability, partially offset by a provision from our foreign operations.

## Liquidity and Capital Resources

### *Sources of Liquidity*

As of December 31, 2019, our principal sources of liquidity consisted of $21.7 million of cash and cash equivalents, and $37.0 million of short-term investments, as well as $2.1 million of restricted cash and $8.9 million of availability under our Revolving Credit Facility.

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

| | Year Ended December 31, | | |
|---|---|---|---|
| | 2019 | 2018 | 2017 |
| Cash flow summary: | | | |
| Net cash used in operating activities | $ (35,210) | $ (25,201) | $ (24,098) |
| Net cash provided by (used in) investing activities | (39,301) | 4,719 | 17,658 |
| Net cash provided by financing activities | 2,790 | 57,660 | 28,997 |
| Net increase (decrease) in cash, cash equivalents and restricted cash | (71,665) | 37,345 | 23,011 |

### *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 and grants. 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 2019 was $35.2 million and consisted of net loss of $64.8 million less non-cash adjustments of $42.8 million, and a net increase in assets and liabilities of $13.2 million. Non-cash items primarily included a loss on extinguishment of debt of $12.0 million, amortization of developed technology of $11.2 million, stock-based compensation expense of $11.4 million, amortization of debt discounts and issuance costs of $1.9 million, depreciation and amortization of $4.6 million, and an intangible asset impairment loss of $0.4 million. The net increase in assets and liabilities was primarily due to lower accrued liabilities for retention bonuses and other variable compensation.

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 $37.3 million, and a net increase in assets and liabilities of $3.5 million. Non-cash items primarily included amortization of developed technology of $11.2 million, stock-based compensation expense of $11.0 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.

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 $27.7 million, and a net reduction in assets and liabilities of $8.8 million. Non-cash items primarily included amortization of developed technology of $11.2 million, stock-based compensation 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 Provided by (Used in) 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 to improve manufacturing efficiencies and strengthen information technology and network security, as well as capital expenditures incurred in moving our corporate headquarters in 2020. However, we may choose to decrease or defer certain capital expenditures and development activities, while further optimizing our organization.

Net cash used in investing activities in 2019 was $39.3 million, which included purchases of investments of $62.4 million offset by proceeds from sales and maturities of investments of $25.6 million, and capital expenditures of $2.5 million to support our business and manufacturing operations.

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 Financing Activities***

We generated cash from financing activities of $2.8 million during 2019. $51.8 million of proceeds from a new $55.0 million debt issuance were used to retire 2014 Notes, as discussed below in more detail. Payments of debt and equity issuance costs of $1.9 million were partially offset by cash inflows from equity programs. 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.

***Capital Resources***

At December 31, 2019 and December 31, 2018, our working capital, excluding deferred revenues and restricted cash, was $74.0 million and $101.0 million, respectively, including cash and cash equivalents of $21.7 million and $95.4 million, respectively, and short-term investments of $37.0 million and nil, respectively.

In February 2014, we closed an underwritten public offering of $201.3 million in aggregate principal amount of our 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 2018 Notes. Following the exchange transactions, approximately $51.3 million in aggregate principal amount of 2014 Notes remained outstanding.

In the first quarter of 2019, we received notices from holders of the 2018 Notes electing to voluntarily convert approximately $138.1 million in aggregate principal amount of the 2018 Notes. In February 2019, we notified trustee U.S. Bank National Association of our intention to exercise our issuer’s conversion option with respect to the remaining approximately $11.9 million in aggregate principal amount of 2018 Notes. In total, $150.0 million of the 2018 Notes were converted into approximately 19.5 million shares of our common stock and the 2018 Notes were retired.

In November 2019, we closed a private placement to qualified institutional buyers pursuant to Rule 144A under the Securities Act of $55.0 million aggregate principal amount of 2019 Notes. Net proceeds of the 2019 Notes issuance were $52.7 million, after deductions for commissions and other debt issuance costs. $51.8 million of the proceeds was used to retire $50.2 million aggregate principal amount of our 2014 Notes, leaving approximately $1.1 million of aggregate principal amount of our 2014 Notes outstanding. The remaining cash proceeds from the issuance of the 2019 Notes will be used for general corporate purposes. Pursuant to the Indenture governing the 2014 Notes, holders of the 2014 Notes have the right, subject to certain conditions specified in such indenture, to require the Company to purchase their 2014 Notes beginning in February 2021. The private placement of the 2019 Notes, and concurrent repurchase of a portion of the 2014 Notes, had the effect of refinancing a portion of the Company's outstanding debt under the 2014 Notes to December 2024.

The 2019 Notes bear interest at 5.25% per annum, payable semiannually on June 1 and December 1 of each year, beginning on June 1, 2020. The Notes will mature on December 1, 2024, unless earlier repurchased or converted pursuant to their terms. The 2019 Notes will be convertible at the option of the holder at any point prior to close of business on the second scheduled trading day preceding the maturity date. The initial conversion rate of the Notes is 344.8276 shares of the Company's common stock per $1,000 principal amount of 2019 Notes (which is equivalent to an initial conversion price of approximately $2.90 per share). The conversion rate will be subject to adjustment upon the occurrence of certain specified events but will not be adjusted for any accrued and unpaid interest.

The 2019 Notes will also be convertible at our option upon certain conditions in accordance with the terms of the indenture governing the 2019 Notes. On or after December 1, 2021 to December 1, 2022, if the price of the Company's common stock has equaled or exceeded 150% of the Conversion Price (as defined in the indenture, currently $2.90, subject to adjustment) for a specified number of days (Issuer's Conversion Option), we may, at our option, elect to convert the 2019 Notes in whole but not in part into shares of the Company, determined in accordance with the terms of the indenture. On or after December 1, 2022, if the price of the Company's common stock has equaled or exceeded 130% of the Conversion Price then in effect for a specified number of days, we may, at its option, elect to convert the 2019 Notes in whole but not in part into shares of the Company, determined in accordance with the terms of the indenture.

The foregoing summaries of the 2014 Notes, the 2018 Notes, the 2019 Notes and the exchange transactions completed in March 2018 and November 2019 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 SEC.

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, 2019, total availability under the Revolving Credit Facility was $8.9 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 our consolidated financial statements for more information about the Revolving Credit Facility.

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 SEC's Regulation S-K.

## Contractual Obligations and Commitments

The following summarizes our contractual obligations as of December 31, 2019 (in thousands):

| | Payments Due by Period | | | | |
|---|---|---|---|---|---|
| | Total | Less than 1 Year | 1-3 Years | 3-5 Years | Thereafter |
| Long-term debt obligations | $ 70,957 | $ 2,917 | $ 5,835 | $ 60,835 | $ 1,370 |
| Commenced operating lease obligations, net | 6,813 | 1,926 | 2,322 | 1,474 | 1,091 |
| Future operating lease obligations (1) | 61,101 | 2,727 | 11,030 | 11,816 | 35,528 |
| Purchase obligations | 2,239 | 2,239 | — | — | — |
| Total | $ 141,110 | $ 9,809 | $ 19,187 | $ 74,125 | $ 37,989 |

(1) This relates to a new lease agreement signed during 2019 for our new corporate headquarters that will begin in the first quarter of 2020.

Debt obligations include the principal amount of the Notes and interest payments to be made under the Notes. Although the 2014 and 2019 Notes mature in 2034 and 2024, respectively, they can be converted into 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 commenced operating lease obligations, net of sublease income, relate to leases for our current corporate 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 currently lease facilities and equipment under non-cancellable lease agreements expiring at various times through 2027. 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 $6.1 million, $5.0 million, and $4.7 million for 2019, 2018, and 2017, respectively.

In December 2019, we entered into a Sales and Purchase Agreement with the shareholders of InstruNor AS, a privately held Norwegian company (InstruNor), to purchase all of the outstanding shares of InstruNor. The purchase price was approximately $5.2 million in cash and 485,451 shares of our stock, with a fair value of $2.0 million, based on the closing price of our stock on the closing date. The transaction closed in January 2020.

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 year ended December 31, 2019, we had a foreign currency gain of $0.1 million compared to a foreign exchange loss of $0.1 million in the prior year. 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 $21.7 million as of December 31, 2019. These amounts were held primarily in cash on deposit with banks and money market funds which are short-term. We also held $37.0 million of investments in treasury securities at December 31, 2019. Cash, 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**

**Index to Consolidated Financial Statements**

## 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, 2019 and 2018, 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, 2019, 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, 2019, 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, 2019 and 2018, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2019 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, 2019, based on criteria established in *Internal Control - Integrated Framework* (2013) issued by the COSO.

*Changes in Accounting Principles*

As discussed in Note 2 to the consolidated financial statements, the Company changed the manner in which it accounts for leases in 2019 and the manner in which it accounts for revenue 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 appearing under Item 9A. 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.

### *Critical Audit Matters*

The critical audit matter communicated below is a matter arising from the current period audit of the consolidated financial statements that was communicated or required to be communicated to the audit committee and that (i) relates to accounts or disclosures that are material to the consolidated financial statements and (ii) involved our especially challenging, subjective, or complex judgments. The communication of critical audit matters does not alter in any way our opinion on the consolidated financial statements, taken as a whole, and we are not, by communicating the critical audit matter below, providing a separate opinion on the critical audit matter or on the accounts or disclosures to which it relates.

*2018 Senior Convertible Notes - Estimation of Fair Value of Debt Upon Retirement*

As described in Notes 2 and 6 to the consolidated financial statements, in the first quarter of 2019 the Company converted $150 million of the 2018 Senior Convertible Notes into 19.5 million shares of its common stock, which resulted in the recording of a $9 million loss, representing the difference between the fair value of the notes retired and their carrying cost. Management determined the fair value of the convertible notes using valuation techniques that require management to make assumptions related to the implied discount rate.

The principal considerations for our determination that performing procedures relating to the 2018 Senior Convertible Notes - estimation of fair value of debt upon retirement is a critical audit matter are there was significant auditor effort in performing procedures and evaluating the implied discount rate assumption used by management in determining the fair value of the convertible notes. In addition, the audit effort involved the use of professionals with specialized skill and knowledge to assist in performing these procedures and in evaluating the audit evidence obtained from these procedures.

Addressing the matter involved performing procedures and evaluating audit evidence in connection with forming our overall opinion on the consolidated financial statements. These procedures included testing the effectiveness of controls relating to management's valuation of the convertible notes, including controls over the development of the assumptions related to the implied discount rate. These procedures also included, among others, the involvement of professionals with specialized skill and knowledge to assist in developing an independent estimate of the implied discount rate, and comparison of this independent estimate to management's assumption.

/s/PricewaterhouseCoopers LLP

San Jose, California
February 27, 2020

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

**FLUIDIGM CORPORATION**

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

| | December 31, | |
|---|---|---|
| | 2019 | 2018 |
| **ASSETS** | | |
| Current assets: | | |
| Cash and cash equivalents | $ 21,661 | $ 95,401 |
| Short-term investments | 36,978 | — |
| Accounts receivable (net of allowances of $6 and $126, at December 31, 2019 and 2018, respectively) | 18,981 | 16,651 |
| Inventories | 13,884 | 13,003 |
| Prepaid expenses and other current assets | 4,592 | 2,051 |
| Total current assets | 96,096 | 127,106 |
| Property and equipment, net | 8,056 | 8,825 |
| Operating lease right-of-use asset, net | 4,860 | — |
| Other non-current assets | 5,492 | 6,208 |
| Developed technology, net | 46,200 | 57,400 |
| Goodwill | 104,108 | 104,108 |
| Total assets | $ 264,812 | $ 303,647 |
| **LIABILITIES AND STOCKHOLDERS' EQUITY** | | |
| Current liabilities: | | |
| Accounts payable | $ 6,510 | $ 4,027 |
| Accrued compensation and related benefits | 5,160 | 14,470 |
| Operating lease liabilities, current | 1,833 | — |
| Other accrued liabilities | 7,515 | 7,621 |
| Deferred revenue, current | 11,803 | 11,464 |
| Total current liabilities | 32,821 | 37,582 |
| Convertible notes, net | 53,821 | 172,058 |
| Deferred tax liability | 11,494 | 13,714 |
| Operating lease liabilities, non-current | 4,323 | — |
| Deferred revenue, non-current | 8,168 | 6,327 |
| Other non-current liabilities | 573 | 1,850 |
| Total liabilities | 111,200 | 231,531 |
| Commitments and contingencies (Note 14) | | |
| Stockholders' equity: | | |
| Preferred stock, $0.001 par value, 10,000 shares authorized, no shares issued and outstanding at either December 31, 2019 or 2018 | — | — |
| Common stock: $0.001 par value, 200,000 shares authorized at December 31, 2019 and 2018; 69,956 and 49,338 shares issued and outstanding at December 31, 2019 and 2018, respectively | 70 | 49 |
| Additional paid-in capital | 777,765 | 631,605 |
| Accumulated other comprehensive loss | (582) | (687) |
| Accumulated deficit | (623,641) | (558,851) |
| Total stockholders' equity | 153,612 | 72,116 |
| Total liabilities and stockholders' equity | $ 264,812 | $ 303,647 |

See accompanying notes

**FLUIDIGM CORPORATION**

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

| | Year Ended December 31, | | |
|---|---|---|---|
| | 2019 | 2018 | 2017 |
| Revenue: | | | |
| Product revenue | $ 95,416 | $ 93,650 | $ 84,399 |
| Service revenue | 21,277 | 19,314 | 17,348 |
| Grant revenue | 550 | — | — |
| License revenue | — | — | 190 |
| Total revenue | 117,243 | 112,964 | 101,937 |
| Cost of sales: | | | |
| Cost of product revenue | 45,461 | 44,861 | 45,039 |
| Cost of service revenue | 7,503 | 6,454 | 4,916 |
| Total cost of sales | 52,964 | 51,315 | 49,955 |
| Gross profit | 64,279 | 61,649 | 51,982 |
| Operating expenses: | | | |
| Research and development | 31,640 | 30,030 | 30,826 |
| Selling, general and administrative | 84,478 | 79,783 | 79,516 |
| Total operating expenses | 116,118 | 109,813 | 110,342 |
| Loss from operations | (51,839) | (48,164) | (58,360) |
| Interest expense | (4,279) | (13,893) | (5,824) |
| Loss from extinguishment of debt | (12,020) | — | — |
| Other income, net | 1,433 | 637 | 385 |
| Loss before income taxes | (66,705) | (61,420) | (63,799) |
| Income tax benefit | 1,915 | 2,407 | 3,264 |
| Net loss | (64,790) | (59,013) | (60,535) |
| Net loss per share, basic and diluted | $ (0.97) | $ (1.49) | $ (1.84) |
| Shares used in computing net loss per share, basic and diluted | 66,779 | 39,652 | 32,980 |

See accompanying notes

**FLUIDIGM CORPORATION**

**CONSOLIDATED STATEMENTS OF COMPREHENSIVE LOSS**
**(In thousands)**

| | Year Ended December 31, | | |
|---|---|---|---|
| | 2019 | 2018 | 2017 |
| Net loss | $ (64,790) | $ (59,013) | $ (60,535) |
| Other comprehensive income (loss), net of tax | | | |
| Foreign currency translation adjustment | 69 | (112) | 183 |
| Net change in unrealized gain (loss) on investments | 36 | (1) | 3 |
| Other comprehensive income (loss), net of tax | 105 | (113) | 186 |
| Comprehensive loss | $ (64,685) | $ (59,126) | $ (60,349) |

See accompanying notes

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

| | Common Stock | | Additional Paid-in Capital | Accumulated Other Comprehensive Income (Loss) | Accumulated Deficit | Total Stockholders' Equity |
|---|---|---|---|---|---|---|
| | Shares | Amount | | | | |
| 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 (loss), net of taxes | — | — | — | 186 | — | 186 |
| Balance at December 31, 2017 | 38,787 | 39 | 531,666 | (574) | (500,196) | 30,935 |
| Market offering | 9,373 | 9 | 59,084 | — | — | 59,093 |
| Issuance of restricted stock, net of shares withheld for taxes, and other | 886 | 1 | (379) | — | — | (378) |
| Issuance of common stock from option exercises | 40 | — | 208 | — | — | 208 |
| Issuance of common stock under ESPP | 252 | — | 1,203 | — | — | 1,203 |
| Conversion option on convertible debt | | | 29,357 | | | 29,357 |
| Conversion cost related to conversion option on convertible debt | — | — | (557) | — | — | (557) |
| Cumulative-effect on new accounting standards for Topic 606 Revenue | — | — | — | — | 358 | 358 |
| Stock-based compensation expense | | | 11,023 | — | | 11,023 |
| Net loss | — | — | — | — | (59,013) | (59,013) |
| Other comprehensive income (loss), net of taxes | — | — | — | (113) | — | (113) |
| Balance at December 31, 2018 | 49,338 | 49 | 631,605 | (687) | (558,851) | 72,116 |
| Issuance of common stock on bond conversion | 19,460 | 19 | 133,280 | — | — | 133,299 |
| Issuance of restricted stock, net of shares withheld for taxes, and other | 666 | 1 | (601) | — | — | (600) |
| Issuance of common stock from option exercises | 195 | — | 1,058 | — | — | 1,058 |
| Issuance of common stock under ESPP | 297 | 1 | 1,074 | — | — | 1,075 |
| Stock-based compensation expense | | — | 11,349 | — | — | 11,349 |
| Net loss | — | — | — | — | (64,790) | (64,790) |
| Other comprehensive income (loss), net of taxes | — | — | — | 105 | — | 105 |
| Balance at December 31, 2019 | 69,956 | $ 70 | $ 777,765 | $ (582) | $ (623,641) | $ 153,612 |

