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

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, 2020
or
☐ TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

Commission file number: 001-34180

FLUIDIGM CORPORATION

(Exact name of registrant as specified in its charter)

Delaware	**77-0513190**
State or other jurisdiction of incorporation or organization	I.R.S. Employer Identification No.

2 Tower Place, Suite 2000	**South San Francisco, CA**	**94080**
Address of principal executive offices		Zip Code

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

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

Title of each class	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

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 has filed a report on and attestation to its management's assessment of the effectiveness of its internal control over financial reporting under Section 404(b) of the Sarbanes-Oxley Act (15 U.S.C. 7262(b)) by the registered public accounting firm that prepared or issued its audit report. Yes ☒ No ☐

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, 2020, the aggregate market value of the voting and non-voting common equity held by non-affiliates of the registrant was approximately $282,343,691, 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, 2021, there were 74,546,957 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 May 2021, 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 2020
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.

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 improves life by driving meaningful insights in health and disease. Our innovative technologies explore the biological complexities of disease to advance human health through research, diagnostics and clinical applications. We create, manufacture, and market a range of products and services, including instruments, consumables, reagents and software that are used by researchers and clinical labs worldwide. Our customers are leading academic and government laboratories, as well as pharmaceutical, biotechnology, plant and animal research organizations, and clinical laboratories worldwide. Together with our customers, we strive to increase the quality of life for all.

Our mass cytometry Helios™ system deeply profiles cell phenotype and function. Referenced by more than one thousand peer-reviewed publications around the world, mass cytometry has set 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 (NGS) 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 for diagnostics and research applications.

Market Opportunity

We believe that we have large, multi-billion-dollar market opportunities for our products. We are a leader in the high-growth cytometry market for high parameter applications and high-plex imaging. Through our work with outside consultants and internal market analysis, we believe that the current potential market for mass cytometry high-parameter applications and addressable markets for spatial imaging is just under $1 billion, but expected to be approximately $3 billion by 2025, growing at a compound annual growth rate of approximately 27% over the next five years. We believe we will gain greater access to this market as use of our products expands beyond research to translational and clinical use.

For our microfluidics products, our work with outside consultants and market analysis reflect a large potential respiratory and COVID-19 molecular diagnostics market opportunity. We believe that our differentiated PCR microfluidics products are well-suited to serve the needs of the diagnostics market and our participation in COVID-19 testing provides an entry point for Fluidigm to build a long-term durable diagnostics business. 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 diagnostic and 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 reveal, understand, and address the biological complexities of disease.

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, highly multiplexed 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 highly 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.

- With the COVID-19 pandemic, key aspects of our microfluidic technologies make such technologies competitive in the global COVID-19 testing market. This has created a new market opportunity that has been incorporated in our 2021 strategy.

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

Our strategy is to provide expanded and enhanced applications, workflows and analytics to allow our customers better productivity, increasing the value of our mass cytometry and microfluidics product lines.

- In response to the need for testing to detect SARS-CoV-2, we developed our Advanta Dx SARS-CoV-2 RT-PCR Assay for use by authorized laboratories with Fluidigm microfluidics instruments. We received U.S. Food and Drug Administration (FDA) Emergency Use Authorization (EUA) for this assay in August 2020, and we also supported customer efforts to develop their own laboratory developed tests and respiratory panels using our microfluidics-based products.

- Our customers have been using our award winning sample-to-answer workflow for comprehensive human immune profiling, for use with our Helios system, has played an important role in immune profiling of COVID-19 patient samples. Our spatial imaging mass cytometry capabilities are also used for immune profiling of lung tissue samples that may inform research and development of new treatment approaches for COVID-19. This workflow and our products are already being used by our customers in ongoing research for cancer, chronic inflammatory conditions, autoimmune and infectious diseases with inclusion in over 1,380 publications and use in 127 clinical trials as of December 31, 2020.

- We have collaborated with industry partners to enable workflows and software for both the Helios and Hyperion systems. In 2020, we also launched our Therapeutic Insights Services and opened a Japan service lab, expanding accessibility of sample-to-answer mass cytometry and Imaging Mass Cytometry services for a broad range of translational and clinical research needs.

- We have leveraged both in-house development as well as externally partnered solutions to drive new applications and sample-to-answer functionality across all our platforms. In 2020, we developed and collaborated with strategic partners to build our applications, software and assays on our microfluidic platforms for diagnostics, as well as gene expression, genotyping and sequencing library preparations.

In 2020:

- We executed a definitive contract with the National Institutes of Health (NIH) for a project under the NIH Rapid Acceleration of Diagnostics (RADx) program. The project encompasses expanding our production capacity and throughput capabilities for COVID-19 tests, with funding of up to $34.0 million upon achievement of certain milestones.

- We expanded an existing collaboration with Icahn School of Medicine at Mount Sinai to include COVID-19-related diagnostics and research work. This study is being funded by the U.S. Department of Defense.

- We entered into an original equipment manufacturer (OEM) development agreement with a customer to develop products based on our microfluidics technology with payments of up to $11.7 million during the development stage, with some of these payments recognized in 2020.

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 (>50) 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 38 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
Flow Conductor	Flow Conductor is an integrated sample preparation system for flow or mass cytometry assays.	Mass Cytometry
Assays and Reagents:		
Maxpar® Reagents	Maxpar® reagents are included in multiple product lines addressing needs in functional and phenotypic profiling of single cells, as well as nucleic acid detection. The product lines include more than 800 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 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 identification and characterization of 37 immune cell populations with automated software. The kit contains 30 pre-titrated antibodies provided in a dry single-tube format and is also compatible with additional expansion panels focusing on specific cell populations.	Mass Cytometry
Maxpar IMC Panel Kits for Immuno-oncology	Contains a mix of non-overlapping metal-conjugated antibodies to deeply profile tumor-infiltrating lymphocytes, immune 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:		
CyTOF Software v7.0	Streamlines the selection and acquisition of multiple Regions of Interest (ROI) from each slide.	Mass Cytometry

Product	Product Description	Applications
Microfluidics		
Preparatory Instruments:		
Juno System	An integrated system that automates the preparation of RNA-seq and amplicon-based libraries for next-generation sequencing (NGS). Additionally, Juno automates microfluidic-based PCR workflows by processing IFCs prior to analysis on Biomark HD or EP1 platforms.	Library preparation for RNA-seq and targeted NGS. PCR applications include sequence detection, sample identification, genotyping, gene expression, and real-time digital PCR
Analytical Instruments:		
Biomark HD System	Real-time PCR analytical instrument for microfluidics-based workflows using Fluidigm IFCs.	Sequence detection, sample identification, genotyping, gene expression, and real-time digital PCR Expression
EP1 System	End-point PCR analytical instrument for microfluidics-based workflows using Fluidigm IFCs.	Genotyping, sample identification, and digital PCR
Integrated Fluidic Circuits (IFCs):		
Library Preparation (LP) IFCs	LP and 48.Atlas IFCs for NGS LP supporting RNA-Seq and targeted amplicon-based sequencing.	Library preparation for RNA-seq and targeted NGS
Juno Genotyping IFC	IFC that incorporates preamplification for genotyping of 96 samples and 96 markers in 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 and end-point PCR; Sequence detection, sample identification, genotyping, gene expression, and real-time digital PCR
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.	Real-time and end-point 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:		
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 IFCs, supports simultaneous processing of up to 48 total RNA samples.	RNA-seq library preparation for NGS

Product	Product Description	Applications
Advanta™ Dx SARS-CoV-2 RT-PCR Assay	qPCR-based test that takes advantage of Fluidigm proprietary microfluidics technology and the Juno™ and Biomark™ HD systems.	Enables reliable, high-capacity testing of saliva samples from patients suspected by their health care providers of COVID-19 (coronavirus) infection to support diagnostic decision making
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 NGS
Targeted DNA Seq Library Assays	Custom designed assays for NGS library preparation using Targeted DNA Sequencing Library Preparation chemistry on the Juno systems.	Library preparation for targeted NGS
Single Cell Microfluidics		
Preparatory Instrument:		
C1 System	Sample preparation system that rapidly and reliably isolates and processes individual cells for genomic analysis.	Single-Cell NGS library preparation for RNA sequencing including full-length, end-counting, and total RNA applications; single-cell targeted gene expression by real-time PCR including microRNA analysis; single-cell epigenetics and multi-omic applications including ATAC-seq and REAP-Seq (RNA and Protein); single-cell NGS library preparation for DNA sequencing including targeted, whole exome and whole genome applications
Preparatory Analytical Instruments:		
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 NGS library preparation for RNA sequencing including full-length, end-counting, and total RNA applications; single-cell targeted gene expression by real-time PCR including microRNA analysis; single-cell epigenetics and multi-omic applications including ATAC-seq and REAP-Seq (RNA and Protein); single-cell NGS library preparation for DNA sequencing including targeted, whole exome and whole genome applications

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, 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 38 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. Lastly, our Flow Conductor sample preparation system provides sample preparation capabilities for both flow and mass cytometry assays. The Flow Conductor system can process up to 100 antibodies at a time and simultaneously stain and prepare up to 18 specimens.