See accompanying notes

# FLUIDIGM CORPORATION

## CONSOLIDATED STATEMENTS OF CASH FLOWS
**(In thousands)**

| | Year Ended December 31, | | |
|---|---|---|---|
| | **2019** | **2018** | **2017** |
| **Operating activities** | | | |
| Net loss | $ (64,790) | $ (59,013) | $ (60,535) |
| Adjustments to reconcile net loss to net cash used in operating activities: | | | |
| Depreciation and amortization | 4,605 | 5,372 | 7,409 |
| Stock-based compensation expense | 11,393 | 11,023 | 9,092 |
| Amortization of developed technology | 11,200 | 11,200 | 11,200 |
| Amortization of debt discounts, premiums and issuance costs | 1,936 | 8,379 | 287 |
| Impairment of intangible | 443 | — | — |
| Loss on extinguishment of debt | 12,020 | — | — |
| Loss on disposal of property and equipment | 89 | 141 | 135 |
| Increase in inventory reserves, net | 1,449 | 1,026 | 434 |
| Other non-cash items | (316) | 175 | (890) |
| Changes in assets and liabilities: | | | |
| Accounts receivable, net | (2,075) | (1,788) | (554) |
| Inventories | (2,689) | 462 | 4,162 |
| Prepaid expenses and other assets | (1,400) | 178 | 1,583 |
| Accounts payable | 2,145 | (294) | 585 |
| Deferred revenue | 2,129 | 2,574 | 1,636 |
| Other liabilities | (11,349) | (4,636) | 1,358 |
| Net cash used in operating activities | (35,210) | (25,201) | (24,098) |
| **Investing activities** | | | |
| Purchases of investments | (62,370) | (1,450) | (6,276) |
| Proceeds from maturities of investments | 25,600 | 6,541 | 25,550 |
| Purchases of intangible assets | — | — | (50) |
| Purchases of property and equipment | (2,531) | (372) | (1,566) |
| Net cash provided by (used in) investing activities | (39,301) | 4,719 | 17,658 |
| **Financing activities** | | | |
| Proceeds from issuance of common stock | — | 59,469 | 28,793 |
| Proceeds from debt issuance | 55,000 | — | — |
| Repayment of long-term debt | (51,826) | — | — |
| Payments of debt and equity issuance cost | (1,888) | (2,862) | — |
| Proceeds from exercise of stock options | 1,058 | 208 | 100 |
| Proceeds from stock issuance from ESPP | 1,075 | 1,203 | 222 |
| Payments for taxes related to net share settlement of equity awards and other | (629) | (358) | (118) |
| Net cash provided by financing activities | 2,790 | 57,660 | 28,997 |
| Effect of foreign exchange rate fluctuations on cash and cash equivalents | 56 | 167 | 454 |
| Net increase (decrease) in cash, cash equivalents and restricted cash | (71,665) | 37,345 | 23,011 |
| **Cash, cash equivalents and restricted cash at beginning of period** | 95,401 | 58,056 | 35,045 |
| Cash, cash equivalents and restricted cash at end of period | $ 23,736 | $ 95,401 | $ 58,056 |
| **Supplemental disclosures of cash flow information** | | | |
| Cash paid for interest | $ 3,542 | $ 5,534 | $ 5,534 |
| Cash paid for income taxes, net of refunds | $ 205 | $ 321 | $ 245 |
| Unpaid debt and equity issuance costs | $ 534 | $ 375 | $ — |
| Asset retirement obligations | $ 312 | $ 314 | $ 203 |

See accompanying notes

## 1. Description of Business

Fluidigm Corporation (the Company, we, our or us) creates, manufactures, and markets technologies and tools for life sciences research, including preparatory and analytical instruments for Mass Cytometry, PCR, Library Prep, Single Cell Genomics, and consumables, including integrated fluidic circuits (IFC), assays, and reagents. Our focus is on the most pressing needs in translational and clinical research, including cancer, immunology and immunotherapy. We sell our instruments, consumables and services to academic institutions, clinical research laboratories, and contract research organizations, as well as biopharmaceutical, biotechnology, and agricultural biotechnology companies. The Company was formerly known as Mycometrix Corporation and changed its name to Fluidigm Corporation in April 2001. Fluidigm Corporation was founded in 1999 and is headquartered in South San Francisco, California.

## 2. Summary of Significant Accounting Policies

### Basis of Presentation and Consolidation

The accompanying consolidated financial statements have been prepared in conformity with U.S. generally accepted accounting principles (U.S. GAAP) and include the accounts of our wholly-owned subsidiaries. As of December 31, 2019, we had wholly-owned subsidiaries in Singapore, Canada, the Netherlands, Japan, France, the United Kingdom, China, and Germany. All subsidiaries, except for Singapore, use their local currency as their functional currency. The Singapore subsidiary uses the U.S. dollar as its functional currency. All intercompany transactions and balances have been eliminated in consolidation.

Certain prior period amounts in the consolidated statements of cash flows were reclassified to conform with the current period presentation. These reclassifications were immaterial and did not affect prior period total assets, total liabilities, stockholders' equity, total revenue, total costs and expenses, loss from operations or net loss.

### Use of Estimates

The preparation of financial statements in accordance with U.S. GAAP requires management to make estimates and assumptions that affect the amounts reported in the consolidated financial statements and accompanying notes. We base our estimates on historical experience and on various other assumptions believed to be reasonable, which together form the basis for making judgments about the carrying values of assets and liabilities. Actual results could differ materially from these estimates and could have a material adverse effect on our consolidated financial statements.

### Foreign Currency

Assets and liabilities of non-U.S. subsidiaries that use the local currency as their functional currency are translated into U.S. dollars at exchange rates in effect on the balance sheet date. The adjustments resulting from the foreign currency translations are recorded in accumulated other comprehensive loss, a separate component of stockholders’ equity. Income and expense accounts are translated at monthly average exchange rates during the year.

### Revenue Recognition

We adopted ASC 606 Revenue from Contracts with Customers on January 1, 2018 and all the related amendments using the modified retrospective method. The Company recognized the cumulative effect of initially applying the new revenue standard as an adjustment to the opening balance of accumulated deficit as of January 1, 2018. The comparative information for 2017 has not been recast and continues to be reported under the accounting standards in effect for that period.

We generate revenue primarily from the sale of our products and services. Product revenue is derived from the sale of instruments and consumables, including IFCs, assays and reagents. Service revenue is derived from the sale of instrument service contracts, repairs, installation, training and other specialized product support services. We receive grants from various entities to perform research and development activities over contractually defined periods. Revenue is generally recognized provided that the conditions under which the grants were provided have been met and any remaining performance obligations are perfunctory. 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 (SSP) 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 generally become due in 30 to 60 days.

We sometimes perform shipping and handling activities after control of the product passes to the customer. We have made an accounting policy election to account for these activities as product fulfillment activities rather than as separate performance obligations.

***Service Revenue***

We recognize revenue from repairs, maintenance, 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 time-elapsed 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. To date, capitalized contract costs have been immaterial.

***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 purchasing consideration in multi-element arrangements and estimating the future amount of our warranty obligations. Moreover, significant judgment is 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.

**Cash and Cash Equivalents**

We consider all highly liquid financial instruments with maturities at the time of purchase of three months or less to be cash equivalents. Cash and cash equivalents may consist of cash on deposit with banks, money market funds, and notes from government-sponsored agencies.

**Investments**

Short-term investments are comprised of notes from government-sponsored agencies that mature within one year. All investments are recorded at estimated fair value. Any unrealized gains and losses from investments are reported in accumulated other comprehensive loss, a separate component of stockholders' equity. We evaluate our investments to assess whether investments with unrealized loss positions are other-than-temporarily impaired. An investment is considered to be other-than-temporarily impaired if the impairment is related to deterioration in credit risk or if it is likely that we will sell the securities before the recovery of their cost basis. No investment has been assessed as other than temporarily impaired, and realized gains and losses were immaterial during the years presented. The cost of securities sold, or the amount reclassified out of accumulated other comprehensive income into earnings is based on the specific-identification method.

**Accounts Receivable**

Trade accounts receivable are recorded at net invoice value. We review our exposure to accounts receivable and provide allowances of specific amounts if collectability is no longer reasonably assured based on historical experience and specific customer collection issues. We evaluate such allowances on a regular basis and adjust them as needed.

**Concentrations of Business and Credit Risk**

Financial instruments that potentially subject us to credit risk consist of cash, cash equivalents, investments, and accounts receivable. Our cash, cash equivalents, and investments may consist of deposits held with banks, money market funds, and other highly liquid investments that may at times exceed federally insured limits. Cash equivalents and investments are financial instruments that potentially subject us to concentrations of risk. Under our investment policy, we invest primarily in securities issued by the U.S. government. The goals of our investment policy, in order of priority, are as follows: preserve capital, meet liquidity needs, and optimize returns.

We generally do not require collateral to support credit sales. To reduce credit risk, we perform credit evaluations of our customers. No single customer represented more than 10% of total revenue for 2019, 2018, or 2017, and no single customer represented more than 10% of total accounts receivable at December 31, 2019, 2018, or 2017.

Our products include components that are currently procured from a single source or a limited number of sources. We believe that other vendors would be able to provide similar components; however, the qualification of such vendors may require start-up time. In order to mitigate any adverse impacts from a disruption of supply, we attempt to maintain an adequate supply of critical limited-source components.

**Inventories**

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. 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.

**Property and Equipment**

Property and equipment, including leasehold improvements, are stated at cost less accumulated depreciation. Accumulated depreciation is calculated using the straight-line method over the estimated useful lives of the assets. Leasehold improvements are amortized over the estimated useful lives of the assets or the remaining term of the lease, whichever is shorter. The estimated useful lives of our property and equipment are generally as follows: computer equipment and software, three to four years; laboratory and manufacturing equipment, two to five years; and office furniture and fixtures, five years.

Depreciation expense for the years ended December 31, 2019, 2018, and 2017 was $3.6 million, $4.2 million, and $5.9 million, respectively.

**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. Events or changes in circumstances that could affect the likelihood that we will be required to recognize an impairment charge include, but are not limited to, declines in our stock price or market capitalization, declines in our market share or revenues, and 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. 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.

In evaluating our goodwill and intangible assets with indefinite lives for indications of impairment, 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 exceed 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 did not recognize any impairment of goodwill for any of the periods presented herein.

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 indicator of impairment exists, 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. In the fourth quarter of 2019, we recognized an impairment charge of $0.4 million on patents and licenses that are not used in current products and are not expected to be used in future product offerings.

**Convertible Notes**

In February 2014, we closed an underwritten public offering of $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 2.75% Exchange Convertible Senior Notes due 2034 (2018 Notes). As the 2018 Notes were 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 was amortized over the expected term of the 2018 N otes, using the effective interest method through the first note holder put date, of February 6, 2023. In the first quarter of 2019, the 2018 Notes were converted into 19.5 million shares of our common stock and the 2018 Notes were retired. We recorded a loss of $9.0 million on the retirement of the 2018 Notes. We have determined the fair value of the 2018 Notes using valuation techniques that require us to make assumptions related to the implied discount rate.

In November 2019, we closed a private placement to qualified institutional buyers pursuant to Rule 144A under the Securities Act of $55.0 million aggregate principal amount of our 5.25% Senior Convertible Notes due 2024 (2019 Notes). The majority of the issuance proceeds were used to retire approximately $50.2 million of aggregate principal amount of our 2014 Notes, leaving approximately $1.1 million of aggregate principal amount of our 2014 Notes outstanding. We recorded a loss of $3.0 million on the extinguishment of the 2014 Notes. This amount represents the difference between the fair value of the 2019 Notes used to extinguish the debt and the carrying value of the 2014 Notes, including unamortized debt issuance costs.

As the 2019 Notes do not provide for a cash conversion feature, the 2019 Notes are recorded for as debt in their entirety in accordance with ASC 470. For the 2014, 2018 and 2019 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.

See Note 6 for a detailed discussion of the accounting treatment of the transactions and additional information.

**Fair Value of Financial Instruments**

Our financial instruments consist primarily of cash and cash equivalents, restricted cash, investments, accounts receivable, accounts payable, and convertible notes. Our cash equivalents, restricted cash, investments, accounts receivable, and accounts payable generally have short maturity or payment periods. Accordingly, their carrying values approximated their fair values at December 31, 2019 and 2018. The convertible notes are presented at their carrying value, with fair value disclosures made in Note 8. As a basis for considering fair value, we follow a three-tier value hierarchy, which prioritizes the inputs used in measuring fair value as follows:

Level I: observable inputs such as quoted prices in active markets;
Level II: inputs other than quoted prices in active markets that are observable either directly or indirectly; and
Level III: unobservable inputs for which there is little or no market data, which requires us to develop our own assumptions.

This hierarchy requires us to use observable market data, when available, and to minimize the use of unobservable inputs when determining fair value. Our cash equivalents, which include money market funds, are classified as Level I because they are valued using quoted market prices. Our investments and convertible notes are generally classified as Level II because their value is based on valuations using significant inputs derived from or corroborated by observable market data. Depending on the security, the income and market approaches are used in the model driven valuations. Inputs of these models include recently executed transaction prices in securities of the issuer or comparable issuers and yield curves.

**Research and Development**

We recognize research and development expenses in the period incurred. Research and development expenses consist of personnel costs, independent contractor costs, prototype and materials expenses, allocated facilities and information technology expenses, and related overhead expenses.

**Advertising Costs**

We expense advertising costs as incurred. We incurred advertising costs of $3.4 million, $2.2 million and $1.8 million during 2019, 2018, and 2017, respectively.

**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 temporary 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. Valuation allowances are provided when the expected realization of deferred tax assets does not meet a “more likely than not” criterion. 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.

**Stock-Based Compensation**

We account for stock options and restricted stock units granted to employees and directors and stock purchases under ESPP based on the fair value of the awards. 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.

**Comprehensive Loss**

Comprehensive loss is comprised of net loss and other comprehensive income (loss). Other comprehensive income (loss) consists of unrealized gains and losses on our investments and foreign currency translation adjustments. Total comprehensive loss for all periods presented has been disclosed in the consolidated statements of comprehensive loss.

The components of accumulated other comprehensive loss, net of tax, for the years ended December 31, 2019, 2018, and 2017 are as follows (in thousands):

| | Foreign Currency Translation Adjustment | Unrealized Gain (Loss) on Investments | Accumulated Other Comprehensive Income (Loss) |
|---|---|---|---|
| Ending balance at December 31, 2017 | $ (575) | $ 1 | $ (574) |
| Change during the year | (112) | (1) | (113) |
| Ending balance at December 31, 2018 | (687) | — | (687) |
| Change during the year | 69 | 36 | 105 |
| Ending balance at December 31, 2019 | $ (618) | $ 36 | $ (582) |

Immaterial amounts of unrealized gains and losses have been reclassified into the consolidated statement of operations for the years ended December 31, 2019, 2018 and 2017.

**Net Loss per Share**

Our basic and diluted net loss per share is calculated by dividing net loss by the weighted-average number of shares of common stock outstanding for the period. Restricted stock units, performance share units, and stock options to purchase our common stock are considered to be potentially dilutive common shares but have been excluded from the calculation of diluted net loss per share as their effect is anti-dilutive for all periods presented.

The following potentially dilutive common shares were excluded from the computations of diluted net loss per share for the periods presented because including them would have been anti-dilutive (in thousands):

| | December 31, | | |
|---|---|---|---|
| | 2019 | 2018 | 2017 |
| Stock options, restricted stock units and performance awards | 5,189 | 4,354 | 3,501 |
| 2019 Convertible Notes | 18,966 | — | — |
| 2019 Convertible Notes potential make-whole shares | 3,182 | — | — |
| 2018 Convertible Notes | — | 19,035 | — |
| 2018 Convertible Notes potential make-whole shares | — | 757 | — |
| 2014 Convertible Notes | 19 | 916 | 3,598 |
| Total | 27,356 | 25,062 | 7,099 |

**Recent Accounting Changes and Accounting Pronouncements**

*Adoption of New Accounting Guidance*

In February 2016, the FASB established Topic 842, Leases, by issuing Accounting Standards Update (ASU) No. 2016-02, which requires lessees to recognize operating leases on the 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 are classified as finance or operating; the classification will impact the expense recognition in the income statement.

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 adopted the new standard on January 1, 2019 and used the effective date of the standard as our date of initial application. Consequently, previously presented financial information has not been updated, and the disclosures required under the new standard have not been provided for dates and periods before January 1, 2019. For dates and periods prior to January 1, 2019, the original disclosures under ASC 840 are disclosed.

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

On adoption, we recognized $9.2 million of lease liabilities, based on the present value of the current minimum lease payments, discounted using our collateralized incremental borrowing rate, with corresponding ROU assets of $7.4 million. The difference between the initial lease liability and ROU asset is attributable to deferred rent. There was no impact to accumulated deficit from the adoption of ASC 842.

The new standard also provides certain accounting elections for an entity's ongoing accounting. We elected the short-term lease recognition exemption for all leases that qualify. This means that, for those leases that qualify, we will not recognize ROU assets or lease liabilities for leases with an initial lease term of one year or less. We also elected to not separate lease and nonlease components for our building leases. The nonlease components are generally variable in nature and are expected to represent most of our variable lease costs. Variable costs are expensed as incurred. We have taken a portfolio approach for our vehicle leases by country. We determine whether an arrangement is a lease, or contains a lease, at inception.

*Recent Accounting Pronouncements*

In November 2019, the FASB issued ASU 2019-12-Income Taxes (Topic 740): Simplifying the Accounting for Income Taxes. The amendments in this update improve consistent application of and simplifies GAAP for Topic 740 by clarifying and amending existing guidance including intra-period allocation, reporting tax law changes and losses in interim periods, state and local taxes not fully based on income and recognition of deferred tax liability related to certain transactions. There is also new guidance related to consolidated group reporting and tax impacts resulting from business combinations. The new guidance is effective for fiscal years beginning after December 15, 2020. We are currently evaluating the impact of adoption on our consolidated financial statements.

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. The adoption of the new guidance is not expected to have a significant impact on our financial results.

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. The adoption of the new guidance is not expected to have a significant impact on our financial results.

The FASB issued two ASUs related to financial instruments – credit losses. The ASUs issued were: (1) in June 2016, ASU 2016-13, Financial Instruments-Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments, and (2) in November 2018, ASU 2018-19-Codification Improvements to Topic 326, Financial Instruments-Credit Losses. ASU 2016-13 is intended to improve financial reporting by requiring more timely recording of credit losses on loans and other financial instruments held by financial institutions and other organizations. ASU 2018-19 clarifies that receivables arising from operating leases are not within the scope of the credit losses standard, but rather, should be accounted for in accordance with the leasing standard. These ASUs are effective for fiscal years beginning after December 15, 2019, and interim periods within those years, with early adoption permitted. The modified retrospective method is required upon adoption. The adoption of the new guidance is not expected to have a significant impact on our financial results.

## 3. Revenue

***Disaggregation of Revenue***

The following table presents our revenue for the year ended December 31, 2019, 2018, and 2017, respectively, based on geographic area and by source (in thousands):

| | Year Ended December 31, | | |
|---|---|---|---|
| | **2019** | **2018** | **2017** |
| **Geographic Markets:** | | | |
| Americas | $ 47,016 | $ 51,172 | $ 49,290 |
| EMEA | 40,024 | 36,617 | 32,642 |
| Asia-Pacific | 30,203 | 25,175 | 20,005 |
| Total | $ 117,243 | $ 112,964 | $ 101,937 |

| | Year Ended December 31, | | |
|---|---|---|---|
| | 2019 | 2018 | 2017 |
| **Source:** | | | |
| Instruments | $ 50,004 | $ 45,491 | $ 42,505 |
| Consumables | 45,412 | 48,159 | 41,894 |
| Product revenue | 95,416 | 93,650 | 84,399 |
| Services | 21,277 | 19,314 | 17,348 |
| Grant | 550 | — | — |
| License | — | — | 190 |
| Total | $ 117,243 | $ 112,964 | $ 101,937 |

***Performance Obligations***

We reported $17.8 million of deferred revenue on our December 31, 2018 consolidated balance sheet. During the twelve months ended December 31, 2019, $10.7 million of the opening balance was recognized as revenue and $12.9 million of net additional advance payments were received from customers, primarily associated with instrument service contracts. At December 31, 2019, we reported $20.0 million of deferred revenue.

The following table summarizes the expected timing of revenue recognition for unfulfilled performance obligations associated with instrument service contracts that were partially completed at December 31, 2019 (in thousands):

| Fiscal Year | Expected Revenue [1] |
|---|---|
| 2020 | $ 10,733 |
| 2021 | 6,403 |
| 2022 | 3,516 |
| Thereafter | 2,081 |
| Total | $ 22,733 |

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[1] Expected revenue includes both billed amounts included in deferred revenue and unbilled amounts that are not reflected in our consolidated financial statements and are subject to change if our customers decide to cancel or modify their contracts. Purchase orders for instrument service contracts can generally be canceled before the service period begins without penalty.

We apply the practical expedient that permits us to not disclose information about unsatisfied performance obligations for service contracts with an expected term of one year or less.

**4. Goodwill and Intangible Assets, net**

In connection with our acquisition of DVS in February 2014, we recognized goodwill of $104.1 million. Intangible assets include developed technology related to the DVS acquisition and other intangible assets are included in other non-current assets.

Intangible assets, net, were as follows (in thousands):

| | December 31, 2019 | | | |
|---|---|---|---|---|
| | Gross Amount | Accumulated Amortization | Net | Weighted-Average Amortization Period |
| Developed technology | $ 112,000 | $ (65,800) | $ 46,200 | 10.0 years |
| Patents and licenses | $ 11,274 | $ (8,342) | $ 2,932 | 7.8 years |

| | December 31, 2018 | | | |
|---|---|---|---|---|
| | Gross Amount | Accumulated Amortization | Net | Weighted-Average Amortization Period |
| Developed technology | $ 112,000 | $ (54,600) | $ 57,400 | 10.0 years |
| Patents and licenses | $ 11,274 | $ (6,861) | $ 4,413 | 7.8 years |

In the fourth quarter of 2019, we concluded that one of our patents and licenses was impaired and reduced its carrying value to zero, recognizing a charge of $0.4 million, which is reflected in accumulated amortization. Total amortization expense for the years ended December 31, 2019, December 31, 2018, and December 31, 2017 was $12.2 million, $12.3 million and $12.4 million, respectively.

Based on the carrying value of intangible assets, net, as of December 31, 2019, the annual amortization expense is expected to be as follows (in thousands):

| Fiscal Year | Developed Technology Amortization Expense | Patents and Licenses Amortization Expense | Total |
|---|---|---|---|
| 2020 | $ 11,200 | $ 916 | $ 12,116 |
| 2021 | 11,200 | 761 | 11,961 |
| 2022 | 11,200 | 677 | 11,877 |
| 2023 | 11,200 | 571 | 11,771 |
| 2024 | 1,400 | 7 | 1,407 |
| Thereafter | — | — | — |
| Total | $ 46,200 | $ 2,932 | $ 49,132 |

## 5. Balance Sheet Details

### Cash, Cash Equivalents and Restricted Cash

Cash, cash equivalents and restricted cash consisted of the following as of December 31, 2019 and 2018 (in thousands):

| | December 31, | |
|---|---|---|
| | 2019 | 2018 |
| Cash and cash equivalents | $ 21,661 | $ 95,401 |
| Restricted cash | 2,075 | — |
| Total cash, cash equivalents and restricted cash | $ 23,736 | $ 95,401 |

Short-term restricted cash of approximately $1.1 million is included in prepaid expenses and other current assets, and $1.0 million of non-current restricted cash is included in other non-current assets in the consolidated balance sheet.

### Inventories

Inventories consisted of the following as of December 31, 2019 and 2018 (in thousands):

| | December 31, | |
|---|---|---|
| | 2019 | 2018 |
| Raw materials | $ 6,133 | $ 5,996 |
| Work-in-process | 659 | 650 |
| Finished goods | 7,092 | 6,357 |
| Total inventories | $ 13,884 | $ 13,003 |

### Property and Equipment, net

Property and equipment consisted of the following as of December 31, 2019 and 2018 (in thousands):

| | December 31, | |
|---|---|---|
| | 2019 | 2018 |
| Computer equipment and software | $ 3,997 | $ 4,201 |
| Laboratory and manufacturing equipment | 19,325 | 18,780 |
| Leasehold improvements | 7,788 | 7,173 |
| Office furniture and fixtures | 1,824 | 1,506 |
| Property and equipment, gross | 32,934 | 31,660 |
| Less accumulated depreciation and amortization | (24,954) | (22,855) |
| Construction-in-progress | 76 | 20 |
| Property and equipment, net | $ 8,056 | $ 8,825 |

**Warranties**

Activity for our warranty accrual for the years ended December 31, 2019 and 2018, which are included in other accrued liabilities, is summarized below (in thousands):

| | Year Ended December 31, | |
|---|---|---|
| | 2019 | 2018 |
| Beginning balance | $ 863 | $ 699 |
| Accrual for current period warranties | 1,386 | 1,573 |
| Warranty costs incurred | (859) | (1,409) |
| Ending balance | $ 1,390 | $ 863 |

**6. Convertible Notes and Credit Facility**

*2014 Senior Convertible Notes (2014 Notes)*

On February 4, 2014, we closed an underwritten public offering of $201.3 million aggregate principal amount of our 2.75% Senior Convertible Notes due 2034 (2014 Notes) pursuant to an underwriting agreement, dated January 29, 2014. The 2014 Notes will mature on February 1, 2034, unless earlier converted, redeemed, or repurchased in accordance with the terms of the 2014 Notes.

The initial conversion rate of the 2014 Notes is 17.8750 shares of our common stock, par value $0.001 per share, per $1,000 principal amount of 2014 Notes (which is equivalent to an initial conversion price of approximately $55.94 per share). Holders may surrender their 2014 Notes for conversion at any time prior to the stated maturity date. On or after February 6, 2018, and prior to February 6, 2021, we may redeem any or all of the 2014 Notes in cash if the closing price of our common stock exceeds 130% of the conversion price for a specified number of days, and on or after February 6, 2021, we may redeem any or all of the 2014 Notes in cash without any such condition. The redemption price of the 2014 Notes will equal 100% of the principal amount of the 2014 Notes plus accrued and unpaid interest. Holders 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 2014 Notes plus accrued and unpaid interest. If we undergo a fundamental change, as defined in the terms of the 2014 Notes, holders 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.

In February 2014, we received $195.2 million, net of underwriting discounts, from the issuance of the 2014 Notes and incurred approximately $1.1 million in offering-related expenses. The underwriting discount of $6.0 million and the debt issuance costs of $1.1 million were recorded as offsets to the proceeds. The underwriting discount and offering-related expenses are being amortized to interest expense using the effective-interest rate method. The effective interest rate on the 2014 Notes, reflecting the impact of debt discounts and issuance costs, is 3.0%.

We have retired the majority of the 2014 Notes through the issuance of the 2018 Notes and 2019 Notes, below discussed. As of December 31, 2019, there is $1.1 million aggregate principal of the 2014 Notes outstanding.

*2018 Senior Convertible Notes (2018 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 2018 Notes, leaving $51.3 million of aggregate principal amount of 2014 Notes outstanding. As of the closing of the 2018 Notes on March 12, 2018, the estimated fair value was $145.5 million. The difference between the $150.0 million aggregate principal amount of the 2018 Notes and its fair value was being 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.

We accounted for the exchange transaction as an extinguishment of debt due to the significance of the change in value of the embedded conversion option, resulting in a $0.1 million gain. The gain on extinguishment of debt was calculated as the difference between the reacquisition price (i.e., the fair value of the principal amount of 2018 Notes) and the net carrying value of the 2014 Notes exchanged, net of unamortized debt discount and debt issuance cost write-offs.

The 2018 Notes accrued interest at a rate of 2.75%, payable semi-annually in arrears on February 1 and August 1 of each year. The 2018 Notes matured on February 1, 2034, unless earlier converted, redeemed, or repurchased in accordance with the terms of the indenture governing the 2018 Notes. The initial conversion rate of the 2018 Notes was 126.9438 shares of our common stock, par value $0.001 per share, per $1,000 principal amount of the 2018 Notes (which is equivalent to an initial conversion price of approximately $7.88 per share). The conversion rate was subject to adjustment upon the occurrence of certain specified events. Those certain specified events included holders who convert their 2018 Notes voluntarily prior to our exercise of the issuer's conversion option described below or in connection with a make-whole fundamental change prior to February 6, 2023, entitling the holders, under certain circumstances, to a make-whole premium in the form of an increase in the conversion rate determined by reference to a make-whole table set forth in the indenture governing the 2018 Notes. Any time prior to the maturity of the 2018 Notes, we could convert the 2018 Notes, in whole but not in part, into cash, shares of our common stock, or combination thereof, if the closing price of our common stock equaled or exceeded 110% of the conversion price then in effect for a specified number of days. On or after February 6, 2022, we could elect to redeem all or any portion of the 2018 Notes at a redemption price equal to 100% of the accreted principal amount of the 2018 Notes on the redemption date of the 2018 Notes, plus accrued and unpaid interest.

Holders of the 2018 Notes had the right, at their option, to require us to purchase all or a portion of the 2018 Notes (i) on February 6, 2023, February 6, 2026, and February 6, 2029, or (ii) in the event of a fundamental change, as defined in the indenture governing the 2018 Notes, in each case, at a repurchase price equal to 100% of the accreted principal amount (i.e., up to 120% of the outstanding principal amount) of the 2018 Notes on the fundamental change repurchase date, plus accrued and unpaid interest.

Offering-related costs for the 2018 Notes were approximately $2.8 million. Offering-related costs of $2.2 million were capitalized as debt issuance costs, recorded as an offset to the carrying value of the 2018 Notes, and were being 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. The effective interest rate on the 2018 Notes was 12.3%.

Offering-related costs of $0.6 million were accounted for as equity issuance costs, recorded as an offset to additional paid-in capital, and were not subject to amortization. Offering-related costs were allocated between debt and equity in the same proportion as the allocation of the 2018 Notes between debt and equity.

In the first quarter of 2019, we received notices from holders of the 2018 Notes electing to voluntarily convert approximately $138.1 million in aggregate principal amount of the 2018 Notes. In February 2019, we notified trustee U.S. Bank National Association of our intention to exercise our issuer’s conversion option with respect to the remaining approximately $11.9 million in aggregate principal amount of 2018 Notes. In total, $150.0 million of the 2018 Notes were converted into 19.5 million shares of our common stock and the bonds were retired. We recognized a loss of $9.0 million on the retirement of the 2018 Notes, which represents the difference between the fair value of the bonds retired and their carrying costs. The net impact on equity was $133.3 million and represents the fair value of the bonds retired.

*2019 Senior Convertible Notes (2019 Notes)*

In November 2019, we issued $55.0 million aggregate principal amount of 2019 Notes. Net proceeds of the 2019 Notes issuance were $52.7 million, after deductions for commissions and other debt issuance costs. Offering related costs were capitalized as debt issuance costs, recorded as an offset to the carrying value of the 2019 Notes and are being amortized over the expected term of the 2019 Notes using the effective interest method. The effective interest rate on the 2019 Notes is 6.2%.

$51.8 million of the proceeds of the 2019 Notes was used to retire $50.2 million aggregate principal amount of our 2014 Notes. We accounted for the transaction as an extinguishment of debt due to the significance of the change in value of the embedded conversion option, resulting in a $3.0 million loss. The loss on extinguishment of debt was calculated as the difference between the reacquisition price (i.e., the fair value of the principal amount of 2019 Notes) and the net carrying value of the 2014 Notes exchanged.

The 2019 Notes bear interest at 5.25% per annum, payable semiannually on June 1 and December 1 of each year, beginning on June 1, 2020. The Notes will mature on December 1, 2024, unless earlier repurchased or converted pursuant to their terms. The 2019 Notes will be convertible at the option of the holder at any point prior to the close of business on the second scheduled trading day preceding the maturity date. The initial conversion rate of the Notes is 344.8276 shares of the C ompany’s common stock per $1,000 principal amount of 2019 Notes (which is equivalent to an initial conversion price of approximately $2.90 per share). The conversion rate is subject to adjustment upon the occurrence of certain specified events. Those certain specified events include voluntary conversion of the 2019 Notes prior to our exercise of the Issuer’s Conversion Option or in connection with a make-whole fundamental change, entitling the holders, under certain circumstances, to a make-whole premium in the form of an increase in the conversion rate determined by reference to a make-whole table set forth in the indenture governing the 2019 Notes. The conversion rate will not be adjusted for any accrued and unpaid interest.

The 2019 Notes will also be convertible at our option upon certain conditions in accordance with the terms of the indenture governing the 2019 Notes. On or after December 1, 2021 to December 1, 2022, if the price of the Company’s common stock has equaled or exceeded 150% of the Conversion Price then in effect for a specified number of days (Issuer’s Conversion Option), we may, at our option, elect to convert the 2019 Notes in whole but not in part into shares of the Company, determined in accordance with the terms of the indenture. On or after December 1, 2022, if the price of the Company’s common stock has equaled or exceeded 130% of the Conversion Price then in effect for a specified number of days, we may, at our option, elect to convert the 2019 Notes in whole but not in part into shares of the Company, determined in accordance with the terms of the indenture.

Offering-related costs for the 2019 Notes were approximately $2.3 million and were capitalized as debt issuance costs, recorded as an offset to the carrying value of the 2019 Notes, and are being be amortized over the expected term of the 2019 Notes using the effective interest method through the maturity date of December 1, 2024.

The carrying values of the components of the 2014 Notes, 2018 Notes and 2019 Notes are as follows (in thousands):

| | December 31, | |
|---|---|---|
| | **2019** | **2018** |
| **2.75% 2014 Notes due 2034** | | |
| Principal amount | $ 1,079 | $ 51,250 |
| Unamortized debt discount | (18) | (1,232) |
| Unamortized debt issuance cost | (4) | (224) |
| | $ 1,057 | $ 49,794 |
| **2.75% 2018 Notes due 2034** | | |
| Principal amount | $ — | $ 149,999 |
| Premium accretion | — | 3,755 |
| Unamortized debt discount | — | (29,558) |
| Unamortized debt issuance cost | — | (1,932) |
| | $ — | $ 122,264 |
| **5.25% 2019 Notes due 2024** | | |
| Principal amount | $ 55,000 | $ — |
| Unamortized debt issuance cost | (2,236) | — |
| | $ 52,764 | $ — |
| Net carrying value of all Notes | $ 53,821 | $ 172,058 |

*2018 Revolving Credit Facility*

On August 2, 2018, we entered into a revolving credit facility with Silicon Valley Bank (Revolving Credit Facility) in an aggregate principal amount of up to the lesser of (i) $15.0 million (Maximum Amount) or (ii) the sum of (a) 85% of our eligible receivables and (b) 50% of our eligible inventory, in each case, subject to certain limitations (Borrowing Base), provided that the amount of eligible inventory that may be counted towards the Borrowing Base shall be subject to a cap as set forth in the Revolving Credit Facility. Subject to the level of this borrowing base, we may make and repay borrowings from time to time until the maturity of the revolving credit facility. The borrowing base as of December 31, 2019 under the revolving credit facility was $8.9 million. There were no borrowings outstanding under the Revolving Credit Facility at December 31, 2019.