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 also offer 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, FCS Express7 Flow, and Maxpar Pathsetter data analysis packages for use with the Helios system. For our Imaging Mass Cytometry platform, Hyperion, we offer various state of the art software packages to enable data analysis from basic to translational research: CyTOF Software 7.0, MCD Viewer, histoCAT, Visiopharm Phenomap and Indica Lab Halo. 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 over 800 metal-conjugated antibodies for use with our mass cytometry and Imaging 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.

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 NGS:

- 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.

- NGS 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 (in the case of DNA sequencing) or gene transcript or sample transcriptome (in the case of RNA sequencing). NGS is routinely used for studies across the research continuum including basic research, biomarker discovery, translational research, and clinical research.

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 single cell 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, as well as providing superior data quality. 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

With the exception of our Advanta™ Dx SARS-CoV-2 RT-PCR Assay (Rx Only), which is for In Vitro Diagnostic use under Emergency Use Authorization (EUA) and CE-IVD, being performed on our instruments, 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 2020, 2019, or 2018.

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.

Manufacturing

Our manufacturing operations are primarily located in Singapore and Canada. Our facility in Singapore manufactures our IFCs and manages production of our microfluidics 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 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 Cytometry instrument in 2016, and successfully launched the commercial Hyperion Imaging System in October 2017. The Hyperion Imaging 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 38 proteins. We also developed metal-labeled antibodies compatible with formalin fixed paraffin embedded tissue samples, to be used with the Hyperion Imaging System. We also invest significantly in research and development efforts to expand our microfluidics 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 2020, we expanded our microfluidics franchise to develop products for the COVID-19 testing marketplace. We launched the AdvantaDx SARS-CoV-2 RT-PCR assay. In addition, we secured significant development partnerships, including for development of OEM systems using our microfluidics technology.

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 CyTOF Software v7.0, an updated CyTOF software application.

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 $36.5 million, $31.6 million and $30.0 million in 2020, 2019, and 2018 respectively.

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 e-commerce 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, 2020, we owned or licensed more than 440 patents and we had approximately 140 pending patent applications worldwide. Our patents have expiration dates ranging up to 2037.

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 now 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 now and 2027.

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. In November 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.

InstruNor AS. In January 2020, we completed the acquisition of InstruNor AS (InstruNor) for $7.2 million, including $5.2 million in cash and $2.0 million in stock. InstruNor provides automated sample preparation solutions for mass cytometry and flow cytometry instrument markets and is now part of Fluidigm's mass cytometry business. Included in this acquisition were certain intellectual property portfolio assets comprising patents and/or patent applications directed to various aspects of automated cell pretreatment instruments. The putative patent expiration dates for this patent portfolio begin in March 2033.

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

Under section 564 of the Federal Food, Drug, and Cosmetic Act (FD&C Act), the FDA has authority to allow certain unapproved medical products or unapproved uses of approved medical products to be used during a public health emergency. In issuing an EUA, the FDA will consider the totality of scientific evidence available to the FDA regarding safety, efficacy and known and potential risks of such products and availability of alternatives to the emergency use products, among others. EUAs issued by the FDA will specify the scope of authorization and conditions of authorization, including limitations on distribution and conditions related to product advertising and promotion. Once granted, an EUA is effective until the declaration that circumstances exist justifying the authorization of the emergency use is terminated under Section 564(b)(2) of the FD&C Act or the EUA is revoked under Section 564(g) of the FD&C Act, after which the product must be cleared or approved by the FDA under a traditional pathway in order to remain on the market or to continue commercialization of the product.

In August 2020, the FDA granted an EUA for our Advanta Dx SARS-CoV-2 RT-PCR Assay for qualitative detection of nucleic acid from SARS-CoV-2 in saliva specimens from individuals suspected by their healthcare providers of having COVID-19. As set forth in the EUA, we are required to comply with the conditions of authorization, including certain requirements pertaining to FDA notification, distribution, printed materials, advertising and promotion. If we, our distributors, or authorized laboratories do not comply with the EUA requirements, our business, financial condition and results of operations may be adversely impacted, and we may be subject to regulatory or enforcement actions, including the issuance of an untitled letter, a warning letter, penalties, or fines, among other adverse actions.

If the FDA's policies and guidance change unexpectedly and/or materially or if we misinterpret them, potential sales of our Advanta Dx SARS-CoV-2 RT-PCR Assay could be adversely impacted. In addition, the FDA will revoke an EUA where it is determined that the underlying public health emergency no longer exists or warrants such authorization, or if new evidence becomes available that indicates the test does not meet the conditions of authorization or perform as provided in the EUA application. We cannot predict how long this EUA will remain effective. The termination or revocation of the EUA and changing policies and regulatory requirements could adversely impact our business, financial condition and results of operations. Given the uncertain nature of the COVID-19 pandemic and future legislation and regulation in this space, we can provide no assurance with respect to our ability to achieve or sustain profitability on a quarterly or annual basis.

Except for the Advanta Dx SARS-CoV-2 RT-PCR Assay authorized by the FDA under the EUA granted in August 2020, all of our other 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 pre- and post-market controls for medical devices by the FDA. The FDA regulations require that research use only products be labeled, "For Research Use Only. Not for use in diagnostic procedures," or RUO products.

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 pre-market and post-market control as medical devices, unless an exemption applies, we would be required to obtain either prior 510(k) clearance or prior pre-market approval (PMA) 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 FD&C Act. 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 pre-market 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 $66.2 million, or 48% of our total revenue, in 2020, compared to $73.9 million, or 63% of our total revenue, in 2019, and $64.8 million, or 57% of our total revenue, in 2018. The majority of our long-lived assets are located within the United States, in Singapore and in Canada. Please see Note 6 and Note 16 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.

Human Resource Capital

Our team members share our commitment to improving the human condition and, in turn, Fluidigm strives to create an environment where our people can do their best work. We know that our employees, who supply the ideas, energy, and innovation that powers our business, are our most valued assets.

We are a values-driven organization. We believe strong shared values are essential for Fluidigm to evolve and grow and to be successful for the long-term. Our values inform our relationships with customers, suppliers, investors and each other. They ensure that we model respect and inclusiveness in our words and actions. Our core values, conceived and developed by our employees, define us when we are at our best and guide us in all that we do. Our core values are to:

- Create what customers need next
- Drive to make a difference
- Collaborate and learn
- Step up

A Growing Global Workforce

As of December 31, 2020, Fluidigm had 627 employees worldwide, 44% of whom were female. In the United States, 35% of our employees were female as of December 31, 2020. None of our employees are represented by a labor union nor are they subject to a collective bargaining agreement.

The table below provides an overview of our employees by function, geographic location, and gender as of December 31, 2020:

	United States	Canada	Singapore	Other	Total	Male	Female	Total
Manufacturing	16	79	88	—	183	87	96	183
Research and Development	41	65	16	1	123	81	42	123
Sales and Marketing	93	29	7	85	214	129	85	214
General and Administration	59	17	27	4	107	51	56	107
Total	209	190	138	90	627	348	279	627

Employee Safety and COVID-19

Employee safety has always been paramount at Fluidigm, a commitment very much in evidence as we continue to navigate the challenges of the COVID-19 pandemic. At the outset of the crisis, we tasked a global, interdisciplinary team of leaders in environmental health and safety, human resources, facilities and information technology to develop guidelines and processes for new health and well-being protocols. Also developed were new practices for cross-functional, remote teamwork, operating disciplines and training programs.

To keep our employees safe, we provide to those who can work remotely the tools and resources to do so. Our pivot to remote work has been successful, with employees taking advantage of our technology resources. Essential work continues not only at our facilities and labs, but also every day in home offices, living rooms, kitchens and spare rooms, made possible by our IT systems and the collective commitment of our people. Many of our employees have worked on-site in labs and other facilities throughout the pandemic, and we have adopted a range of protocols and practices to keep them safe.