The Revolving Credit Facility matures on August 2, 2020, and is collateralized by substantially all our property, other than intellectual property. Outstanding loans under the Revolving Credit Facility will bear interest, at the greater of (i) prime rate plus 0.50% or (ii) 5.50%. Interest on any outstanding loans is due and payable monthly and the principal balance is due at maturity though loans can be prepaid at any time without penalty. In addition, we pay a quarterly unused revolving line facility fee of 0.75% per annum on the average unused facility.

Subject to certain exceptions, we must pay a prepayment fee equal to (i) 2.00% of the Maximum Amount if it prepays all advances and terminates the Loan Agreement prior to August 2, 2019, or (ii) 1.00% of the Maximum Amount if it prepays all advances and terminates the Loan Agreement on or after August 2, 2019, and prior to the maturity date.

We incurred approximately $335,000 of debt issuance costs in connection with the facility, including $225,000 in commitment fees. Half of the commitment fee was paid at the inception of the facility and the remainder was paid on August 2, 2019. Debt issuance costs were capitalized and are being amortized to interest expense over the life of the Revolving Credit Facility.

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. The Revolving Credit Facility also contains customary events of default, subject to customary cure periods for certain defaults, that include, among other things, non-payment defaults, covenant defaults, material judgment defaults, bankruptcy and insolvency defaults, cross-defaults to certain other material indebtedness, and defaults due to inaccuracy of representation and warranties. Upon an event of default, the lender may declare all or a portion of the outstanding obligations payable by us to be immediately due and payable and exercise other rights and remedies provided for under the Revolving Credit Facility. During the existence of an event of default, interest on the obligations under the Revolving Credit Facility could be increased to 5.0% above the otherwise applicable rate of interest.

We were in compliance with all the terms and conditions of the Revolving Credit Facility at December 31, 2019.

**7. Leases**

We have operating leases for buildings, equipment and vehicles. Existing leases have remaining terms of less than one year to eight years. Some leases contain options to extend the lease, usually for up to five years, and termination options.

Operating lease right-of-use assets, net, consisted of the following (in thousands):

| | December 31, 2019 | | |
|---|---|---|---|
| | Gross Amount | Accumulated Amortization | Net |
| Operating lease right-of-use buildings | $ 6,234 | $ (1,618) | $ 4,616 |
| Operating lease right-of-use equipment | 69 | (34) | 35 |
| Operating lease right-of-use vehicles | 355 | (146) | 209 |
| Total | $ 6,658 | $ (1,798) | $ 4,860 |

In the first half of 2019, we entered into a new operating lease for our corporate headquarters in South San Francisco, California, which is expected to commence in March 2020. The lease term is approximately 10 years. Future minimum lease payments over the life of the lease are expected to be approximately $61.1 million.

The components of lease expense were:

| (in thousands) | Twelve months ended December 31, 2019 |
|---|---|
| Operating lease cost (including variable costs) | $ 6,093 |
| Variable costs including non-lease component | $ 2,624 |
| | |
| **Supplemental information:** | |
| Cash paid for amounts included in the measurement of operating lease liabilities (included in net cash used in operating activities) | |
| Operating cash flows from operating leases | $ 4,008 |

| | December 31, 2019 |
|---|---|
| Weighted average remaining lease term (in years) | 4.7 |
| Weighted average discount rate | 5.0% |

Future minimum lease payments and minimum sublease income under commenced non-cancelable operating leases, which are as of December 31, 2019 as follows (in thousands):

| Fiscal Year | Minimum Lease Payments for Operating Leases | Minimum Sublease Income | Net Amount |
|---|---|---|---|
| 2020 | $ 2,058 | $ (132) | $ 1,926 |
| 2021 | 1,371 | — | 1,371 |
| 2022 | 951 | — | 951 |
| 2023 | 733 | — | 733 |
| 2024 | 741 | — | 741 |
| Thereafter | 1,091 | — | 1,091 |
| Total future minimum payments (income) | $ 6,945 | $ (132) | $ 6,813 |
| Less: imputed interest | (789) | | |
| Total | $ 6,156 | | |

| December 31, 2019 | |
|---|---|
| Operating lease liabilities, current | $ 1,833 |
| Operating lease liabilities, non-current | 4,323 |
| Total | $ 6,156 |

*Disclosures related to periods prior to adoption of ASC 842*

Operating lease rent expense, net of amortization of lease incentives and sublease income was $5.0 million and $4.7 million for the twelve months ended December 31, 2018 and 2017, respectively, for the comparative prior years before the adoption of ASC 842.

As of December 31, 2018, future minimum lease payment obligations and minimum sublease income, net of expenses, under noncancelable operating leases before the adoption of ASC 842 were disclosed as follows (in thousands):

| Fiscal Year | Minimum Lease Payments for Operating Leases | Minimum Sublease Income | Net Amount |
|---|---|---|---|
| 2019 | $ 4,184 | $ (520) | $ 3,664 |
| 2020 | 2,213 | (164) | 2,049 |
| 2021 | 1,245 | — | 1,245 |
| 2022 | 827 | — | 827 |
| 2023 | 552 | — | 552 |
| Thereafter | 1,241 | — | 1,241 |
| Total future minimum payments (income) | $ 10,262 | $ (684) | $ 9,578 |

## 8. Fair Value of Financial Instruments

The following tables summarize our cash and available-for-sale securities that were measured at fair value by significant investment category within the fair value hierarchy (in thousands):

| | December 31, 2019 | | | | | | |
|---|---|---|---|---|---|---|---|
| | Amortized Cost | Gross Unrealized Gain | Gross Unrealized Loss | Fair Value | Cash and Cash Equivalents | Short-Term Marketable Securities | Cash- Restricted |
| Assets: | | | | | | | |
| Cash | $ 16,614 | $ — | $ — | $ 16,614 | $ 16,614 | $ — | $ — |
| Cash-restricted | 2,075 | — | — | 2,075 | — | — | 2,075 |
| Total cash | $ 18,689 | $ — | $ — | $ 18,689 | $ 16,614 | $ — | $ 2,075 |
| Available-for-sale: | | | | | | | |
| Level I: | | | | | | | |
| Money market funds | $ 5,047 | $ — | $ — | $ 5,047 | $ 5,047 | $ — | $ — |
| U.S. treasury securities | 36,942 | 36 | — | 36,978 | — | 36,978 | — |
| Subtotal | $ 41,989 | $ 36 | $ — | $ 42,025 | $ 5,047 | $ 36,978 | $ — |
| Total | $ 60,678 | $ 36 | $ — | $ 60,714 | $ 21,661 | $ 36,978 | $ 2,075 |

| | December 31, 2018 | | | | | |
|---|---|---|---|---|---|---|
| | Amortized Cost | Gross Unrealized Gain | Gross Unrealized Loss | Fair Value | Cash and Cash Equivalents | Short-Term Marketable Securities |
| Assets: | | | | | | |
| Cash | $ 17,685 | $ — | $ — | $ 17,685 | $ 17,685 | $ — |
| Available-for-sale: | | | | | | |
| Level I: | | | | | | |
| Money market funds | $ 77,716 | $ — | $ — | $ 77,716 | $ 77,716 | $ — |
| U.S. treasury securities | — | — | — | — | — | — |
| Subtotal | $ 77,716 | $ — | $ — | $ 77,716 | $ 77,716 | $ — |
| Total | $ 95,401 | $ — | $ — | $ 95,401 | $ 95,401 | $ — |

There were no transfers between Level I and Level II measurements, and no changes in the valuation techniques used during the years ended December 31, 2019, and 2018.

Based on an evaluation of securities that were in a loss position, we did not recognize any other-than-temporary impairment charges for the years ended December 31, 2019, 2018, and 2017. None of our investments have been in a continuous loss position for more than 12 months. We concluded that the declines in market value of our available-for-sale securities investment portfolio were temporary in nature and did not consider any of our investments to be other-than-temporarily impaired.

*Convertible Notes*

For 2018, the estimated fair value of the 2014 and 2018 Notes was based on a market approach and represents a Level II valuation. When determining the estimated fair value of our long-term debt, we used a commonly accepted valuation methodology and market-based risk measurements that are indirectly observable, such as credit risk. In 2019, we significantly reduced the amount of our debt outstanding. As a result, these securities are not traded frequently, so it is difficult to estimate a reliable and accurate market price and represent Level III valuations. A fair value for these assets cannot be determined by using readily observable inputs or measures, such as market prices or models. Fair values were estimated using pricing models and risk-adjusted value ranges.

The following table summarizes the par value, carrying value and the estimated fair value of the 2014, 2018 and 2019 Notes at December 31, 2019 and 2018, respectively (in thousands):

| | December 31, 2019 | | | December 31, 2018 | | |
|---|---|---|---|---|---|---|
| | Par Value | Carrying Value | Fair Value | Par Value | Carrying Value | Fair Value |
| 2014 Notes | $ 1,079 | $ 1,057 | $ 1,122 | $ 51,250 | $ 49,794 | $ 43,665 |
| 2018 Notes | — | — | — | 149,999 | 122,264 | 171,843 |
| 2019 Notes | 55,000 | 52,764 | 73,975 | — | — | — |
| Total | $ 56,079 | $ 53,821 | $ 75,097 | $ 201,249 | $ 172,058 | $ 215,508 |

## 9. Shareholders' Equity

*Conversion of 2018 Notes*

In the first quarter of 2019, we issued 19,460,260 shares of our common stock in connection with the conversion of our 2018 Notes (see Note 6). As a result of this issuance of our common stock, we recorded a total of $133.3 million of equity, which is equivalent to the fair value of the bonds retired.

*2018 Market Offering*

On December 14, 2018, we closed on an underwritten public offering of 9,372,500 shares our common stock, $0.001 par value. The common stock was sold at a price to the public of $6.75 per share, for aggregate gross proceeds of approximately $63.3 million, from our existing shelf registration statement. Net proceeds from the offering were approximately $59.1 million after deducting underwriting discounts and commissions of $3.8 million and the $0.4 million of estimated expenses of the offering. We intend to use the net proceeds of the offering for general corporate purposes, including working capital, capital expenditures and continued research and development with respect to products and technologies, and to fund possible investments in or acquisitions of complementary businesses, products, or technologies.

*2017 At-the-Market Offering*

On August 10, 2017, we sold 9,090,909 shares of our common stock, $0.001 par value per share, pursuant to an earlier Sales Agreement, for aggregate gross proceeds of $30.0 million. Our aggregate net proceeds were approximately $28.8 million, after deducting related expenses, including commissions of approximately $0.7 million and issuance costs of approximately $0.5 million. These sales fully exhausted the shares that were available for sale under the Sales Agreement.

*Tax Benefit Preservation Plan*

On August 1, 2017, the Tax Benefit Preservation Plan (Tax Plan) dated as of November 21, 2016 expired and all of the preferred share purchase rights distributed to the holders of our common stock pursuant to the Tax Plan expired.

At December 31, 2019, we had reserved shares of common stock for future issuance under equity compensation plans as follows:

| (in 000's) | Securities To Be Issued Upon Exercise Of Options | Securities To Be Issued Upon Release Of Restricted Stock and Performance Share Units | Number Of Remaining Securities Available For Future Issuance |
|---|---|---|---|
| 2009 Equity Incentive Plan | 28 | — | — |
| 2011 Equity Incentive Plan | 1,769 | 2,829 | 5,312 |
| DVS Sciences Inc. 2010 Equity Incentive Plan | 23 | — | — |
| 2017 Inducement Award Plan | 207 | 332 | — |
| 2017 Employee Stock Purchase Plan | — | — | 401 |
| | 2,027 | 3,161 | 5,713 |

## 10. Stock-Based Plans

Our board of directors sets the terms, conditions, and restrictions related to our ESPP and the grant of stock options, RSUs and performance-based awards under our various stock-based plans. Our board of directors determines the number of awards to grant and also sets vesting criteria.

In general, RSUs vest on a quarterly basis over a period of four years from the date of grant at a rate of 25% on the first anniversary of the grant date and ratably each quarter over the remaining 12 quarters, subject to the employees' continued employment.

Incentive stock options and non-statutory stock options granted under the 2011 Plan have a term of no more than ten years from the date of grant and an exercise price of at least 100% of the fair market value of the underlying common stock on the date of grant. If a participant owns stock representing more than 10% of the voting power of all classes of our stock on the grant date, an incentive stock option awarded to the participant will have a term of no more than five years from the date of grant and an exercise price of at least 110% of the fair market value of the underlying common stock on the date of grant. Generally, options vest at a rate of either 25% on the first anniversary of the option grant date and ratably each month over the remaining period of 36 months, or ratably each month over 48 months. We may grant options with different vesting terms from time to time.

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.

### 2011 Equity Incentive Plan

On January 28, 2011, our board of directors adopted the 2011 Equity Incentive Plan (the 2011 Plan) under which incentive stock options, non-statutory stock options, restricted stock units (RSUs), stock appreciation rights, performance units, and performance shares may be granted to our employees, directors, and consultants. In April 2019, our board of directors authorized, and in June 2019, our stockholders approved, the amendment and restatement of the 2011 Plan to make various changes, including increasing the number of shares reserved for issuance by approximately 5.0 million shares and extending the term of the 2011 Plan until April 2029.

### 2009 Equity Incentive Plan and 1999 Stock Option Plan

Our 2009 Equity Incentive Plan (the 2009 Plan) terminated on the date the 2011 Plan was adopted. Options granted, or shares issued under the 2009 Plan that were outstanding on the date the 2011 Plan became effective, remained subject to the terms of the 2009 Plan.

### 2017 Inducement Award Plan

On January 5, 2017, we adopted the Fluidigm Corporation 2017 Inducement Award Plan (Inducement Plan) and reserved 2 million shares of our common stock for issuance pursuant to equity awards granted under the Inducement Plan. The Inducement Plan provides for the grant of equity-based awards and its terms are substantially similar to the 2011 Plan. In accordance with Rule 5635(c)(4) of the Nasdaq Listing Rules, awards under the Inducement Plan may only be made to individuals not previously our employees or non-employee members of our board of directors (or following such individual's bona fide period of non-employment), as an inducement material to the individual's entry into employment with us or in connection with a merger or acquisition, to the extent permitted by Rule 5635(c)(3) of the Nasdaq Listing Rules. In June 2019, concurrently with the increase in shares available for grant under the 2011 Plan, the Inducement Plan was terminated such that no further grants could be made thereunder. Options granted and shares issued under the Inducement Plan that were outstanding when the Inducement Plan was terminated remain outstanding subject to their terms and the terms of the Inducement Plan.

**Valuation and Expense Information**

We use the Black-Scholes option-pricing model to estimate the fair value of stock options granted under our equity incentive plans. The weighted average assumptions used to estimate the fair value were as follows:

| | Year Ended December 31, | | |
|---|---|---|---|
| | 2019 | 2018 | 2017 |
| Stock options: | | | |
| Weighted average expected volatility | 69.5% | 68.4% | 65.0% |
| Weighted average expected term | 4.3 years | 4.7 years | 4.2 years |
| Weighted average risk-free interest rate | 1.9% | 2.7% | 1.7% |
| Dividend yield | — | — | — |
| Weighted-average fair value per share | $ 7.17 | $ 3.45 | $ 2.97 |

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 life. Each of these inputs is subjective and generally requires significant judgment by us. The fair value of the underlying common stock is also required to compute the fair value calculation of options and ESPP. We account for forfeitures as they occur.

We grant stock options at exercise prices not less than the fair value of our common stock at the date of grant. The fair value of RSUs granted to employees was estimated on the date of grant by multiplying the number of shares granted by the fair market value of our common stock on the grant date. Activity under the 2011 Plan, the 2009 Plan, the 1999 Plan, and the Inducement Plan is as follows:

***Restricted Stock Units***:

| | Number of Units (in 000's) | Weighted-Average Grant Date Fair Value per Unit |
|---|---|---|
| Balance at December 31, 2016 | 1,065 | $ 15.31 |
| RSU granted | 916 | $ 5.73 |
| RSU released | (445) | $ 15.57 |
| RSU forfeited | (368) | $ 13.11 |
| Balance at December 31, 2017 | 1,168 | $ 8.55 |
| RSU granted | 1,822 | $ 5.98 |
| RSU released | (945) | $ 9.63 |
| RSU forfeited | (233) | $ 8.50 |
| Balance at December 31, 2018 | 1,812 | $ 7.09 |
| RSU granted | 1,808 | $ 8.08 |
| RSU released | (730) | $ 8.06 |
| RSU forfeited | (339) | $ 7.80 |
| Balance at December 31, 2019 | 2,551 | $ 7.43 |

The total intrinsic value of RSUs vested and released during the year ended December 31, 2019, 2018 and 2017 were approximately $5.8 million, $6.8 million and $2.3 million, respectively. The intrinsic value of vested and released RSUs is calculated by multiplying the fair market value of our common stock on the vesting date by the number of shares vested. As of December 31, 2019, the unrecognized compensation costs related to outstanding unvested RSUs under our equity incentive plans were $15.9 million. We expect to recognize those costs over a weighted average period of 3.1 years.

*2018 Retention Bonus Program*

Included in the 2018 RSU activity are 379,593 of grants and releases related to a retention bonus program. As disclosed in our Current Report on Form 8-K filed on February 10, 2017, we previously implemented a company-wide retention bonus incentive program in which our executive officers at the time also participated. The bonus program provides for the payment of cash bonuses to program participants who were employees at the time the plan was implemented and who remain with Fluidigm through January 1, 2019. On September 18, 2018, the compensation committee of our board of directors approved an exchange program for our executive officers and for employees resident in the United States and Canada who are retention bonus program participants. In the exchange program, eligible participants could elect to surrender their right to receive a cash bonus in exchange for fully vested restricted stock units issued under our 2011 Equity Incentive Plan on the terms described below. Among other reasons, our compensation committee adopted the exchange program to encourage employee stock ownership and to effectively manage cash resources.

In connection with the bonus exchange program, each eligible employee could elect to exchange 25%, 50%, 75%, or 100% of the retention cash bonus otherwise payable under the terms of the program. Each employee participating in the exchange would receive a number of fully vested restricted stock units equal to the quotient, rounded up to the next whole number, determined by dividing the cash amount of the retention cash bonus that such eligible employee elects to exchange by an amount equal to 85% of the lower of the closing prices of one share of our common stock on the commencement date of the exchange offer or the closing date of the exchange offer. The exchange offer closed on November 5, 2018. The total value of the 379,593 shares of common stock issued under this program was $2.8 million and is included in the total intrinsic value of RSUs released in 2018.

***Stock Options*:**

| | Number of Options (000's) | Weighted-Average Exercise Price per Option | | Weighted-Average Remaining Contractual Life (in Years) | Aggregate Intrinsic Value (1) in (000's) | |
|---|---|---|---|---|---|---|
| Balance at December 31, 2016 | 3,560 | $ | 16.62 | 6.8 | | |
| Options granted | 1,364 | $ | 5.61 | | | |
| Options exercised | (25) | $ | 4.07 | | $ | 42 |
| Option forfeited | (2,735) | $ | 16.33 | | | |
| Balance at December 31, 2017 | 2,164 | $ | 10.41 | 6.6 | | |
| Options granted | 758 | $ | 6.05 | | | |
| Options exercised | (40) | $ | 5.24 | | $ | 81 |
| Option forfeited | (497) | $ | 16.09 | | | |
| Balance at December 31, 2018 | 2,385 | $ | 7.56 | 7.8 | | |
| Options granted | 50 | $ | 13.08 | | | |
| Options exercised | (197) | $ | 5.43 | | $ | 1,198 |
| Option forfeited | (211) | $ | 8.73 | | | |
| Balance at December 31, 2019 | 2,027 | $ | 7.78 | 6.8 | $ | 81 |
| Vested at December 31, 2019 | 1,357 | $ | 8.61 | 6.2 | $ | 69 |
| Unvested awards at December 31, 2019 | 670 | $ | 6.08 | 8.0 | $ | 12 |

(1) Aggregate intrinsic value as of December 31, 2019 was calculated as the difference between the closing price per share of our common stock on the last trading day of 2019, which was $3.48, and the exercise price of the options, multiplied by the number of in-the-money options.

As of December 31, 2019, the unrecognized compensation costs related to outstanding unvested options under our equity incentive plans were $2.2 million. We expect to recognize those costs over a weighted average period of 1.8 years.

*2017 Stock Option Exchange*

Included in the 2017 option activity above is the impact of our 2017 Stock Option Exchange Program. On August 23, 2017, we launched a one-time Stock Option Exchange Program (the Program), which eligible employees were able to exchange certain outstanding stock options (Eligible Options), whether vested or unvested, with an exercise price greater than $4.37 per share and greater than the closing price of a share of our common stock on the Nasdaq Global Select Market on the expiration date of the exchange offer (the Offer), for restricted stock units or stock options (New Awards) covering a lesser number of shares than were subject to the Eligible Options exchanged immediately before being canceled in the Offer. Non-employee members of our board of directors were not eligible to participate in the Program. The Program expired on September 20, 2017, with a closing price of $5.13 per share.

Employees elected to surrender Eligible Options to purchase a total of 1,204,198 shares of our common stock. All surrendered options were canceled effective as of the expiration date, and immediately thereafter, in exchange for such surrendered options, we issued (i) new options to purchase an aggregate of 399,117 shares of our common stock with an exercise price of $5.13; and (ii) restricted stock units representing 54,944 shares of our common stock, each, pursuant to the terms of the Offer and our 2011 Equity Incentive Plan. The new awards granted under the Program generally vest over three years.

The Program did not result in a material incremental stock-based compensation expense because the fair value of the new awards was approximately equal to the fair value of the surrendered options immediately prior to the exchange date. The original fair value of the surrendered options plus the incremental stock-based compensation expense is being recognized over the vesting periods of the New Awards.

***Performance-based Awards***

*Performance Stock Units with Market Conditions*

During the twelve months ended December 31, 2019 and 2018, we granted performance stock units to certain executive officers and senior level employees. The number of performance stock units ultimately earned under these awards is calculated based on the Total Shareholder Return (TSR) of our common stock as compared to the TSR of a defined group of peer companies during the applicable three-year performance period. The percentage of performance stock units that vest will depend on our relative position at the end of the performance period and can range from 0% to 200% of the number of units granted.

Under FASB ASC Topic 718, the provisions of the performance stock unit awards related to TSR are considered a market condition, and the effects of that market condition are reflected in the grant date fair value of the awards. We used a Monte Carlo simulation pricing model to incorporate the market condition effects at our grant date.

Activity under the performance stock units is as follows:

| | Number of Units (in 000's) | Weighted-Average Grant Date Fair Value per Unit |
|---|---|---|
| Balance at December 31, 2017 | — | $ — |
| PSU granted | 167 | $ 10.09 |
| PSU released | — | — |
| PSU forfeited | (12) | $ 10.09 |
| Balance at December 31, 2018 | 155 | $ 10.09 |
| PSU granted | 401 | $ 16.90 |
| PSU released | — | $ — |
| PSU forfeited | (9) | $ 10.09 |
| Balance at December 31, 2019 | 547 | $ 15.09 |

As of December 31, 2019, the unrecognized compensation costs related to these awards were $5.5 million. We expect to recognize those costs over a weighted average period of 2.0 years.

*Performance Stock Units with Performance Conditions*

During 2019, we also granted performance stock units to a certain employee. The number of performance stock units that ultimately vest under these awards is dependent on achieving certain discrete operational milestones between September 30, 2019 and December 31, 2020. Activity under these performance stock units is as follows:

| | Number of Units (in 000s) | Weighted-Average Grant Date Fair Value per Unit |
|---|---|---|
| Balance at December 31, 2018 | — | $ — |
| PSU granted | 68 | $ 7.05 |
| PSU released | (4) | $ 7.05 |
| PSU forfeited | — | $ — |
| Balance at December 31, 2019 | 64 | $ 7.05 |

**2017 Employee Stock Purchase Plan**

On August 1, 2017, our stockholders approved our 2017 Employee Stock Purchase Plan (ESPP) at the annual meeting of stockholders. Our ESPP offers U.S. and some non-U.S. employees the right to purchase shares of our common stock. Our first ESPP offering period began on October 1, 2017 with a shorter offering period ending on November 30, 2017.

Prior to June 2019, our ESPP program had a six-month offering period, with a new period commencing on the first trading day on or after May 31 and November 30 of each year. Employees were eligible to participate through payroll deductions of up to 10% of their compensation. The purchase price at which shares were sold under the ESPP was 85% of the lower of the fair market value of a share of our common stock on the first day of the offering period or the last day of the offering period.

Effective in June 2019, our ESPP program was amended to offer a twelve-month offering period with two six-month purchase periods beginning on each of May 31 and November 30. Employees are eligible under the amended program to participate through payroll deductions of up to 15% of their compensation. Employees may not purchase more than $25 thousand of stock for any calendar year.

Under the updated program, the purchase price at which shares are sold for the first purchase period is 85% of the lower of the fair market value of a share of our common stock on the first day of the offering period or the last day of the first purchase period. For the second purchase period, the purchase price at which shares are sold is 85% of the lower of the fair market value of the common stock on the first day of the offering period and the last day of the offering period. In the event the fair market value of the common stock at the beginning of the second purchase period is less than the fair market value on the beginning of the offering period, the purchase price for the second offering period is reset to 85% of the lower of the fair value of the common stock at the beginning of the second purchase period and last day of the offering period.

The offering period of June 1, 2019 to May 31, 2020 has two purchase periods, with one ending November 30, 2019 and the other May 31, 2020. As the fair market value of the common stock at November 30, 2019 was lower than the fair value of the common stock at the beginning of the offering period, the purchase price for the second purchase period was reset based on the lower of the November 30, 2019 price and May 31, 2019 price. The resetting of the purchase price is considered to be a modification of the original terms of the award. Under ASC 718, the incremental fair value based on the difference between the fair value of the modified award and the fair value of the original award immediately before it was modified was approximately $0.3 million. This amount is being amortized over the remaining offering period.

Total stock-based compensation expense recognized was as follows (in thousands):

| | For the Year Ended December 31, | | |
|---|---|---|---|
| | 2019 | 2018 | 2017 |
| 2018 Retention Bonus Program | $ — | $ 2,809 | $ — |
| Options, Performance Share Units, and Restricted Stock Units | 10,555 | 7,716 | 8,972 |
| Employee Stock Purchase Plan | 838 | 498 | 120 |
| Total Share-based Compensation | $ 11,393 | $ 11,023 | $ 9,092 |

**11. Income Taxes**

Our loss before income taxes consists of the following (in thousands):

| | Year Ended December 31, | | |
|---|---|---|---|
| | 2019 | 2018 | 2017 |
| Domestic | $ (59,900) | $ (47,600) | $ (56,885) |
| International | (6,805) | (13,820) | (6,914) |
| Loss before income taxes | $ (66,705) | $ (61,420) | $ (63,799) |

Significant components of our benefit for income taxes are as follows (in thousands):

| | Year Ended December 31, | | |
|---|---|---|---|
| | 2019 | 2018 | 2017 |
| Current: | | | |
| Federal | $ — | $ (27) | $ — |
| State | (31) | (19) | (17) |
| Foreign | (568) | (32) | (501) |
| Total current tax (expense) benefit | (599) | (78) | (518) |
| Deferred: | | | |
| State | — | — | — |
| Foreign | 2,514 | 2,485 | 3,782 |
| Total deferred benefit | 2,514 | 2,485 | 3,782 |
| Total benefit for income taxes | $ 1,915 | $ 2,407 | $ 3,264 |

Reconciliation of income taxes at the statutory rate to the benefit from income taxes recorded in the statements of operations is as follows:

| | Year Ended December 31, | | |
|---|---|---|---|
| | 2019 | 2018 | 2017 |
| Tax benefit at federal statutory rate | 21.0 % | 21.0 % | 34.0 % |
| State tax expense, net of federal benefit | 0.9 | 2.3 | 5.5 |
| Foreign tax benefit (expense) | (0.1) | (1.1) | 0.4 |
| Change in valuation allowance | (6.0) | (19.2) | 39.2 |
| Federal research and development credit | 0.7 | 1.5 | 1.9 |
| Unrecognized tax benefit | (0.1) | (0.2) | (0.6) |
| Impact of the 2017 Tax Cuts and Jobs Act | — | — | (74.6) |
| Non-deductible interest/premium | (7.9) | — | — |
| Global Intangible Low-Tax Income (GILTI) | (5.6) | — | — |
| Other, net | — | (0.4) | (0.7) |
| Effective tax rate | 2.9 % | 3.9 % | 5.1 % |

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.

Significant components of our deferred tax assets and liabilities are as follows (in thousands):

| | December 31, | |
|---|---|---|
| | 2019 | 2018 |
| Deferred tax assets: | | |
| Net operating loss carryforwards | $ 105,702 | $ 98,920 |
| Reserves and accruals | 3,597 | 7,167 |
| Depreciation and amortization | 3,715 | 4,262 |
| Tax credit carryforwards | 17,267 | 16,675 |
| Stock-based compensation | 2,501 | 1,899 |
| Total gross deferred tax assets | 132,782 | 128,923 |
| Valuation allowance on deferred tax assets | (130,084) | (126,109) |
| Total deferred tax assets, net of valuation allowance | 2,698 | 2,814 |
| Deferred tax liabilities: | | |
| Fixed assets and intangibles | (13,899) | (16,528) |
| Total deferred tax liabilities | (13,899) | (16,528) |
| Net deferred tax liability | $ (11,201) | $ (13,714) |

We evaluate a number of factors to determine the realizability of our deferred tax assets. Recognition of deferred tax assets is appropriate when realization of these assets is more likely than not. Assessing the realizability of deferred tax assets is dependent upon several factors including historical financial results. The net deferred tax assets have been partially offset by a valuation allowance because we have incurred losses since our inception. The valuation allowance increased by $4.0 million and $6.9 million during 2019 and 2018, respectively, and decreased by $27.1 million during 2017. The changes in valuation allowance during 2019 and 2018 are mainly due to significant taxable losses and an increase in tax attributes. The change in valuation allowance during 2019 also includes a release of the valuation allowance against our deferred tax assets in Japan due to achievement of recent profitability and the expectation of future profitability in the jurisdiction, which decreased the valuation allowance by $294 thousand.

The valuation allowances of $130.1 million and $126.1 million as of December 31, 2019 and 2018, respectively, primarily relate to temporary tax differences, net operating losses and research and development credits generated in the current and prior years. We believe it is more likely than not that U.S. federal and state of California deferred tax assets relating to temporary differences, net operating losses and research and development credits are not realizable. As such, full valuation allowances have been applied against the deferred tax assets relating to jurisdictions of the federal U.S. and the state of California.

A reconciliation of the beginning and ending amount of the valuation allowance for the years ended December 31, 2019, 2018, and 2017 is as follows (in thousands):

| | Valuation Allowance |
|---|---|
| December 31, 2016 | $ 146,285 |
| Charges to earnings | 830 |
| Charges to other accounts | (27,887) |
| December 31, 2017 | 119,228 |
| Charges to earnings | — |
| Charges to other accounts | 6,880 |
| December 31, 2018 | 126,108 |
| Charges to earnings | — |
| Charges to other accounts | 3,976 |
| December 31, 2019 | $ 130,084 |

As of December 31, 2019, we had net operating loss carryforwards for U.S. federal income tax purposes of $470.0 million, which expire beginning in 2020, and U.S. federal research and development tax credits of $9.0 million, which expire in the years 2020 through 2040. As of December 31, 2019, we had net operating loss carryforwards for state income tax purposes of $176.5 million, which expire beginning in 2020 through 2040, and California research and development tax credits of $11.7 million, which do not expire. As of December 31, 2019, we had no foreign net operating loss carryforwards.

Utilization of the net operating loss carryforwards and credits may be subject to a substantial annual limitation due to the ownership change limitations provided by Section 382 of the Internal Revenue Code of 1986, as amended, and similar state provisions. The annual limitation may result in the expiration of net operating losses and credits before utilization. In 2015, we completed a Section 382 analysis for the period from our inception in May 1999 through December 31, 2015, which excluded the net operating loss carryforwards for DVS prior to the acquisition and determined that an ownership change as defined under Section 382 occurred in November 2001, which resulted in a reduction to our U.S. federal net operating losses. In 2019, we continued the Section 382 analysis as historically performed through December 31, 2019 and determined that an ownership change did not occur during the current year.

**Uncertain Tax Positions**

The aggregate changes in the balance of our gross unrecognized tax benefits during 2019, 2018, and 2017 were as follows (in thousands):

| | |
|---|---|
| December 31, 2016 | $ 9,333 |
| Increases in balances related to tax positions taken during current period | 61 |
| Decreases in balances related to tax positions taken during prior period | (2,077) |
| December 31, 2017 | 7,317 |
| Increases in balances related to tax positions taken during current period | 255 |
| Decreases in balances related to tax positions taken during prior period | (228) |
| December 31, 2018 | 7,344 |
| Increases in balances related to tax positions during a prior period | 155 |
| Increases in balances related to tax positions taken during current period | 354 |
| Decreases in balances related to tax positions taken during prior period | (20) |
| December 31, 2019 | $ 7,833 |

Accrued interest and penalties related to unrecognized tax benefits were included in the income tax provision and are immaterial as of December 31, 2019 and 2018.

As of December 31, 2019, there are $0.7 million unrecognized tax benefits that, if recognized, would affect our effective tax rate. We do not anticipate that our existing unrecognized tax benefits will significantly increase or decrease within the next 12 months.

We file income tax returns in the United States, various states, and certain foreign jurisdictions. As a result of net operating loss carryforwards, all of our tax years are open to federal and state examination in the United States. Tax years from 2009 are open to examination in various foreign countries.

**12. Employee Benefit Plans**

We sponsor a 401(k) savings plan for our employees in the United States that stipulates that eligible employees may elect to contribute to the plan, subject to certain limitations, up to the lesser of 90% of eligible compensation or the maximum amount allowed by the U.S. Internal Revenue Service. In 2015, we implemented a match formula of 100% up to $2,000 annually, following a 4-year vesting schedule. In 2019, the match was increased to up to $3,000 annually. Employer matching contributions to the 401(k) plan for the years ended December 31, 2019, 2018, and 2017 were $0.6 million, $0.4 million, and $0.5 million, respectively.

**13. Information About Geographic Areas**

We operate in one reporting segment that develops, manufacturers and commercializes tools for life sciences research. Our chief executive officer manages our operations and evaluates our financial performance on a consolidated basis. For purposes of allocating resources and evaluating regional financial performance, our chief executive officer reviews separate sales information for the different regions of the world. Our general and administrative expenses and our research and development expenses are not allocated to any specific region. Most of our principal operations, other than manufacturing, and our decision-making functions are located at our corporate headquarters in the United States.