We have empowered each Fluidigm business location to adopt health and safety recommendations that address local requirements, and we have made site-specific COVID-19 prevention plans readily available for all our employees. In addition, we provide team members practical recommendations based on guidelines from the Centers for Disease Control and Prevention, the World Health Organization, the U.S. Department of Health and Human Services, the Occupational Safety and Health Administration, and other regional government entities. We are committed to updating these recommendations and communicating new pertinent information when available.

Each Fluidigm site will determine how and when more people return, based on site-specific factors related to health and safety, the needs of the business and each individual's ability to work remotely versus needing to be onsite. We are prepared to be flexible as new information becomes available or as conditions change. As we consider a return to the workplace for more people, safety is our priority.

Compensation and Benefits

The primary goal of our compensation program is to ensure that we attract, hire, and retain talented and highly skilled team members who are motivated to achieve or exceed our corporate goals.

We offer competitive total reward packages comprising various elements including market-driven base pay, short- and long-term incentives in the form of performance-based cash and equity, as well as comprehensive health and welfare benefits that include medical, dental, vision, group life, disability, and accidental death and dismemberment insurance, as well as our 401(k) or comparable non-U.S. retirement plans, subject to applicable law. We also provide vacation and other paid holidays to all employees at levels that we believe are comparable to those provided at peer companies.

Our intention is to align our compensation practices with the changing marketplace, working to exceed our peer competitors. By doing so, we strive to provide incentives to our team members to achieve short- and long-term business goals, ensuring they feel rewarded for their performance and contributions.

Professional Development

In addition to providing attractive and competitive total rewards packages, Fluidigm believes in fostering individual and organizational effectiveness by offering our team members a variety of professional development programs. These programs are designed to:

- inform, educate, and inspire our people to reach their professional goals;
- provide professional growth opportunities in different, easily accessible ways to accommodate diverse learning styles, including via classroom/live instructor-led trainings, online/e-learning modules, webinar/virtual trainings, blended learning, and professional coaching;
- provide individuals and the organization with the knowledge and skills to respond effectively to customer needs as well as current and future business demands; and
- provide ongoing support to the organization's development efforts.

Our culture is one that actively supports participation in learning activities and the application of new knowledge and skills on the job. As such, we strive to create a work environment that both challenges and supports all our team members to do their best work.

Diversity and Inclusion

At Fluidigm, our commitment to diversity, inclusion and equity is woven into our values and the belief that our global company is strongest when we embrace the full spectrum of humanity, regardless of what we look like, where we come from, or who we love. As an equal opportunity workplace and affirmative action employer, our ongoing commitment is to recruit and reward team members based on capability and performance—regardless of race, color, gender, sexual orientation, gender identity or expression, lifestyle, genetic information, marital status, pregnancy, educational background, national origin, religion, veteran status, physical ability, or any legally protected status. As Fluidigm evolves, we will continue to work together on building an inclusive and diverse culture that empowers all of us to connect, belong, and grow.

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 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 file electronically 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 Annual Report on 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, global sociopolitical 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 these risks occur, our business, results of operations, or financial condition could suffer, the trading price of our securities could decline, and you may lose all or part of your investment.

Summary of Risk Factors

Risks Related to our Business, Industry, and Strategy

- The COVID-19 pandemic has significantly affected our business operations.
- Our financial results and revenue growth rates have varied significantly from quarter-to-quarter and year-to-year, and may not be consistent with market expectations.
- We have incurred losses since inception, and we may continue to incur substantial losses for the foreseeable future.
- The life science markets are highly competitive and subject to rapid technological change.
- 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.
- Market opportunities may not develop as quickly as we expect, limiting our ability to successfully sell our products.
- Our future success is dependent upon our ability to expand our customer base and introduce new applications.
- If our products fail to achieve and sustain sufficient market acceptance, our revenue will be adversely affected.
- We may not be able to develop new products or enhance the capabilities of our existing systems.
- Our business growth strategy involves the potential for significant acquisitions.
- Our efficiency and cost-savings initiatives could be disruptive to our operations.
- Implementation of a company-wide enterprise resource planning (ERP) system could adversely affect our business.

Risks Related to Operations and Reliance on Third Parties

- We may experience development or manufacturing problems or delays.
- Our business depends on research and development spending levels of our customers.
- 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.
- Disruption of our manufacturing facilities or other operations, or in the operations of our customers or business partners, could result in cancellation of orders, delays in deliveries or other business activities, or loss of customers.
- Any disruption or delay in the shipping or off-loading of our products 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.
- Our business operations depend upon the continuing efforts of our management team and other key employees.
- Security breaches, loss of data, cyberattacks, and other IT failures could adversely affect our business.
- To use our analytical systems, customers typically need to purchase specialized reagents.
- Our distribution capabilities and direct sales, field support, and marketing forces must be sufficient to meet our customers' needs.

Risks Related to Quality and the Regulatory Environment

- Our products could have defects or errors.
- Although the FDA granted Emergency Use Authorization (EUA) for our Advanta Dx SARS-CoV-2 RT-PCR Assay in August 2020, this authorization is only valid during the COVID-19 public health emergency.
- Our contract with the National Institutes of Health (NIH) could expose us to risks and costs.

- To the extent we elect to label and promote any of our non-EUA products as medical devices, we would be required to obtain prior approval or clearance by the FDA or comparable foreign regulatory authority.
- Our products could become subject to regulation as medical devices by the FDA or other regulatory agencies.
- Compliance or the failure to comply with current and future regulations affecting our products and business operations worldwide could cause us significant expense and adversely impact our business.

Risks Related to Economic Conditions and Operating a Global Business

- We generate a substantial portion of our revenue internationally.
- Adverse conditions in the global economy may significantly harm our revenue, profitability, and results of operations.
- We are subject to fluctuations in the exchange rate of the U.S. dollar and foreign currencies.

Financial, Tax, and Accounting Risks

- Our future capital needs are uncertain and we may need to raise additional funds in the future.
- Any failure to maintain effective internal control over financial reporting could adversely affect our business.
- We may not realize the value of our goodwill or other intangible assets.
- 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.
- We are subject to risks related to taxation in multiple jurisdictions.
- Changes in accounting principles, or interpretations thereof, could impact our financial position and results of operations.
- We have a significant amount of outstanding indebtedness.

Risks Related to Intellectual Property

- Our ability to protect our intellectual property and proprietary technology is uncertain.
- We may be involved in lawsuits to protect or enforce our patents and proprietary rights.
- We may be subject to damages resulting from claims that we or our employees have wrongfully used or disclosed alleged trade secrets.
- We depend on certain technologies that are licensed to us.
- 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 obligations and restrictions relating to technologies developed in cooperation with Canadian government agencies.

Risks Related to Our Common Stock

- Our stock price is volatile.
- Future sales of our common stock in the public market could cause our stock price to fall.
- We will have broad discretion over the use of the proceeds to us from our ATM equity offering program.
- If securities or industry analysts publish unfavorable research about us or cease to cover our business, our stock price and/or trading volume could decline.
- Anti-takeover provisions in our charter documents and under Delaware law could make an acquisition of us more difficult.
- Any conversions of our 2014 Notes or 2019 Notes will dilute the ownership interest of our existing stockholders.

RISKS RELATED TO OUR BUSINESS, INDUSTRY, AND STRATEGY

The global COVID-19 pandemic has significantly affected our business operations and could adversely impact our financial position and cash flows to an extent that is unknown and difficult to predict.

The pandemic and international public health emergency caused by SARS-CoV-2, the novel strain of coronavirus that causes the disease commonly known as COVID-19, has spread throughout all the countries in which we and our customers, suppliers, and other business partners operate, causing significant disruption and volatility in global financial markets and raising the prospect of an extended global recession. Public health problems resulting from COVID-19 and precautionary measures instituted by governments and businesses to mitigate its spread, including travel restrictions and quarantines, could continue to contribute to a general slowdown in the global economy, cause increasingly adverse impacts on our customers, suppliers, and other business partners, and further disrupt our operations. Changes in our operations as a result of the COVID-19 pandemic have resulted in inefficiencies and delays, including in sales and product development efforts, and additional costs related to business continuity initiatives that cannot be fully mitigated through succession planning, employees working remotely, or teleconferencing technologies.