A summary table of our total revenue by geographic areas of our customers and by product and services for the years ended December 31, 2019, 2018 and 2017 is included in Note 3 to the consolidated financial statements.

Sales to customers in the United States represented $43.4 million or 37%, of total revenues for the year ended December 31, 2019. Sales to customers in the United States represented $48.1 million or 43% of total revenues for the year ended December 31, 2018, and $45.8 million or 45% for the year ended December 31, 2017.

Sales to customers in China represented $15.4 million or 13%, of total revenues for the year ended December 31, 2019. Sales to customers in China represented $14.0 million or 12% for year ended December 31, 2018, and 11% or $11.1 million, of total revenues for 2017. Except for China, no other foreign country or jurisdiction had sales in excess of 10% of our total revenue during the years 2019, 2018 and 2017.

No individual customer represented more than 10% of our total revenues for the fiscal years ended December 31, 2019, 2018, and 2017 respectively. Revenues from our five largest customers were 17% for both the years ended December 31, 2019 and 2018, and 14% for the year ended December 31, 2017.

We had long-lived assets consisting of property, plant and equipment, net of accumulated depreciation, in the following geographic areas for each year presented (in thousands):

| | December 31, | |
|---|---|---|
| | 2019 | 2018 |
| United States | $ 422 | $ 1,881 |
| Singapore | 2,489 | 3,748 |
| Canada | 4,942 | 3,104 |
| EMEA | 169 | 66 |
| Asia-Pacific | 34 | 26 |
| Total | $ 8,056 | $ 8,825 |

**14. Commitments and Contingencies**

**Commitments**

In the normal course of business, we enter into various contractual and legally binding purchase commitments. As of December 31, 2019, these commitments were approximately $2.2 million.

In December 2019, we also entered into a Sales and Purchase Agreement with the shareholders of InstruNor AS to purchase all of the outstanding shares of InstruNor AS. The purchase price was approximately $5.2 million in cash and 485,451 shares of our stock. The transaction closed in January 2020.

**Indemnifications**

From time to time, we have entered into indemnification provisions under certain of our agreements in the ordinary course of business, typically with business partners, customers, and suppliers. Pursuant to these agreements, we may indemnify, hold harmless, and agree to reimburse the indemnified parties on a case-by-case basis for losses suffered or incurred by the indemnified parties in connection with any patent or other intellectual property infringement claim by any third party with respect to our products. The term of these indemnification provisions is generally perpetual from the time of the execution of the agreement. The maximum potential amount of future payments we could be required to make under these indemnification provisions is typically not limited to a specific amount. In addition, we have entered into indemnification agreements with our officers, directors, and certain other employees. With certain exceptions, these agreements provide for indemnification for related expenses including, among others, attorneys' fees, judgments, fines and settlement amounts incurred by any of these individuals in any action or proceeding.

We incurred legal expenses between October 2015 and the third quarter of 2017 to defend claims by Thermo Fisher Scientific, Inc., (Thermo) against one of our employees. In December 2015, Thermo filed a complaint in the Circuit Court for the County of Kalamazoo, Michigan against one of its former employees who had recently been hired by us alleging, among other claims, misappropriation of proprietary information and breach of contractual and fiduciary obligations to Thermo while such individual was still an employee of Thermo. In November 2016, Thermo amended its complaint to add us as a party to the litigation, making various commercial and employment-related claims and seeking damages and injunctive relief. In July 2017, we entered into a settlement agreement with Thermo. Pursuant to the terms of the settlement agreement, we agreed to pay Thermo a one-time payment of $3.0 million in exchange for a release and dismissal of all claims with prejudice upon payment of the settlement. In August 2017, we paid the settlement of $3.0 million and received an insurance recovery payment of $1.0 million related to this matter.

**Contingencies**

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. The costs associated with the intrusion to be approximately $0.1 million, net of insurance proceeds.

From time to time, we may be subject to various legal proceedings and claims arising in the ordinary course of business. These include disputes and lawsuits related to intellectual property, mergers and acquisitions, licensing, contract law, tax, regulatory, distribution arrangements, employee relations and other matters. Periodically, we review the status of each matter and assess its potential financial exposure. If the potential loss from any claim or legal proceeding is considered probable and a range of possible losses can be estimated, we accrue a liability for the estimated loss. Legal proceedings are subject to uncertainties, and the outcomes are difficult to predict. Because of such uncertainties, accruals are based only on the best information available at the time. As additional information becomes available, we continue to reassess the potential liability related to pending claims and litigation and may revise estimates.

## 15. Quarterly Results of Operations (Unaudited)

Selected quarterly results of operations for the years ended December 31, 2019 and 2018 are as follows (in thousands, except for per share amounts):

| **2019** | | **First Quarter** | | **Second Quarter** | | **Third Quarter** | | **Fourth Quarter** |
|---|---|---|---|---|---|---|---|---|
| Total revenue | $ | 30,111 | $ | 28,196 | $ | 26,496 | $ | 32,440 |
| Net loss | $ | (25,465) | $ | (13,753) | $ | (12,887) | $ | (12,685) |
| Net loss per share, basic and diluted | $ | (0.44) | $ | (0.20) | $ | (0.19) | $ | (0.18) |

| **2018** | | **First Quarter** | | **Second Quarter** | | **Third Quarter** | | **Fourth Quarter** |
|---|---|---|---|---|---|---|---|---|
| Total revenue | $ | 25,248 | $ | 26,428 | $ | 28,963 | $ | 32,325 |
| Net loss | $ | (13,247) | $ | (16,241) | $ | (14,750) | $ | (14,775) |
| Net loss per share, basic and diluted | $ | (0.34) | $ | (0.42) | $ | (0.38) | $ | (0.36) |

### 16. Subsequent Event

On December 17, 2019, we entered into a Sales and Purchase Agreement with the shareholders of InstruNor AS, a privately held Norwegian company (InstruNor), to purchase all of the outstanding shares of InstruNor. The purchase price was approximately $5.2 million in cash and 485,451 shares of our stock. The transaction closed on January 17, 2020 for a total purchase price of $7.2 million.

## ITEM 9. CHANGES IN AND DISAGREEMENTS WITH ACCOUNTANTS ON ACCOUNTING AND FINANCIAL DISCLOSURE

None.

## ITEM 9A. CONTROLS AND PROCEDURES

*Evaluation of Disclosure Controls and Procedures*

Our management, with the participation of our Chief Executive Officer and our Chief Financial Officer, evaluated the effectiveness of our disclosure controls and procedures as of December 31, 2019. The term “disclosure controls and procedures,” as defined in Rules 13a-15(e) and 15d-15(e) under the Exchange Act, means controls and other procedures of a company that are designed to ensure that information required to be disclosed by a company in the reports that it files or submits under the Exchange Act is recorded, processed, summarized and reported, within the time periods specified in the SEC’s rules and forms. Disclosure controls and procedures include, without limitation, controls and procedures designed to ensure that information required to be disclosed by a company in the reports that it files or submits under the Exchange Act is accumulated and communicated to the company’s management, including its principal executive and principal financial officers, as appropriate to allow timely decisions regarding required disclosure. Management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving their objectives and management necessarily applies its judgment in evaluating the cost-benefit relationship of possible controls and procedures. Based on the evaluation of our disclosure controls and procedures as of December 31, 2019, our Chief Executive Officer and Chief Financial Officer concluded that, as of such date, our disclosure controls and procedures were effective at the reasonable assurance level.

*Management's Report on Internal Control Over Financial Reporting*

Our management is responsible for establishing and maintaining adequate internal control over financial reporting (as such term is defined in Exchange Act Rule 13a-15(f) to provide reasonable assurance regarding the reliability of our financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. Management assessed our internal control over financial reporting as of December 31, 2019. Management based its assessment on criteria established in *Internal Control—Integrated Framework* issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 Framework). Based on that evaluation, our management concluded that our internal control over financial reporting was effective as of December 31, 2019.

The effectiveness of our internal control over financial reporting as of December 31, 2019 has been audited by PricewaterhouseCoopers, LLP, an independent registered public accounting firm, as stated in their report included in this Annual Report on Form 10-K.

*Changes in Internal Control Over Financial Reporting*

There were no changes in our internal control over financial reporting that occurred during the three months ended December 31, 2019 that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

*Inherent Limitations on the Effectiveness of Controls*

Control systems, no matter how well conceived and operated, are designed to provide a reasonable, but not an absolute, level of assurance that the objectives of the control system are met. Further, the design of a control system must reflect the fact that there are resource constraints, and the benefits of controls must be considered relative to their costs. Because of the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that all control issues and instances of fraud, if any, have been detected. Because of the inherent limitations in any control system, misstatements due to error or fraud may occur and not be detected.

## ITEM 9B. OTHER INFORMATION

On February 26, 2020, Nicholas Khadder notified the Company of his intention to resign from his position as Senior Vice President, General Counsel and Corporate Secretary, and from any and all other positions he holds as an officer or employee of the Company, in order to pursue another opportunity. Mr. Khadder's resignation is effective as of March 13, 2020.

## PART III

### ITEM 10. DIRECTORS, EXECUTIVE OFFICERS AND CORPORATE GOVERNANCE

The information called for by this item will be set forth in our Proxy Statement for the Annual Meeting of Stockholders to be filed with the SEC within 120 days of the fiscal year ended December 31, 2019 and is incorporated herein by reference.

Our board of directors has adopted a Code of Ethics and Conduct that applies to all of our employees, officers and directors, including our Chief Executive Officer, Chief Financial Officer and other executive and senior financial officers. The full text of our code of business conduct and ethics is posted on the investor relations page on our website which is located at www.fluidigm.com. We will post any amendments to our code of business conduct and ethics, or waivers of its requirements, on our website.

### ITEM 11. EXECUTIVE COMPENSATION

The information called for by this item will be set forth in our Proxy Statement and is incorporated herein by reference.

### ITEM 12. SECURITY OWNERSHIP OF CERTAIN BENEFICIAL OWNERS AND MANAGEMENT AND RELATED STOCKHOLDER MATTERS

The information, if any, required by this item will be set forth in our Proxy Statement and is incorporated herein by reference.

### ITEM 13. CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS, AND DIRECTOR INDEPENDENCE

The information, if any, required by this item will be set forth in our Proxy Statement and is incorporated herein by reference.

### ITEM 14. PRINCIPAL ACCOUNTING FEES AND SERVICES

The information required by this item will be set forth in our Proxy Statement and is incorporated herein by reference.

## PART IV

### ITEM 15. EXHIBITS, FINANCIAL STATEMENT SCHEDULES

1. **Financial Statements.** See "Index to Consolidated Financial Statements" in Part II, Item 8 of this Form 10-K.

2. **Financial Statement schedule.** See "Index to Consolidated Financial Statements" in Part II, Item 8 of this Form 10-K.

3. **Exhibits.** The exhibits listed in the accompanying Index to Exhibits are filed herewith or are incorporated by reference to exhibits previously filed with the U.S. Securities and Exchange Commission.

**SCHEDULE II—VALUATION AND QUALIFYING ACCOUNTS AND RESERVES**

| | In thousands | | | |
|---|---|---|---|---|
| | Balance at Beginning of Period | Additions/ Charged to Expense | Deductions | Balance at End of Period |
| Year ended December 31, 2019 | | | | |
| Accounts receivable allowance | $ 126 | $ 179 | $ (299) | $ 6 |
| Year ended December 31, 2018 | | | | |
| Accounts receivable allowance | $ 391 | $ 162 | $ (427) | $ 126 |
| Year ended December 31, 2017 | | | | |
| Accounts receivable allowance | $ 502 | $ 24 | $ (135) | $ 391 |

| | In thousands | | | |
|---|---|---|---|---|
| | Balance at Beginning of Period | Additions/ Charged to Expense | Deductions | Balance at End of Period |
| Year ended December 31, 2019 | | | | |
| Warranty allowance | $ 863 | $ 1,386 | $ (859) | $ 1,390 |
| Year ended December 31, 2018 | | | | |
| Warranty allowance | $ 699 | $ 1,573 | $ (1,409) | $ 863 |
| Year ended December 31, 2017 | | | | |
| Warranty allowance | $ 1,023 | $ 695 | $ (1,019) | $ 699 |

## ITEM 16. FORM 10-K SUMMARY

None.

## INDEX TO EXHIBITS

| Exhibit Number | Description | Incorporated by Reference From Form | Incorporated by Reference From Exhibit Number | Date Filed |
|---|---|---|---|---|
| 2.1 | Agreement and Plan of Merger dated January 28, 2014 by and among Fluidigm Corporation, DVS Sciences, Inc., Dawid Merger Sub, Inc. and Shareholder Representative Services LLC. | 8-K | 2.1 | 1/29/2014 |
| 3.1 | Eighth Amended and Restated Certificate of Incorporation of Fluidigm Corporation filed on February 15, 2011. | 10-K | 3.1 | 3/28/2011 |
| 3.2 | Amended and Restated Bylaws of Fluidigm Corporation effective as of February 9, 2011. | 10-K | 3.2 | 3/28/2011 |
| 3.3 | Certificate of Designation of Rights, Preferences and Privileges of Series A Participating Preferred Stock. | 8-K | 3.1 | 11/22/2016 |
| 3.4 | Certificate of Elimination of Series A Participating Preferred Stock of Fluidigm Corporation. | 8-K | 3.1 | 8/2/2017 |
| 4.1 | Specimen Common Stock Certificate of Fluidigm Corporation. | S-8 | 4.1 | 8/3/2017 |
| 4.2 | Indenture, dated February 4, 2014, by and between Fluidigm Corporation and U.S. Bank National Association. | 8-K | 4.1 | 2/4/2014 |
| 4.3 | First Supplemental Indenture, dated February 4, 2014, by and between Fluidigm Corporation and U.S. Bank National Association. | 8-K | 4.2 | 2/4/2014 |
| 4.4 | Form of Global Note (included in Exhibit 4.3). | 8-K | 4.3 | 2/4/2014 |
| 4.5 | Description of Securities. | Filed herewith | | |
| 4.6 | Indenture, dated November 22, 2019, by and between Fluidigm Corporation and U.S. Bank National Association. | 8-K | 4.1 | 11/22/2019 |
| 4.7 | Form of 5.25% Convertible Senior Note due 2024 (included in Exhibit 4.7). | 8-K | 4.2 | 11/22/2019 |
| 10.1 | Form of Indemnification Agreement between Fluidigm Corporation and its directors and officers. | S-1/A | 10.1 | 1/28/2011 |
| 10.2 | Lease between AP3-SF3 CT North, LLC and Fluidigm Corporation, dated March 20, 2019. | 10-Q | 10.1 | 5/7/2019 |
| 10.2A | First Amendment to Lease between AP3-SF3 CT North, LLC and Fluidigm Corporation, dated April 26, 2019. | 10-Q | 10.2 | 5/7/2019 |
| 10.3# | 2009 Equity Incentive Plan of Fluidigm Corporation, as amended. | S-1 | 10.3 | 12/3/2010 |
| 10.3A# | Forms of agreements under the 2009 Equity Incentive Plan. | S-1 | 10.3A | 12/3/2010 |
| 10.4# | Fluidigm Corporation 2011 Equity Incentive Plan, as amended and restated effective June 3, 2019. | 8-K | 10.1 | 6/5/2019 |
| 10.4A# | Forms of agreements under the 2011 Equity Incentive Plan. | S-1/A | 10.4A | 1/28/2011 |
| 10.4B# | Amendments to the Fluidigm Corporation 2011 Equity Incentive Plan and 2009 Equity Incentive Plan and the DVS Sciences, Inc. 2010 Equity Incentive Plan. | 8-K | 10.2 | 8/2/2017 |

| Exhibit Number | Description | Incorporated by Reference From Form | Incorporated by Reference From Exhibit Number | Date Filed |
|---|---|---|---|---|
| 10.4C# | Forms of U.S. agreements under the 2011 Equity Incentive Plan. | SC TO-I | (d)(2) | 8/23/2017 |
| 10.4D | Rules of the Fluidigm Corporation 2011 Equity Incentive Plan for Restricted Stock Unit Awards Granted to French Participants. | SC TO-I | (d)(3) | 8/23/2017 |
| 10.4E | Rules of the Fluidigm Corporation 2011 Equity Incentive Plan for Options Granted to French Participants. | SC TO-I | (d)(4) | 8/23/2017 |
| 10.4F | UK Sub-plan to the Fluidigm Corporation 2011 Equity Incentive Plan. | SC TO-I | (d)(5) | 8/23/2017 |
| 10.4G# | Form of Restricted Stock Unit Agreement-Non-U.S. under the 2011 Equity Incentive Plan. | SC TO-I | (d)(6) | 8/23/2017 |
| 10.4H# | Form of Stock Option Agreement-Non-U.S. under the 2011 Equity Incentive Plan. | SC TO-I | (d)(7) | 8/23/2017 |
| 10.5# | Fluidigm Corporation 2017 Inducement Award Plan and related form agreements. | 8-K | 10.1 | 1/11/2017 |
| 10.6# | 2017 Employee Stock Purchase Plan. | 8-K | 10.1 | 8/2/2017 |
| 10.7# | Executive Bonus Plan. | 10-K | 10.25 | 3/28/2011 |
| 10.8† | Second Amended and Restated License Agreement between California Institute of Technology and Fluidigm Corporation, effective as of May 1, 2004. | S-1 | 10.5 | 12/3/2010 |
| 10.8A† | First Addendum, effective as of March 29, 2007, to Second Amended and Restated License Agreement between California Institute of Technology and Fluidigm Corporation effective as of May 1, 2004. | S-1 | 10.5A | 12/3/2010 |
| 10.9† | Co-Exclusive License Agreement between President and Fellows of Harvard College and Fluidigm Corporation effective as of October 15, 2000. | S-1 | 10.6 | 12/3/2010 |
| 10.9A† | First Amendment to Co-Exclusive License Agreement between President and Fellows of Harvard College and Fluidigm Corporation effective as of October 15, 2000. | S-1 | 10.6A | 12/3/2010 |
| 10.10† | Co-Exclusive License Agreement between President and Fellows of Harvard College and Fluidigm Corporation effective as of October 15, 2000. | S-1 | 10.7 | 12/3/2010 |
| 10.11† | Co-Exclusive License Agreement between President and Fellows of Harvard College and Fluidigm Corporation effective as of October 15, 2000. | S-1 | 10.8 | 12/3/2010 |
| 10.12† | Letter Agreement between President and Fellows of Harvard College and Fluidigm Corporation dated December 22, 2004. | S-1 | 10.9 | 12/3/2010 |
| 10.13 | Loan and Security Agreement, dated as of August 2, 2018 by and between Fluidigm Corporation and Silicon Valley Bank. | 8-K | 10.1 | 8/2/2018 |
| 10.13A | Default Waiver and First Amendment to Loan and Security Agreement, dated September 1, 2018, between the Company and Silicon Valley Bank. | Filed herewith | | |
| 10.13B | Second Amendment to Loan and Security Agreement, dated November 20, 2019, between the Company and Silicon Valley Bank. | 8-K | 10.2 | 11/22/2019 |
| 10.14 | Purchase Agreement, dated November 20, 2019, between Fluidigm Corporation and Barclays Capital Inc., as representative of the several initial purchasers named in Schedule I thereto. | 8-K | 10.1 | 11/22/2019 |

| Exhibit Number | Description | Incorporated by Reference From Form | Incorporated by Reference From Exhibit Number | Date Filed |
|---|---|---|---|---|
| 10.15# | Form of Amended and Restated Employment and Severance Agreement between Fluidigm Corporation and each of its executive officers. | 8-K | 10.14 | 12/11/2012 |
| 10.16# | Fluidigm Corporation Change of Control and Severance Plan. | 8-K | 10.1 | 8/23/2017 |
| 10.17# | Endorsement Split-Dollar Life Insurance Agreement. | 10-Q | 10.5 | 11/7/2017 |
| 10.18# | Offer Letter to Stephen Christopher Linthwaite, dated July 14, 2016. | 10-Q | 10.1 | 5/8/2018 |
| 10.19# | Employment and Severance Agreement, effective as of August 1, 2016, by and between Fluidigm Corporation and Stephen Christopher Linthwaite. | 10-Q | 10.2 | 11/9/2016 |
| 10.20# | Offer Letter to Vikram Jog dated January 29, 2008. | S-1 | 10.17 | 12/3/2010 |
| 10.21# | Offer Letter to Bradley A. Kreger dated February 13, 2018. | 10-K | 10.18 | 3/18/2019 |
| 10.22 | Lease Agreement between ARE - San Francisco No. 17 LLC and Fluidigm Corporation, dated September 14, 2010, as amended September 22, 2010. | S-1/A | 10.19 | 1/7/2011 |
| 10.22A | Second Amendment to Lease Agreement between ARE-San Francisco No. 17, LLC and Fluidigm Corporation, dated April 9, 2013. | 10-Q | 10.19A | 5/9/2013 |
| 10.22B | Fourth Amendment to Lease Agreement between ARE-San Francisco No. 17, LLC and Fluidigm Corporation, dated June 4, 2014. | 10-Q | 10.3 | 8/4/2014 |
| 10.22C | Fifth Amendment to Lease Agreement between ARE-San Francisco No. 17, LLC and Fluidigm Corporation, dated September 15, 2014. | 10-Q | 10.2 | 11/6/2014 |
| 10.22D | Sixth Amendment to Lease Agreement between ARE-San Francisco No. 17, LLC and Fluidigm Corporation, dated December 8, 2015. | 8-K | 10.1 | 12/14/2015 |
| 10.22E | Seventh Amendment to Lease Agreement between ARE-San Francisco No. 17, LLC and Fluidigm Corporation, dated March 23,2017. | 10-Q | 10.1 | 5/9/2017 |
| 10.22F | Eighth Amendment to Lease Agreement between ARE-San Francisco No. 17, LLC and Fluidigm Corporation, dated August 2, 2017. | 8-K | 10.1 | 8/3/2017 |
| 10.22G | Ninth Amendment to Lease Agreement between ARE-San Francisco No. 17, LLC and Fluidigm Corporation, dated May 31, 2018. | 10-Q | 10.2 | 8/8/2018 |
| 10.22H | Tenth Amendment to Lease Agreement between ARE-San Francisco No. 17, LLC and Fluidigm Corporation, dated August 14, 2019. | 10-Q | 10.1 | 11/8/2019 |
| 10.23 | Tenancy for Flatted Factory Space in Singapore between JTC Corporation and Fluidigm Corporation dated July 27, 2005, as amended August 12, 2008 and May 31, 2010. | S-1 | 10.20 | 12/3/2010 |
| 10.24 | Offer of Tenancy for Facility Lease between Fluidigm Singapore Pte. Ltd. and SBC Institutional Trust Services (Singapore) Limited, as trustee of Ascendas Real Estate Investment Trust dated October 14, 2013. | 10-K | 10.21 | 3/12/2014 |
| 10.25 | Offer of Tenancy for Lease of Additional Space at Singapore Facility between Fluidigm Singapore Pte. Ltd. and HSBC Institutional Trust Services (Singapore) Limited, as trustee of Ascendas Real Estate Investment Trust, dated April 2, 2015. | 10-Q | 10.1 | 8/10/2015 |

| Exhibit Number | Description | Incorporated by Reference From Form | Incorporated by Reference From Exhibit Number | Date Filed |
|---|---|---|---|---|
| 10.26† | Office Lease by and among Rodick Equities Inc., Fluidigm Canada Inc., and Fluidigm Corporation, dated August 17, 2015. | 10-Q | 10.1 | 11/9/2015 |
| 10.27† | License Agreement between MDS Analytical Technologies, a business unit of MDS INC., and DVS Sciences Inc., dated July 17, 2008. | 10-Q/A | 10.3 | 9/15/2014 |
| 10.28† | Sublicense Agreement between DVS Sciences Inc. and Fluidigm Corporation, dated January 28, 2014. | 10-Q/A | 10.4 | 9/15/2014 |
| 21.1 | Subsidiaries of Fluidigm Corporation. | 10-K | 21.1 | 3/3/2017 |
| 23.1 | Consent of PricewaterhouseCoopers LLP, Independent Registered Public Accounting Firm. | Filed herewith | | |
| 24.1 | Power of Attorney (contained in the signature page to this Form 10-K). | Filed herewith | | |
| 31.1 | Certification Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 302 of the Sarbanes-Oxley Act of 2002 of Chief Executive Officer. | Filed herewith | | |
| 31.2 | Certification Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 302 of the Sarbanes-Oxley Act of 2002 of Chief Financial Officer. | Filed herewith | | |
| 32.1~ | Certification Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002 of Chief Executive Officer. | Filed herewith | | |
| 32.2~ | Certification Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002 of Chief Executive Officer. | Filed herewith | | |
| 101.INS | XBRL Instance Document - the instance document does not appear in the Interactive Data File because its XBRL tags are embedded within the Inline XBRL document. | Filed herewith | | |
| 101.SCH | XBRL Taxonomy Extension Schema Document | Filed herewith | | |
| 101.CAL | XBRL Taxonomy Extension Calculation Linkbase Document | Filed herewith | | |
| 101.DEF | XBRL Taxonomy Extension Definition Linkbase Document | Filed herewith | | |
| 101.LAB | XBRL Taxonomy Extension Label Document | Filed herewith | | |
| 101.PRE | XBRL Taxonomy Extension Presentation Document | Filed herewith | | |

# Management contracts or compensation plans or arrangements in which directors or executive officers are eligible to participate.

† Portions of the exhibit have been omitted pursuant to an order granted by the Securities and Exchange Commission for confidential treatment.

~ In accordance with Item 601(b)(32)(ii) of Regulation S-K and SEC Release No. 33-8238 and 34-47986, Final Rule: Management's Reports on Internal Control Over Financial Reporting and Certification of Disclosure in Exchange Act Periodic Reports, the certifications furnished in Exhibits 32.1 and 32.2 hereto are deemed to accompany this Form 10-K and will not be deemed "filed" for purposes of Section 18 of the Exchange Act. Such certifications will not be deemed to be incorporated by reference into any filings under the Securities Act or the Exchange Act, except to the extent that Fluidigm Corporation specifically incorporates it by reference.

## SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized.

FLUIDIGM CORPORATION

Dated: February 27, 2020

By: /s/ Stephen Christopher Linthwaite

**Stephen Christopher Linthwaite**

**President and Chief Executive Officer**

## POWER OF ATTORNEY

KNOW ALL PERSONS BY THESE PRESENTS, that each person whose signature appears below constitutes and appoints Stephen Christopher Linthwaite and Vikram Jog, jointly and severally, as his or her true and lawful attorneys-in-fact and agents, with full power of substitution and resubstitution, for him or her and in his or her name, place and stead, in any and all capacities, to sign this Form 10-K, and to file the same, with all exhibits thereto, and other documents in connection therewith, with the Securities and Exchange Commission, granting unto said attorneys-in-fact and agents full power and authority to do and perform each and every act and thing requisite or necessary to be done in and about the premises hereby ratifying and confirming all that said attorneys-in-fact and agents, or his or their substitute or substitutes, may lawfully do or cause to be done by virtue hereof.

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the registrant and in the capacities and on the dates indicated.

| Signature | Title | Date |
|---|---|---|
| /s/ Stephen Christopher Linthwaite<br>**Stephen Christopher Linthwaite** | President and Chief Executive Officer (Principal Executive Officer); Director | February 27, 2020 |
| /s/ Vikram Jog<br>**Vikram Jog** | Chief Financial Officer (Principal Financial and Accounting Officer) | February 27, 2020 |
| /s/ Samuel D. Colella<br>**Samuel D. Colella** | Chairman of the Board of Directors | February 27, 2020 |
| /s/ Nicolas M. Barthelemy<br>**Nicolas M. Barthelemy** | Director | February 27, 2020 |
| /s/ Gerhard F. Burbach<br>**Gerhard F. Burbach** | Director | February 27, 2020 |
| /s/ Laura M. Clague<br>**Laura M. Clague** | Director | February 27, 2020 |
| /s/ Bill W. Colston<br>**Bill W. Colston** | Director | February 27, 2020 |
| /s/ Patrick S. Jones<br>**Patrick S. Jones** | Director | February 27, 2020 |
| /s/ Carlos V. Paya<br>**Carlos V. Paya** | Director | February 27, 2020 |

**Exhibit 4.5**

# DESCRIPTION OF THE REGISTRANT'S SECURITIES REGISTERED PURSUANT TO SECTION 12 OF THE SECURITIES EXCHANGE ACT OF 1934

As of February 27, 2020, Fluidigm Corporation ("we," "us," "our," or the "Company") has one class of securities registered under Section 12 of the Securities Exchange Act of 1934, as amended (the “Exchange Act”), our Common Stock.

## Description of Common Stock

The following description of our Common Stock is a summary and does not purport to be complete. It is subject to and qualified in its entirety by reference to our Eighth Amended and Restated Certificate of Incorporation, as amended (the “Certificate of Incorporation”) and our Amended and Restated Bylaws (the “Bylaws”), each of which are incorporated by reference as an exhibit to the Annual Report on Form 10-K of which this Exhibit 4.5 is a part. We encourage you to read our Certificate of Incorporation, our Bylaws and the applicable provisions of the Delaware General Corporation Law, for additional information.

### Authorized Capital Shares

Our authorized capital stock consists of 200,000,000 shares of common stock, $0.001 par value per share (“Common Stock”), and 10,000,000 shares of preferred stock, $0.001 par value per share.

### Common Stock

The holders of our Common Stock are entitled to one vote per share on all matters to be voted on by our stockholders. Subject to preferences that may be applicable to any outstanding shares of preferred stock, holders of Common Stock are entitled to receive ratably such dividends as may be declared by our Board of Directors out of funds legally available for that purpose. In the event of our liquidation, dissolution or winding up, the holders of Common Stock are entitled to share ratably in all assets remaining after the payment of liabilities, subject to the prior distribution rights of preferred stock then outstanding. Holders of Common Stock have no preemptive, conversion or subscription rights. There are no redemption or sinking fund provisions applicable to the Common Stock.

### Preferred Stock

Our Board of Directors has the authority, without further action by our stockholders, to designate and issue up to 10,000,000 shares of preferred stock in one or more series. Our Board of Directors may also designate the rights, preferences and privileges each such series of preferred stock, any or all of which may be greater than or senior to those of the Common Stock. Though the actual effect of any such issuance on the rights of the holders of Common Stock will not be known until our Board of Directors determines the specific rights of the holders of preferred stock, the potential effects of such an issuance include:

- diluting the voting power of the holders of Common Stock;
- reducing the likelihood that holders of Common Stock will receive dividend payments;
- reducing the likelihood that holders of Common Stock will receive payments in the event of our liquidation, dissolution, or winding up; and
- delaying, deterring or preventing a change-in-control or other corporate takeover.

**Voting Rights**

Holders of our Common Stock are entitled to one vote for each share of Common Stock held by such holder on any matter submitted to a vote at a meeting of stockholders. In addition, our Certificate of Incorporation provides that certain corporate actions require the approval of our stockholders. These actions, and the vote required, are as follows:

- the removal of a director requires the vote of a majority of the voting power of our issued and outstanding capital stock entitled to vote in the election of directors; and
- the amendment of provisions of our Certificate of Incorporation relating to blank check preferred stock, the classification of our directors, the removal of directors, the filling of vacancies on our Board of Directors, cumulative voting, annual and special meetings of our stockholders and require the vote of 66 2/3% of our then outstanding voting securities.

**Anti-Takeover Effects of Delaware Law and Our Certificate of Incorporation and Bylaws**

Certain provisions of Delaware law and our Certificate of Incorporation and Bylaws contain provisions that could have the effect of delaying, deferring or discouraging another party from acquiring control of the Company. These provisions, which are summarized below, are expected to discourage certain types of coercive takeover practices and inadequate takeover bids. These provisions are also designed in part to encourage anyone seeking to acquire control of us to first negotiate with our Board of Directors. We believe that the advantages gained by protecting our ability to negotiate with any unsolicited and potentially unfriendly acquirer outweigh the disadvantages of discouraging such proposals, including those priced above the then-current market value of our Common Stock, because, among other reasons, the negotiation of such proposals could improve their terms.

***Certificate of Incorporation and Bylaws***

Our Certificate of Incorporation and Bylaws include 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;
- provide that 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;
- establish that our Board of Directors is divided into three classes, Class I, Class II, and Class III, with each class serving staggered terms;
- specify that no stockholder is permitted to cumulate votes at any election of the Board of Directors; and
- require a super majority of votes to amend certain of the above-mentioned provisions.

***Delaware Anti-Takeover Statute***

We are subject to the provisions of Section 203 of the Delaware General Corporation Law regulating corporate takeovers (“Section 203”). In general, Section 203 prohibits a publicly-held Delaware corporation from engaging, under certain circumstances, in a business combination with an interested stockholder for a period of three years following the date the person became an interested stockholder unless:

- prior to the date of the transaction, the Board of Directors of the corporation approved either the business combination or the transaction which resulted in the stockholder becoming an interested stockholder;

- upon completion of the transaction that resulted in the stockholder becoming an interested stockholder, the interested stockholder owned at least 85% of the voting stock of the corporation outstanding at the time the transaction commenced, excluding for purposes of determining the voting stock outstanding, but not for determining the outstanding voting stock owned by the interested stockholder, (i) shares owned by persons who are directors and also officers, and (ii) shares owned by employee stock plans in which employee participants do not have the right to determine confidentially whether shares held subject to the plan will be tendered in a tender or exchange offer; or
- at or subsequent to the date of the transaction, the business combination is approved by the Board of Directors of the corporation and authorized at an annual or special meeting of stockholders, and not by written consent, by the affirmative vote of at least 66 2/3% of the outstanding voting stock which is not owned by the interested stockholder.

Generally, a business combination includes a merger, asset or stock sale, or other transaction resulting in a financial benefit to the interested stockholder. An interested stockholder is a person who, together with affiliates and associates, owns or, within three years prior to the determination of interested stockholder status, did own 15% or more of a corporation's outstanding voting stock. We expect the existence of this provision to have an anti-takeover effect with respect to transactions our board of directors does not approve in advance. We also anticipate that Section 203 may discourage business combinations or other attempts that might result in a premium over the market price for the shares of Common Stock held by our stockholders.

The provisions of Delaware law and our Certificate of Incorporation and Bylaws could have the effect of discouraging others from attempting hostile takeovers and, as a consequence, they may also inhibit temporary fluctuations in the market price of our Common Stock that often result from actual or rumored hostile takeover attempts. These provisions may also have the effect of preventing changes in our management. It is possible that these provisions could make it more difficult to accomplish transactions that stockholders may otherwise deem to be in their best interests.

**Transfer Agent and Registrar**

The transfer agent and registrar for our Common Stock is Computershare Trust Company, N.A. The transfer agent's address is 462 South 4th Street, Suite 1600, Louisville, KY 40202, and its telephone number is (800) 662-7232 or (781) 575-2879.