The COVID-19 pandemic and related governmental reactions have had, and may continue to have, a negative impact on our business, liquidity, results of operations, and stock price due to the occurrence of some or all of the following events or circumstances among others:

- reduced demand for some of our products and services due to the impact of COVID-19 on our customers, including in the global academic research community;
- diminished business productivity due to inefficiencies in employees working from home or increasing physical distancing and other pandemic response protocols in our production facilities;
- increased susceptibility to the risk of information technology security breaches and other disruptions due to increased volumes of remote access to our information systems from our employees working at home;
- the negative impact of travel restrictions and social distancing policies on our sales operations, marketing efforts, and customer field support;
- impaired ability to hire and effectively train new personnel due to travel restrictions and physical distancing protocols;
- increased operating costs if one of our facilities were to experience a COVID-19 outbreak;
- disruption of the operations of our contract manufacturers, suppliers, and other business partners; and
- increased volatility in our stock price due to financial market instability.

The extent to which the COVID-19 pandemic will continue to adversely impact our business and financial results will depend on future developments, which are highly uncertain and cannot be predicted with confidence, such as the continued spread of the disease, the duration of the public health emergency, and actions taken in the United States and elsewhere to contain the virus and prevent new outbreaks, such as social distancing and quarantines, business closures or business disruptions.

Because the severity, magnitude, and duration of the COVID-19 pandemic and its economic consequences are uncertain and rapidly changing, we are unable to predict the impact of COVID-19 on our operations, our financial performance, and our ability to successfully execute our business strategies and initiatives. The ultimate impact of the COVID-19 pandemic on our operations and financial performance depends on many factors that are not within our control, including, but not limited, to: governmental, business, and individual actions that have been and continue to be taken in response to the pandemic (including restrictions on travel, transport and workforce pressures); the impact of the pandemic and actions taken in response on global and regional economies, travel, and economic activity; the availability of federal, state, local or non-U.S. funding programs; general economic uncertainty in key global markets and financial market volatility; global economic conditions and levels of economic growth; and the pace of recovery when the COVID-19 pandemic subsides.

As the COVID-19 crisis continues to adversely affect our operating and financial results, it may also have the effect of heightening many of the other risks described in our other risk factors below. COVID-19 may also affect our operating and financial results in a manner that is not presently known to us or that we currently do not expect to present significant risks to our operations or financial results, particularly if the pandemic and its associated impacts reoccur in the coming months.

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 from market expectations, 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. Our revenue increased year-over-year in 2019 compared to 2018, and again in 2020 compared to 2019, but we may not be able to achieve similar revenue growth in future periods. Variability in our quarterly or annual results of operations, mix of product revenue, including any decline in our revenue related to the COVID-19 pandemic, 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 $53.0 million, $64.8 million and $59.0 million during the years 2020, 2019, and 2018, respectively. As of December 31, 2020, we had an accumulated deficit of $676.8 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 (NGS), 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 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 for our mass cytometry market share, and that IonPath Inc., Akoya Biosciences, Inc., NanoString, and 10x Genomics, Inc. are our principal competitors for our Imaging Mass Cytometry™ market share. 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.

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.

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.

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.

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 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 NGS 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 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;
- the possibility that we may not realize the value of acquired assets recorded as goodwill or intangible assets, and would be required to incur material charges relating to the impairment of those assets; 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.

Our efficiency and cost-savings initiatives could be disruptive to our operations and adversely affect our results of operations and financial condition.

From time to time, we have implemented efficiency and cost-savings initiatives intended to stabilize our business operations. These efficiency initiatives have included targeted workforce reductions, optimizing our facilities, and reducing excess space. In 2020, in response to the uncertainty arising from the COVID-19 pandemic, we initiated a range of additional actions aimed at temporarily reducing our operating expenses and preserving liquidity. These actions included implementing temporary enterprise-wide salary reductions of 20% for employees at or above the 'director' level and 10% for all others, temporarily reducing our board members' cash retainers by 20%, and constraining hiring. Although we have discontinued our hiring constraints and pandemic-related pay reductions, actions such as these may be required in the future to preserve liquidity and 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 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.

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.

RISKS RELATED TO OPERATIONS AND RELIANCE ON THIRD PARTIES

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 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.

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 and practices of these customers—which have been impacted by the COVID-19 pandemic and may additionally be impacted by other factors—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 our customers. For example, reductions in operating expenditures by global academic research facilities

because of the COVID-19 pandemic have resulted in lower than expected sales of our mass cytometry instruments. Similar reductions and delays in customer spending may result from other factors that are not within our control, such as:

- changes in economic conditions;
- natural disasters or public health crises;
- 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 microfluidics 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, public health crises, 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, public health crises (including the ongoing COVID-19 pandemic), 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.

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, complications related to public health crises (including the ongoing COVID-19 pandemic),

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 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. For example, as part of our cost reduction program to manage the impact of the COVID-19 pandemic, we implemented temporary enterprise-wide salary reductions and delayed implementation of 2020 merit-based salary increases. Although all salaries have been restored as of the date of this filing, any reinstatement of salary reductions or any other failure to maintain competitive levels of compensation may negatively impact our ability to retain the personnel necessary to achieve our goals. 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.

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

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

We have implemented security controls to protect our information technology infrastructure but, despite our efforts, we are not fully insulated from technology disruptions that could adversely impact us. For example, in early 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 were 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. We believe our mitigation measures have reduced, but cannot eliminate, the risk of a similar attack, and 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.

Due to the COVID-19 pandemic, we have an increased number of employees working remotely. As a result, we may have increased cyber security and data security risks, due to increased use of home wi-fi networks and virtual private networks, as well as increased disbursement of physical machines. While we have implemented security controls to reduce the risk of cyberattacks and security breaches, there is no guarantee that these measures will be adequate to safeguard all systems with the increased number of employees working remotely.

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 are unable to expand our direct sales, field support, and marketing forces 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 increase the scope of our marketing efforts and develop and substantially expand our direct sales force and field application specialist and service engineer teams. 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. We have experienced significant changes in our sales organization. In addition, as part of our cost reduction program to manage the impact of the COVID-19 pandemic, we implemented temporary enterprise-wide salary reductions, including with respect to our sales and marketing employees. Although all salaries have been restored to prior levels as of the date of this filing, any reinstatement of salary reductions or any other failure to maintain competitive levels of compensation may negatively impact our ability to maintain the skilled sales and marketing force necessary to support our business activities. As a result, our future success will depend largely on our ability to retain and motivate such personnel. Because competition for such employees is intense, we can provide no assurance that we will be able to retain them on favorable or commercially reasonable terms, if at all. Failure to attract and retain our current personnel or to build an efficient and effective sales and marketing force 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.

RISKS RELATED TO QUALITY AND THE REGULATORY ENVIRONMENT

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 NGS 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.

Although the FDA granted Emergency Use Authorization (EUA) for our Advanta Dx SARS-CoV-2 RT-PCR Assay in August 2020, this authorization is only valid during the COVID-19 public health emergency, and when the federally declared public health emergency ends, we will be required to stop commercial distribution of our assay immediately in the United States unless we can obtain FDA clearance or approval for our assay under a traditional regulatory pathway for in vitro diagnostics, which is lengthy and expensive.

Under section 564 of the Federal Food, Drug, and Cosmetic Act (FD&C Act), the FDA has authority to allow certain unapproved medical products or unapproved uses of approved medical products to be used during a public health emergency under an EUA. In issuing an EUA, the FDA will consider the totality of scientific evidence available to the FDA regarding safety, efficacy and known and potential risks of such products and availability of alternatives to the emergency use products, among others. EUAs issued by the FDA will specify the scope of authorization and conditions of authorization, including limitations on distribution and conditions related to product advertising and promotion. Once granted, an EUA is effective until the declaration that circumstances exist justifying the authorization of the emergency use is terminated under Section 564(b)(2) of the FD&C Act or the EUA is revoked under Section 564(g) of the FD&C Act, after which the product must be cleared or approved by the FDA under a traditional pathway and we must comply with the quality system regulation at 21 CFR 820 in order to remain on the market or to continue commercialization of the product.

In August 2020, the FDA granted EUA for our Advanta Dx SARS-CoV-2 RT-PCR Assay for qualitative detection of nucleic acid from SARS-CoV-2 in saliva specimens from individuals suspected by their healthcare providers of having COVID-19, with the use of the assay limited to authorized laboratories. Three supplements have been submitted and authorized as follows: S001 for addition of the FDA reference Panel Results, S002 for software updates and labeling changes, S003 for addition of alternative source of targets and labeling updates. As set forth in the EUA, we are required to comply with the conditions of authorization, including certain requirements pertaining to FDA notification, distribution, printed materials, advertising and promotion. If we, our distributors, or authorized laboratories do not comply with the EUA requirements, our business, financial condition and results of operations may be adversely impacted, and we may be subject to regulatory or enforcement actions, including the issuance of an untitled letter, a warning letter, penalties, or fines, among other adverse actions.

If the FDA's policies and guidance change unexpectedly and/or materially or if we misinterpret them, potential sales of Advanta Dx SARS-CoV-2 RT-PCR could be adversely impacted. In addition, the FDA will revoke an EUA where it is determined that the underlying public health emergency no longer exists or warrants such authorization, or if new evidence becomes available that indicates the test does not meet the conditions of authorization or perform as provided in the EUA application. We cannot predict how long this EUA will remain effective. The termination or revocation of the EUA and changing policies and regulatory requirements could adversely impact our business, financial condition and results of operations. The demand for our product and our profitability may decline or be adversely impacted by the federal government's implementation of a national COVID-19 testing strategy. Given the uncertain nature of the COVID-19 pandemic and future

legislation and regulation in this space, we can provide no assurance with respect to our ability to achieve or sustain profitability on a quarterly or annual basis.

Our contract with the National Institutes of Health (NIH) could expose us to unique risks and costs as an entity contracting with the federal government.

The NIH launched the Rapid Acceleration of Diagnostics (RADx) program to expedite development, commercialization, and implementation of technologies for COVID-19 testing to help increase testing in the United States. In July 2020, we entered into a letter contract with the NIH for a project under the RADx program. The letter contract provided access to approximately $12.2 million of the total proposed funding for the project prior to execution of a further definitive contract for the project. In September 2020, we executed a definitive contract with the NIH as an amendment to the letter contract (collectively, the NIH Contract) to expand production capacity and throughput capabilities for COVID-19 testing with our microfluidics technology. Pursuant to the terms of the NIH Contract, the funding for the project was increased by approximately $22.0 million, for a total contract value of up to approximately $34.0 million. Release of funding under the NIH Contract is based on the achievement of milestones, including expansion of our manufacturing facilities, addition of production lines, and achieving full production capacity.

There is significant competition among RADx projects, which are evaluated by experts on a rolling basis. Projects with the most potential for success are advanced to the next stage. There is no certainty that we can meet all the milestones in our NIH Contract on a timely basis, if at all. If we do not meet all the milestones, we will not be able to access all $34.0 million in funding under the NIH Contract. We cannot guarantee that we will be able to access all the available funding under the NIH Contract in a timely manner, or at all. We must prioritize among many different opportunities, and we may expend our limited resources on programs that do not yield a successful or profitable product candidate and may forego other more profitable opportunities. Further, the Bayh-Dole Act applies to all NIH research and development funding granted to for-profit organizations, which requires the government to be provided a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States any subject invention throughout the world.

Factors that could materially adversely affect our funding under the NIH Contract include:

- budgetary constraints affecting U.S. government spending generally, or NIH in particular;
- changes in U.S. government or NIH fiscal policies or available funding, including due to changes in Congressional appropriations;
- changes in U.S. government or NIH programs, requirements or priorities;
- adoption of new laws or regulations;
- technological developments;
- U.S. government shutdowns, threatened shutdowns or budget delays;
- competition and consolidation in our industry; and
- general economic conditions.

These or other factors could cause NIH to reduce its funding or future activities under the NIH Contract, or to exercise its right to terminate the NIH Contract for convenience, either of which could have a material adverse effect on the revenue generated by the NIH Contract.

The NIH Contract includes certain provisions from the Federal Acquisition Regulations, some of which are customary or legally required, that give the U.S. government substantial rights and remedies, many of which are not typically found in commercial contracts. For example, the NIH Contract contains provisions permitting unilateral termination or modification, in whole or in part, at the convenience of the U.S. government. Under general principles of government contracting law, if the U.S. government terminates a contract for convenience, the government contractor may recover only its incurred or committed costs, settlement expenses and profit on work completed prior to the termination. If the U.S. government terminates a contract for default, the government contractor is entitled to recover costs incurred and associated profits on accepted items only and may be liable for excess costs incurred by the government in procuring undelivered items from another source. In addition, government contracts normally contain additional requirements that may increase our costs of doing business, reduce our profits, and expose us to liability for failure to comply with these terms and conditions. These requirements include, for example, mandatory internal control systems and policies, mandatory socioeconomic compliance requirements, including labor standards, non-discrimination and affirmative action programs and environmental compliance requirements and public disclosures of certain contract information, which may enable competitors to gain insights into our research program. If we fail to maintain compliance with these requirements, we may be subject to potential contract or False Claims Act liability and to termination of our NIH Contract.

Other examples of rights and remedies under the NIH Contract include provisions that allow NIH to:

- terminate the NIH Contract, in whole or in part, for any reason or no reason;
- unilaterally reduce or modify the U.S. government's obligations under the NIH Contract, without our consent, including by imposing price adjustments;
- claim rights, including intellectual property rights, in or to (i) products, (ii) data, and (iii) facilities, in each case developed under the NIH Contract;
- under certain circumstances involving public health and safety, license inventions made under such agreements to third parties;
- suspend us from receiving new contracts pending resolution of alleged violations of procurement laws or regulations;
- impose U.S. manufacturing requirements for products that embody inventions conceived or first reduced to practice under the NIH Contract;
- suspend or debar us from doing future business with the government;
- change the course of a development program in a manner that differs from the NIH Contract's original terms or from our desired development plan, including decisions regarding our partners in the program;
- pursue civil or criminal remedies under the False Claims Act and False Statements Act; and
- control or prohibit the export of products.

Furthermore, we may be required to enter into agreements and subcontracts with third parties, including suppliers, consultants and other third-party contractors in order to satisfy our contractual obligations pursuant to our agreements with the U.S. government. Negotiating and entering into such arrangements can be time-consuming and we may not be able to reach agreement with such third parties. Any such agreement must also be compliant with the terms of the NIH Contract. Any delay or inability to enter into such arrangements or entering into such arrangements in a manner that is non-compliant with the terms of our contract, may result in violations of our contract.

U.S. government agencies routinely audit and investigate government contractors and recipients of federal grants and contracts. These agencies review a contractor's performance under its contracts, cost structure and compliance with applicable laws, regulations and standards. The audit may also include review of the adequacy of, and a contractor's compliance with, its internal control systems and policies, including the contractor's accounting, purchasing, property, estimating, compensation and management information systems. If an audit uncovers improper or illegal activities, we may be subject to civil and criminal penalties and administrative sanctions. In addition, we could suffer serious reputational harm if allegations of impropriety were made against us, which could cause our stock price to decrease.

To the extent we elect to label and promote any of our non-EUA products as medical devices, we would be required to obtain prior approval or clearance by the FDA or comparable foreign regulatory authority, which could take significant time and expense and could fail to result in a marketing authorization for the intended uses we believe are commercially attractive. Obtaining marketing authorization in one jurisdiction does not mean that we will be successful in obtaining marketing authorization in other jurisdictions where we conduct business.

Except for the Advanta Dx SARS-CoV-2 Assay authorized by the FDA under an EUA granted in August 2020, our other 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 "research use only" (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 are currently registered with the FDA as a medical device manufacturer, with the reagents for the Advanta Dx SARS-CoV-2 Assay listed as our sole medical device product. As noted in the issued EUA for the Advanta Dx SARS-CoV-2 Assay, the FDA has waived certain quality system requirements under 21 CFR Part 820 for the duration of the EUA. We may in the future list some of our other products with the FDA pursuant to an FDA Class I listing for general purpose laboratory equipment if we pursue clinical applications for such equipment. While this regulatory classification is generally 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. If we do not comply with all the requirements of the EUA or the normal

regulatory requirements for any of our medical device products, including additional regulatory requirements that would apply to the Advanta Dx SARS-CoV-2 Assay after the expiration or termination of the EUA, we may be subject to regulatory or enforcement actions, including the issuance of an untitled letter, a warning letter, penalties, or fines, among other adverse actions, any of which may adversely impact our business, financial condition and results of operations. Compliance with additional or changing regulatory requirements can be time-consuming and costly.

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 material 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, to the extent we decide to seek regulatory marketing authorization for certain of our products in countries outside of the United States, we or our partners, or collaborators, will need to obtain regulatory marketing authorization for our products for the intended use in the jurisdiction where such products will be marketed. Regulatory clearance or approval in one jurisdiction does not mean that we will be successful in obtaining regulatory marketing authorization in other jurisdictions where we conduct business. 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 need to comply with the In Vitro Diagnostic Directive 98/79/EC and transition to the In Vitro Diagnostic Regulation 2017/746, which became effective May 26, 2017, with an application date of May 26, 2022. 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.