**Nasdaq Global Select Market Listing**

Our Common Stock is traded on The Nasdaq Global Select Market under the trading symbol "FLDM."

**Exhibit 10.13A**

# DEFAULT WAIVER AND FIRST AMENDMENT
# TO
# LOAN AND SECURITY AGREEMENT

This **DEFAULT WAIVER AND FIRST AMENDMENT** to Loan and Security Agreement (this "Agreement") is entered into this 7th day of September, 2018 (the "First Amendment Effective Date"), by and between Silicon Valley Bank ("Bank") and FLUIDIGM CORPORATION, a Delaware corporation ("Borrower").

## RECITALS

**A.** Bank and Borrower have entered into that certain Loan and Security Agreement dated as of August 2, 2018 (as the same may from time to time be amended, modified, supplemented or restated, the "Loan Agreement"). Bank has extended credit to Borrower for the purposes permitted in the Loan Agreement.

**B.** In addition, Borrower acknowledges it is currently in default of the Loan Agreement for failing to (a) deliver to Bank duly executed original signatures to the Control Agreement(s) entered into for the benefit of Bank with respect to the Bank of America Lockbox Accounts pursuant to Section 3.3(d) of the Loan Agreement and (b) opening additional cash collateral accounts with Bank of America not permitted by Section 6.8 of the Loan Agreement (each of the defaults under (a) and (b), collectively, the "Waived Defaults").

**C.** Borrower has requested that Bank waive its rights and remedies against Borrower, limited specifically to the Waived Defaults. Although Bank is under no obligation to do so, Bank is willing to not exercise its rights and remedies against Borrower related to the specific Waived Defaults on the terms and conditions set forth in this Agreement, so long as Borrower complies with the terms, covenants and conditions set forth in this Agreement.

**D.** Borrower has further requested that Bank amend the Loan Agreement to (1) revise the postclosing requirements and (2) make certain other revisions to the Loan Agreement as more fully set forth herein. Bank has agreed to so amend certain provisions of the Loan Agreement, but only to the extent, in accordance with the terms, subject to the conditions and in reliance upon the representations and warranties set forth below.

## AGREEMENT

**NOW, THEREFORE,** in consideration of the foregoing recitals and other good and valuable consideration, the receipt and adequacy of which is hereby acknowledged, and intending to be legally bound, the parties hereto agree as follows:

**1. Definitions.** Capitalized terms used but not defined in this Agreement shall have the meanings given to them in the Loan Agreement.

**2. Waiver of Default.** Bank hereby waives filing any legal action or instituting or enforcing any rights and remedies it may have against Borrower with respect to the Waived Defaults. Bank's waiver of Borrower's compliance with Sections 3.3(d) and 6.8 shall apply only with respect to Borrower's failure to do so as of the First Amendment Effective Date. Accordingly, hereinafter, Borrower shall be in compliance with such sections. Bank's agreement to waive the Waived Defaults (a) in no way shall be deemed an agreement by Bank to waive Borrower's compliance with the above-referenced sections as of all other dates after the First Amendment Effective Date, and (b) shall not limit or impair the Bank's right to demand strict performance of such sections as of all other dates after the First Amendment Effective Date.

**3. Amendments to Loan Agreement**.

**3.1 Section 3.3 (Covenant to Deliver)**. Sections 3.3(b), (c) and (d) of the Loan Agreement are amended in their entirety and replaced with the following:

"(b) As soon as possible, but in any event not later than sixty (60) days after the Effective Date, Borrower shall deliver to Bank a landlord's consent in favor of Bank for Borrower's leased location at 7000 Shoreline Court, Suite 100, San Francisco, CA 94080, by the respective landlord thereof, together with the duly executed original signatures thereto.

(c) As soon as possible, but in any event not later than sixty (60) days after the Effective Date, Borrower shall deliver to Bank a bailee's waiver in favor of Bank for each location where Borrower maintains property with a third party, by each such third party, together with the duly executed original signatures thereto. For the avoidance of doubt, only Inventory stored at a location that is subject to a landlord consent or bailee waiver in favor of Bank shall be considered Eligible Inventory.

(d) As soon as possible, but in any event not later than sixty (60) days after the Effective Date, Bank shall have received duly executed original signatures to the Control Agreement(s) entered into for the benefit of Bank with respect to the Bank of America Lockbox Accounts."

**3.2 Section 6.8 (Accounts)**. Section 6.8(a) of the Loan Agreement is amended in its entirety and replaced with the following:

"(a) Maintain its and all of its Subsidiaries' operating and other deposit accounts, the Cash Collateral Account and excess cash with Bank and Bank's Affiliates; provided, however, notwithstanding the foregoing,
(I) Borrower may maintain (a) subject to a Control Agreement entered into for the benefit of Bank, its existing collections accounts at Bank of America listed on the Perfection Certificate delivered by Borrower to Bank on or prior to the Effective Date (the "**Bank of America Lockbox Accounts**") so long as such accounts are blocked and all amounts in such accounts are swept to the Cash Collateral Account on a daily basis, (b) subject to a Control Agreement entered into for the benefit of Bank, depository accounts (other

than the Bank of America Payroll Account) at Bank of America (the “**Bank of America Deposit Accounts**”) so long as the aggregate amount of cash in such accounts does not, at any time, exceed Three Million Five Hundred Thousand Dollars ($3,500,000) in the aggregate, (c) its existing payroll account at Bank of America listed on the Perfection Certificate delivered by Borrower to Bank on or prior to the Effective Date (the “**Bank of America Payroll Account**”) so long as the aggregate amount of cash in such accounts does not, at any time, exceed an amount equal to one hundred percent (100%) of the next payroll (including but not limited to any bonuses payable), (d) for a period of time not to exceed twelve (12) months following the Effective Date, its existing account at Wells Fargo Bank listed on the Perfection Certificate delivered by Borrower to Bank on or prior to the Effective Date (the “**Wells Fargo Account**”) so long as the aggregate amount of cash in such account does not, at any time, exceed Four Hundred Thousand Dollars ($400,000) in the aggregate, (e) for a period of time not to exceed (12) months following the Effective Date, its existing account at Bridge Bank listed on the Perfection Certificate delivered by Borrower to Bank on or prior to the Effective Date (the “**Bridge Bank Account**”) so long as the aggregate amount of cash in such account does not, at any time, exceed Sixty Thousand Dollars ($60,000) in the aggregate, and (f) accounts securing Indebtedness described in subsection (j) of the defined term Permitted Indebtedness so long as the aggregate amount of cash in such accounts does not, at any time, exceed Eight Hundred Forty Thousand Dollars ($840,000) in the aggregate and (II) Borrower’s Foreign Subsidiaries may maintain accounts with banks outside of the United States so long as the aggregate amount of cash in such account does not, at any time, exceed the lesser of (i) Eight Million Dollars ($8,000,000) or (ii) thirty percent (30%) of all of Borrower’s and its Subsidiaries’ cash in the aggregate. In addition, Borrower (i) shall use its best efforts to use Bank Services provided such Bank Services meet Borrower’s ordinary course of business needs and (ii) Borrower shall maintain all its credit cards with Bank.”

**3.3 Section 13 (Definitions)**. Subsection (j) of the defined term Permitted Indebtedness set forth in Section 13.1 of the Loan Agreement, as appropriate, as follows:

“(j) Indebtedness consisting of reimbursement obligations in respect of letters of credit, bank guarantees or bankers**’** acceptances issued for the benefit of customers, suppliers or distributors located in foreign jurisdictions in a face amount not to exceed Seven Hundred Thousand Dollars ($700,000);”

**3.4 Exhibit A**. Exhibit A to the Loan Agreement shall be amended and restated in its entirety in the form attached hereto as Exhibit A.

**4. Limitation**.

**4.1** This Agreement is effective for the purposes set forth herein and shall be limited precisely as written and shall not be deemed to (a) be a consent to any amendment, waiver or modification of any other term or condition of any Loan Document, or (b) otherwise prejudice any right or remedy which Bank may now have or may have in the future under or in connection with any Loan Document.

**4.2** This Agreement shall be construed in connection with and as part of the Loan Documents, and all terms, conditions, representations, warranties, covenants and agreements set forth in the Loan Documents are hereby ratified and confirmed and shall remain in full force and effect.

**5. Representations and Warranties.** Borrower represents and warrants to Bank as follows:

**5.1** (a) the representations and warranties contained in the Loan Documents are true, accurate and complete in all material respects as of the date hereof (except to the extent such representations and warranties relate to an earlier date, in which case they are true and correct as of such date), and (b) no Event of Default other than and the Waived Defaults has occurred and is continuing;

**5.2** Borrower has the power and authority to execute and deliver this Agreement and to perform its obligations under the Loan Agreement;

**5.3** The organizational documents of Borrower delivered to Bank on the Effective Date remain true, accurate and complete and have not been amended, supplemented or restated and are and continue to be in full force and effect;

**5.4** The execution and delivery by Borrower of this Agreement and the performance by Borrower of its obligations under the Loan Agreement have been duly authorized by all necessary action on the part of Borrower;

**5.5** The execution and delivery by Borrower of this Agreement and the performance by Borrower of its obligations under the Loan Agreement do not and will not contravene (a) any law or regulation binding on or affecting Borrower, (b) any contractual restriction with a Person binding on Borrower, (c) any order, judgment or decree of any court or other governmental or public body or authority, or subdivision thereof, binding on Borrower, or (d) the organizational documents of Borrower;

**5.6** The execution and delivery by Borrower of this Agreement and the performance by Borrower of its obligations under the Loan Agreement do not require any order, consent, approval, license, authorization or validation of, or filing, recording or registration with, or exemption by any governmental or public body or authority, or subdivision thereof, binding on either Borrower, except as already has been obtained or made; and

**5.7** This Agreement has been duly executed and delivered by Borrower and is the binding obligation of Borrower, enforceable against Borrower in accordance with its terms, except as such enforceability may be limited by bankruptcy, insolvency, reorganization, liquidation, moratorium or other similar laws of general application and equitable principles relating to or affecting creditors' rights.

**6. Ratification of Perfection Certificate**. Borrower hereby ratifies, confirms and reaffirms, all and singular, the terms and disclosures contained in a certain Perfection Certificate dated on or prior to the Effective Date and acknowledges, confirms and agrees that the disclosures and information Borrower provided to Bank in such Perfection Certificate have not changed, as of the date hereof.

**7. Integration**. This Agreement and the Loan Documents represent the entire agreement about this subject matter and supersede prior negotiations or agreements. All prior agreements, understandings, representations, warranties, and negotiations between the parties about the subject matter of this Agreement and the Loan Documents merge into this Agreement and the Loan Documents.

**8. Counterparts.** This Agreement may be executed in any number of counterparts and all of such counterparts taken together shall be deemed to constitute one and the same instrument.

**9. Conditions to Effectiveness**. The parties agree that this amendment shall be effective upon the due execution and delivery to Bank of this Agreement by each party hereto.

**10. Miscellaneous.**

**10.1** This Agreement shall constitute a Loan Document under the Loan Agreement; the failure to comply with the covenants contained herein shall constitute an Event of Default under the Loan Agreement; and all obligations included in this Agreement (including, without limitation, all obligations for the payment of principal, interest, fees, and other amounts and expenses) shall constitute obligations under the Loan Agreement and secured by the Collateral.

**10.2** Each provision of this Agreement is severable from every other provision in determining the enforceability of any provision.

**11. Governing Law.** This Agreement and the rights and obligations of the parties hereto shall be governed by and construed in accordance with the laws of the State of California.

[Signature page follows.]

**IN WITNESS WHEREOF,** the parties hereto have caused this Agreement to be duly executed and delivered as of the date first written above.

| | |
|---|---|
| **BANK** | **BORROWER** |
| SILICON VALLEY BANK | FLUIDIGM CORPORATION |
| By: /s/ Shawn Parry | By: /s/ Nicholas Khadder |
| Name: Shawn Parry | Name: Nicholas Khadder |
| Title: Director | Title: General Counsel and Secretary |

## EXHIBIT A - COLLATERAL DESCRIPTION

The Collateral consists of all of Borrower's right, title and interest in and to the following personal property:

All goods, Accounts (including health-care receivables), Equipment, Inventory, contract rights or rights to payment of money, leases, license agreements, franchise agreements, General Intangibles (except as provided below), commercial tort claims, documents, instruments (including any promissory notes), chattel paper (whether tangible or electronic), cash, deposit accounts, certificates of deposit, fixtures, letters of credit rights (whether or not the letter of credit is evidenced by a writing), securities, and all other investment property, supporting obligations, and financial assets, whether now owned or hereafter acquired, wherever located; and

all Borrower's Books relating to the foregoing, and any and all claims, rights and interests in any of the above and all substitutions for, additions, attachments, accessories, accessions and improvements to and replacements, products, proceeds and insurance proceeds of any or all of the foregoing.

Notwithstanding the foregoing, the Collateral does not include (a) with respect to stock in Foreign Subsidiaries, more than sixty-five percent (65.0%) of the presently existing and hereafter arising issued and outstanding shares of capital stock owned by Borrower of any Foreign Subsidiary which shares entitle the holder thereof to vote for directors or any other matter, (b) any interest of Borrower as a lessee or sublessee under a real property lease or an Equipment lease if Borrower is prohibited by the terms of such lease from granting a security interest in such lease or under which such an assignment or Lien would cause a default to occur under such lease (but only to the extent that such prohibition is enforceable under all applicable laws including, without limitation, the Code); provided, however, that upon termination of such prohibition, such interest shall immediately become Collateral without any action by Borrower or Bank; (c) cash collateral accounts not held with Bank or Bank's Affiliates securing reimbursement obligations under letters of credit or (d) any Intellectual Property; provided, however, the Collateral shall include all Accounts and all proceeds of Intellectual Property. If a judicial authority (including a U.S. Bankruptcy Court) would hold that a security interest in the underlying Intellectual Property is necessary to have a security interest in such Accounts and such property that are proceeds of Intellectual Property, then the Collateral shall automatically, and effective as of the Effective Date, include the Intellectual Property to the extent necessary to permit perfection of Bank's security interest in such Accounts and such other property of Borrower that are proceeds of the Intellectual Property.

Pursuant to the terms of a certain negative pledge arrangement with Bank, Borrower has agreed not to encumber any of its Intellectual Property without Bank's prior written consent.

**Exhibit 23.1**

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

We hereby consent to the incorporation by reference in the Registration Statements on Form S-3 as amended (No. 333-230383), Form S-8 (Nos. 333-172206, 333-180363, 333-187204, 333-202325, 333-209904, 333-215555, 333-219667, 333-222561, 333-229214, 333-232441), and Form S-3/S-8 (No. 333-194084) of Fluidigm Corporation of our report dated February 27, 2020 relating to the financial statements and financial statement schedule, and the effectiveness of internal control over financial reporting, which appears in this Form 10-K.

/s/ PricewaterhouseCoopers LLP
San Jose, California
February 27, 2020

**Exhibit 31.1**

**CERTIFICATION OF THE PRESIDENT AND CHIEF EXECUTIVE OFFICER**
**PURSUANT TO SECURITIES EXCHANGE ACT RULES 13a-14(a) AND 15d-14(a),**
**AS ADOPTED PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002**

I, Stephen Christopher Linthwaite, certify that:

1. I have reviewed this annual report on Form 10-K of Fluidigm Corporation;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

   a. Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

   b. Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, 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;

   c. Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

   d. Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

   a. All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

   b. Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: February 27, 2020

By: /s/ Stephen Christopher Linthwaite
Stephen Christopher Linthwaite
President and Chief Executive Officer

**Exhibit 31.2**

**CERTIFICATION OF THE CHIEF FINANCIAL OFFICER**
**PURSUANT TO SECURITIES EXCHANGE ACT RULES 13a-14(a) AND 15d-14(a),**
**AS ADOPTED PURSUANT TO SECTION 302 OF THE SARBANES-OXLEY ACT OF 2002**

I, Vikram Jog, certify that:

1. I have reviewed this annual report on Form 10-K of Fluidigm Corporation;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

   a. Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

   b. Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, 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;

   c. Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

   d. Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

   a. All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

   b. Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: February 27, 2020

By: /s/ Vikram Jog
Vikram Jog
Chief Financial Officer

**Exhibit 32.1**

**CERTIFICATION OF CHIEF EXECUTIVE OFFICER**
**PURSUANT TO 18 U.S.C. SECTION 1350,**
**AS ADOPTED PURSUANT TO SECTION 906**
**OF THE SARBANES-OXLEY ACT OF 2002**

I, Stephen Christopher Linthwaite, the chief executive officer of Fluidigm Corporation (the “Company”), certify for the purposes of 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, to the best of my knowledge,

1. the Company’s Annual Report on Form 10-K for the fiscal year ended December 31, 2019 (the “Report”), fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended; and

2. the information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Company.

Date: February 27, 2020

By: /s/ Stephen Christopher Linthwaite
Stephen Christopher Linthwaite
President and Chief Executive Officer

**Exhibit 32.2**

**CERTIFICATION OF CHIEF FINANCIAL OFFICER
PURSUANT TO 18 U.S.C. SECTION 1350,
AS ADOPTED PURSUANT TO SECTION 906
OF THE SARBANES-OXLEY ACT OF 2002**

I, Vikram Jog, the chief financial officer of Fluidigm Corporation (the “Company”), certify for the purposes of 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, to the best of my knowledge,

1. the Company’s Annual Report on Form 10-K for the fiscal year ended December 31, 2019 (the “Report”), fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended; and

2. the information contained in the Report fairly presents, in all material respects, the financial condition and results of operations of the Company.

Date: February 27, 2020

By: /s/ Vikram Jog
Vikram Jog
Chief Financial Officer