In February 2021, we announced a supply and distribution agreement to market our CyTOF technology, panels, and reagents to clinical labs in China. As part of the agreement, we are working to seek National Medical Products Administration (NMPA) approval for our CyTOF instrument for diagnostic use in China. As we increase our operations outside of the United States, our compliance and operational costs will increase, and we will be exposed to greater liability under additional laws and regulations.

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 manufacturers of products used for LDTs, 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, 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.

In August 2020, as part of the U.S. government's efforts to combat COVID-19 and consistent with the direction in Executive Orders 13771 and 13924, the Department of Health and Human Services (HHS) announced rescission of guidances and other informal issuances of the FDA regarding premarket review of LDTs absent notice-and-comment rulemaking, stating that, absent notice-and-comment rulemaking, those seeking approval or clearance of, or an emergency use authorization, for an LDT may nonetheless voluntarily submit a premarket approval application, premarket notification or an EUA request, respectively, but are not required to do so. However, laboratories opting to use LDTs without FDA premarket review or authorization would not be eligible for liability protection under the Public Readiness and Emergency Preparedness Act, or the PREP Act. Following this HHS announcement, the FDA announced in October 2020 that it will no longer review EUA requests for COVID-19 LDTs at this time and will continue to prioritize review of EUA requests for point-of-care tests, home collection tests, at-home tests, tests that reduce reliance on test supplies, and high-throughput tests that are widely distributed. While these actions by HHS and the FDA are expected to reduce the regulatory burden on clinical laboratories certified under the Clinical Laboratory Improvement Amendments of 1988 that develop LDTs, it is unclear how this action as well as legislation and executive orders by the Biden administration and state governments and FDA regulation will impact the industry, including our business and that of our customers. In an FDA FAQ updated on January 13, 2021, FDA indicated that it is reviewing EUA requests from laboratories that offer COVID-19 diagnostic tests and appears to take a different position from the HHS rescission policy. HHS's policy and the FDA's position with respect to LDTs in the short term and in general in the long-term may change, especially as the leadership at FDA changes under the Biden administration. Congress could also enact legislation restricting LDTs. Any restrictions on LDTs by the FDA, HHS, Congress, or state regulatory authorities may decrease the demand for our products. The adoption of new restrictions on RUOs, whether by the FDA or Congress, could adversely affect demand for our specialized reagents and instruments. Further, we could be required to obtain premarket clearance or approval from the FDA before we can sell our products to certain customers.

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 decision-making 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.

The Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) regulation (EC) No. 1907/206 is the European Union's regulation on chemicals and their safe use. The list of chemicals has been updated and some of the updates affect chemicals used in our products. We will request a research exception, but if not granted, we will need to reduce the concentration of some of the chemicals in our products, which will require significant research and development and operations efforts.

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.

RISKS RELATED TO ECONOMIC CONDITIONS AND OPERATING A GLOBAL BUSINESS

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

During the years 2020, 2019, and 2018, approximately 54%, 63%, and 57% 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 and REACH regulation, which regulate the use and importation 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 Assets 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);
- business interruptions resulting from global sociopolitical events, including war and terrorism, public health crises (including the ongoing COVID-19 pandemic), and natural disasters including earthquakes, typhoons, floods and fires;
- 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.

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

Adverse economic conditions in the U.S. and international markets, including the worldwide economic disruption related to the COVID-19 pandemic, have negatively affected our revenues and operating results and may continue to do so. Even before the current public health crisis took hold, the global credit and financial markets had been experiencing 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. Geopolitical events including the COVID-19 pandemic, 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 that 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.

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.

FINANCIAL, TAX, AND ACCOUNTING RISKS

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. However, 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 efficiency and cost-savings initiatives;
- the impact of any natural disasters or public health crises (including the COVID-19 pandemic);
- 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. The ongoing COVID-19 pandemic has led to significant disruption and volatility in the global capital markets, increasing the cost of—and adversely impacting access to—capital. We entered into an Open Market Sale Agreement (Sale Agreement) with Jefferies LLC (Jefferies) to sell shares of our common stock having aggregate sales proceeds of up to $50 million, from time to time, through an at-the-market (ATM) equity offering program under which Jefferies acts as sales agent. During the third quarter of 2020, we sold approximately 2.5 million shares of our common stock pursuant to the Sale Agreement, for aggregate gross proceeds of $20.9 million. Our net proceeds were approximately $20.1 million, after deducting related expenses, including commissions of approximately $0.6 million and issuance costs of approximately $0.2 million. If we raise additional funds by issuing equity securities, either under the ATM program or otherwise, our stockholders will 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, and our ability to raise additional capital may be adversely impacted by the impact of the COVID-19 pandemic on the economy.

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 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 Stock Market LLC, the SEC, or other regulatory authorities, which would require additional financial and management resources.

We may not realize the value of our goodwill or other intangible assets, which would be reflected in an impairment charge.

Our business acquisitions typically result in goodwill and other intangible assets, which affect the amount of future period amortization expense and possible impairment expense. We make estimates and assumptions in valuing such intangible assets that affect our consolidated financial statements. As of December 31, 2020, we had approximately $148.8 million of goodwill and net intangible assets, including approximately $106.6 million of goodwill and $42.2 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 and InstruNor in 2020. 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.

We assess the realizability of goodwill and indefinite-lived intangible assets annually as well as whenever events or changes in circumstances indicate that these assets may be impaired. We assess the realizability of definite-lived intangible assets whenever events or changes in circumstances indicate that these assets may be impaired. These events or circumstances would generally include operating losses or a significant decline in earnings associated with the acquired business or asset. Our ability to realize the value of the goodwill and intangible assets will depend on the future cash flows of these businesses. These cash flows in turn depend in part on how well we have integrated these businesses. If we are not able to realize the value of the goodwill and intangible assets, we may be required to incur material charges relating to the impairment of those assets.

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 April 2020, we amended our Revolving Credit Facility, which provides for secured revolving loans in an aggregate amount of up to $15.0 million, to extend the maturity date to August 2, 2022. 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 Loan and Security Agreement dated as of August 2, 2018, between the Company and Silicon Valley Bank (SVB) (as amended by the Default Waiver and First Amendment to Loan and Security Agreement dated September 7, 2018, the Second Amendment to Loan and Security Agreement dated November 20, 2019, and the Third Amendment to Loan and Security Agreement dated April 21, 2020, the Revolving Credit Agreement) and, if they are not repaid, could foreclose upon the assets securing our obligations under the Revolving Credit Facility.

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.

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.

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.

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, 2020, 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. On February 6, 2021, holders of $0.5 million of the 2014 Notes caused us to repurchase such 2014 Notes in accordance with the terms of the indenture governing the 2014 Notes (2014 Notes Indenture) at a repurchase price in cash equal to 100% of the principal amount of such 2014 Notes plus accrued and unpaid interest thereon. Pursuant to the terms of the 2014 Notes Indenture, holders of the remaining 2014 Notes may require us to repurchase all or a portion of such remaining 2014 Notes, on the same terms, on each of February 6, 2024 and February 6, 2029. 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 2014 Notes indenture or the indenture governing the 2019 Notes, as applicable (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 all or any portion of the Convertible 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 which 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 which 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 which 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 which our employees may have been previously affiliated. Litigation may be necessary to defend against these claims. A resulting 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 such claims, 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. (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 our 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 is volatile.

Our stock is currently traded on the Nasdaq Global Select Market (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, 2020, we had 74,543,141 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 33.6% of such shares. 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 38.3% held by our top six stockholders) means that a relatively small number of stockholders have significant control over the outcomes of stockholder voting.

The trading price of our common stock is highly volatile and subject to wide fluctuations in response to various factors, some of which are beyond our control. These factors include:

- the impact of public health crises, including the COVID-19 pandemic, on global financial markets;
- actual or anticipated quarterly variation in our results of operations or the results of our competitors;
- our failure to achieve performance consistent with our financial guidance and/or market expectations;
- 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 contract research organization 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. As discussed in Item 3 (Legal Proceedings) of this Annual Report on Form 10-K, a class action securities lawsuit against us is currently pending. While we are continuing to defend such action vigorously, the defense of this action and any additional actions can be costly, divert the time and attention

of our management, and harm our operating results, and any judgment against us or any future stockholder litigation could result in substantial costs.

Future sales of our common stock in the public market could cause our stock price to fall.

Our stock price could decline as a result of sales of a large number of shares of our common stock or the perception that these sales could occur. These sales, or the possibility that these sales may occur, also might make it more difficult for us to sell equity securities in the future at a time and at a price that we deem appropriate.

In addition, in the future, we may issue additional shares of common stock or other equity or debt securities convertible into common stock in connection with a financing, acquisition, litigation settlement, employee arrangements or otherwise. Any such future issuance, including any issuances pursuant to our ATM equity offering program under our Sale Agreement with Jefferies, could result in substantial dilution to our existing stockholders and could cause our stock price to decline.

We will have broad discretion over the use of the proceeds to us from our ATM equity offering program and may apply the proceeds to uses that do not improve our operating results or the value of your securities.

We will have broad discretion to use the net proceeds to us from our ATM equity offering program, and investors will be relying solely on the judgment of our board of directors and management regarding the application of these proceeds. Investors will not have the opportunity, as part of their investment decision, to assess whether the proceeds are being used appropriately. Our use of the proceeds may not improve our operating results or increase the value of the securities offered pursuant to the ATM equity offering program.

If securities or industry analysts publish unfavorable research about us 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.

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 78,000 square feet of office and laboratory space at our headquarters in South San Francisco, California under a lease that commenced in March 2020 for a lease term of approximately 10 years. Additionally, we lease office, laboratory, and manufacturing space in Singapore consisting of approximately 40,000 square feet expiring in June 2022, and approximately 5,000 square feet expiring in January 2022. In Ontario, Canada, we have leased two properties, comprising approximately 44,500 square feet expiring in March 2026 and approximately 19,000 square feet expiring in March 2027. As of December 31, 2020, we also leased office space in Japan, China, and France, with various expiration dates through February 2026. We believe that our properties are in good condition and are adequate and suitable for their purposes. Refer to Note 10 of our consolidated financial statements for additional information about leased properties in this Form 10-K.

ITEM 3. LEGAL PROCEEDINGS

In September 2020, a putative class action complaint alleging violations of the federal securities laws was filed against the Company (also naming our Chief Executive Officer and Chief Financial Officer as defendants) in the U.S. District Court for the Northern District of California (Reena Saintjermain, et al. v. Fluidigm Corporation, et al). The Court appointed a lead plaintiff and lead counsel in December 2020, and an amended complaint was filed on February 19, 2021. The complaint, as amended, seeks unspecified damages on behalf of a purported class of persons and entities who acquired our common stock between February 7, 2019 and November 5, 2019 and alleges securities laws violations based on statements and alleged omissions made by the Company during such period. The Company intends to file a motion to dismiss the complaint, which motion is currently due to be filed in early April 2021. We believe the claims alleged in the complaint lack merit and we intend to defend this action vigorously.

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.

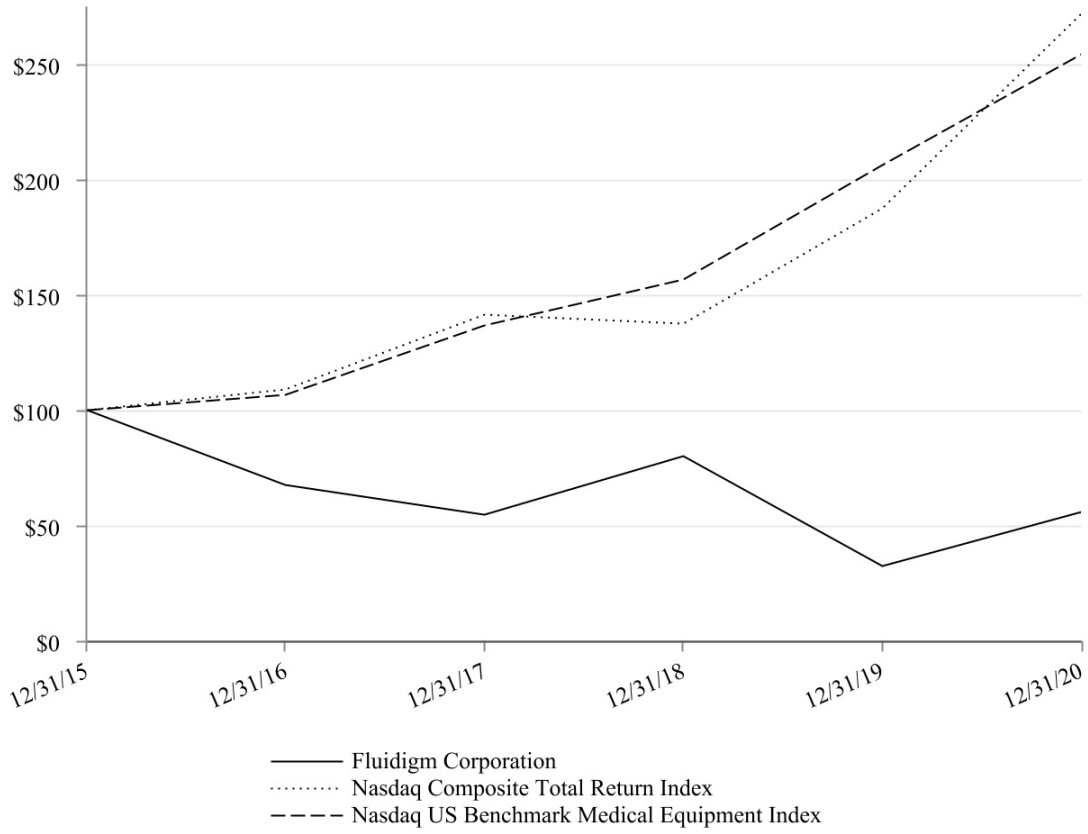
We had 85 stockholders of record as of January 31, 2021; however, because many of our outstanding shares are held by brokers or other institutions on behalf of stockholders, we are unable to estimate the total number of beneficial owners represented by the holders of record.

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, 2015 through December 31, 2020, 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, 2020.

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, 2020, 2019, and 2018, and consolidated balance sheet data as of December 31, 2020, and December 31, 2019 from audited consolidated financial statements included elsewhere in this Form 10-K. The consolidated statement of operations data for the years ended December 31, 2017, and 2016, and the consolidated balance sheet data as of December 31, 2018, December 31, 2017, and December 31, 2016 were derived from audited consolidated financial statements that are not included in this Form 10-K.

	2020	2019	2018	2017	2016
	(in thousands, except per share amounts)				
Consolidated Statement of Operations Data:					
Total revenue	$ 138,144	$ 117,243	$ 112,964	$ 101,937	$ 104,446
Loss from operations	(51,036)	(51,839)	(48,164)	(58,360)	(73,190)
Net loss	(53,020)	(64,790)	(59,013)	(60,535)	(75,985)
Net loss per share, basic and diluted	(0.74)	(0.97)	(1.49)	(1.84)	(2.62)

	2020	2019	2018	2017	2016
	(in thousands)				
Consolidated Balance Sheet Data:					
Cash, cash equivalents, and short and long-term investments	$ 68,520	$ 58,639	$ 95,401	$ 63,136	$ 59,430
Working capital (1)	76,873	74,003	100,988	71,565	76,334
Total assets	324,757	264,812	303,647	287,351	306,395
Total long-term debt	54,224	53,821	172,058	195,238	194,951
Total stockholders' equity	139,050	153,612	72,116	30,935	53,233

(1) Working capital excludes deferred revenue.

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 improves life by driving meaningful insights in health and disease. Our innovative technologies explore the biological complexities of disease to advance human health through research, diagnostics and clinical applications. We create, manufacture, and market a range of products and services, including instruments, consumables, reagents and software that are used by researchers and clinical labs worldwide. Our customers are leading academic and government laboratories, as well as pharmaceutical, biotechnology, plant and animal research organizations, and clinical laboratories worldwide. Together with our customers, we strive to increase the quality of life for all.

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 microfluidics instruments, which are assembled by our contract manufacturer located within our Singapore facility. All of our microfluidic products are fabricated at our Singapore facility. Our mass cytometry instruments, assays and reagents are manufactured at our facility in Canada. We also use U.S.-based third-party contract manufacturers for reagent manufacturing.

Our total revenue was $138.1 million in 2020, of which $122.5 million was product and service revenue; $117.2 million in 2019, of which $116.7 million was product and service revenue and $113.0 million in 2018, which was entirely product and service revenue. We have incurred significant net losses since our inception in 1999 and, as of December 31, 2020, our accumulated deficit was $676.8 million.

Recent Developments

We have been responding to the COVID-19 pandemic by taking steps to protect our employees, support our customers, and manage our liquidity. As Fluidigm is a designated essential business, some of our essential workers have been working at our laboratories and offices, and in some cases, at customer sites, while our administrative employees have been working from home. We have implemented health and safety practices in accordance with evolving government and public health agency guidelines in all of our facilities around the world, including maintaining social distancing and enhanced cleaning protocols, facilities modifications, temperature checks in some locations, and usage of face masks and other personal protective equipment where appropriate. Other operational adjustments made in response to COVID-19 include increased stocking levels of raw materials and proactive supplier management. We have taken steps to help keep our workforce healthy and safe, and to ensure a strong data security and internal control environment.

While Fluidigm is a designated essential business, widespread global adoption of work-from-home and shelter-in-place orders resulted in a significant slowdown in customer activities. We also saw near-term COVID-19-related priorities temporarily displace longer term projects and research activities. As customers have returned to work, we have seen some customer ordering recover, but the timing of complete recovery remains uncertain given additional waves of infection and the need to distribute vaccines. We estimate that about 10% of our customers are either closed or working at reduced capacity as of the end of 2020 because of the COVID-19 pandemic, compared to 60% to 70% in the first quarter and an estimated 30% to 40% of our global academic research community either remaining closed or working at a slower pace at the end of the second quarter. Although most of our customers are working, they have not returned to pre-pandemic levels of activity. We believe the impact of COVID-19 on our customers has resulted in the delay of sales of our mass cytometry instrument systems to future periods.

In August 2020, we received Emergency Use Authorization (EUA) from the U.S. Food and Drug Administration (FDA) for our Advanta™ Dx SARS-CoV-2 RT-PCR Assay, a newly developed, extraction-free saliva-based test to detect nucleic acid from the SARS-CoV-2 virus, designed to be run on the Fluidigm® Biomark™ HD microfluidics platform. In January 2021, we received the CE-IVD mark for our saliva-based Advanta Dx SARS-CoV-2 Assay allowing for commercial sales of this CE-IVD commercial kit in Europe. In addition, Fluidigm is actively supporting customers who are developing lab-developed tests,

as well as customers who are providing COVID-19 diagnostic tests outside of the U.S. The development of COVID-19 related applications has positively impacted sales of our microfluidics instruments, consumables, and mass cytometry reagents.

We believe our microfluidics and mass cytometry capabilities can play a significant role in virus detection as well as in immune profiling of patients and populations. Furthermore, we believe our technologies and solutions will be important to the durable response from government and medical institutions to be prepared for future outbreaks. Despite these opportunities, there is still uncertainty regarding the impact of COVID-19 on the global economy, our customers, and our business over the near term. Also, though we are now able to sell our Advanta Dx SARS-CoV-2 Assay for diagnostic use and certain clinical laboratory customers are developing lab developed tests using our technology, our experience selling into diagnostic markets is limited and we face significant competition. Many of our target customers in these markets do not have significant prior experience using Fluidigm instruments and consumables and require validation steps and assistance in establishing, integrating and scaling up testing programs using our technology and products. Also, many such laboratories have experience working with certain of our competitors for diagnostic testing, and we have faced, and expect to continue to face, complex sales processes and competition in the COVID-19 testing market. We expect to seek collaborations with third parties to meet the challenges associated with penetrating these markets.

We have actively sought government funding to support our investment to expand our diagnostics capabilities for microfluidics. In September 2020, we executed a contract with the National Institutes of Health (NIH) for a project under the NIH Rapid Acceleration of Diagnostics (RADx) program (collectively the NIH Contract). The RADx program provides grants to support a range of new lab-based and point-of-care tests that could significantly increase the number, type and availability of COVID-19 tests. The NIH Contract has a total value of up to $34.0 million upon the achievement of certain milestones. Through December 31, 2020, we have achieved milestones and received funding of $25.4 million. Proceeds from the NIH Contract will be used primarily to expand production capacity for COVID-19 testing with Fluidigm microfluidics technology and, to a lesser extent, to reimburse research and development costs. We have spent approximately $10.2 million for capital expenditures through December 31, 2020 for the expansion of our Singapore facility as a result of the NIH Contract. We expected to complete the NIH Contract and related spending for the expansion in 2021.

The NIH has the right to terminate the NIH Contract for convenience. In the event of termination for convenience, Fluidigm will be paid a percentage of the NIH Contract price reflecting the percentage of the work performed prior to the notice of termination, plus reasonable charges. In the event of termination for cause due to our default, NIH is not liable for supplies or services not accepted. If we fail to deliver within the time specified in the NIH Contract and the delay is due to Fluidigm's fault or negligence, we are required to pay liquidated damages in the amount of 33% of the amount(s) already disbursed to date under the NIH Contract within six months from the date of termination. We have not paid, and do not currently expect to pay any liquidated damages and are in compliance with the terms of the contract. We are working with the NIH continuously to ensure we are in compliance with the contract requirements and milestones.

In March 2020, we entered into an Open Market Sale Agreement (Sale Agreement) with Jefferies LLC (Jefferies) to sell shares of our common stock having aggregate sales proceeds of up to $50 million, from time to time, through an at-the-market equity offering program under which Jefferies acts as sales agent. During the third quarter of 2020, we sold 2.5 million shares of our common stock, $0.001 par value per share, pursuant to the Sale Agreement, for aggregate gross proceeds of $20.9 million. Our net proceeds were approximately $20.1 million, after deducting related expenses, including commissions of approximately $0.6 million and issuance costs of approximately $0.2 million.

In this period of uncertainty, we are actively managing our operating expenses and cash flows in response to the evolving market conditions. In addition, we implemented reductions in our operating expense structure including temporary salary reductions which began in the second quarter and ended in the third quarter of 2020 and constrained hiring until our business returned to more normal volumes. We have also taken advantage of various government programs available to us. For example, we have applied for or received wage subsidies in certain countries. In the U.S., the Coronavirus Aid, Relief and Economic Security (CARES) Act includes provisions relating to refundable payroll tax credits, deferment of the employer portion of certain payroll taxes, and other tax-related provisions. As a result, we have been preserving cash by deferring payment of U.S. payroll taxes.

We are continuing to assess the potential impact of the COVID-19 pandemic on our business and operations. For additional information on the various risks posed by the pandemic, refer to Part I, Item 1A. Risk Factors of this Form 10-K.

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 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. The full extent to which the COVID-19 pandemic impacts our business, results of operations and financial condition will depend on numerous evolving factors including, but not limited to, the magnitude and duration of the pandemic, the extent to which it will impact worldwide macroeconomic conditions, including the speed of recovery, and governmental and business reactions to the pandemic. We assessed certain accounting matters that generally require consideration of forecasted financial information, including the unknown impact of COVID-19 as of December 31, 2020. These accounting matters included, but were not limited to, our allowance for doubtful accounts and credit losses, inventory and related reserves and the carrying value of goodwill and other long-lived assets. Actual results could differ materially from these estimates and could have a material adverse effect on our consolidated financial statements.

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 our audited 2020 consolidated financial statements.

Revenue Recognition

We generate revenue primarily from the sale of our products and services. Product revenue is derived from the sale of instruments and consumables, assays and reagents. Service revenue is primarily derived from the sale of instrument service contracts, repairs, installation, training and other specialized product support services. We also generate revenue from development agreements, license and royalty agreements and grants. Revenue is reported net of any sales, use and value-added taxes we collect from customers as required by government authorities. Research and development cost includes costs associated with development and grant revenue.

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 by 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.

Development Revenue

The Company has entered and may continue to enter into development agreements with third parties that provide for up-front and periodic milestone payments. Our development agreements may include more than one performance obligation. At the inception of the contract, we assess whether each obligation represents a separate performance obligation or whether such obligations should be combined as a single performance obligation. The transaction price for each development agreement is determined based on the amount of consideration we expect to be entitled to for satisfying all performance obligations within the agreement.

We assess the nature of the combined performance obligation to determine whether the combined performance obligation is satisfied over time or at a point in time and, if over time, the appropriate method of measuring progress for purposes of recognizing revenue. In arrangements where we satisfy performance obligation(s) over time, we recognize development revenue typically using an input method based on our costs incurred relative to the total expected cost which determines the extent of our progress toward completion. As part of the accounting for these arrangements, we develop estimates and assumptions that require judgment to determine the transaction price and progress towards completion. We review our estimate of the transaction price and progress toward completion based on the best information available to recognize the cumulative progress toward completion as of the end of each reporting period, and make revisions to such estimates as necessary.

We also generate revenue from development or collaboration agreements that do not include upfront or milestone-based payments and generally recognize revenue on these types of agreements based on the timing of development activities.

Other Revenue

Other revenue consists of license and royalty revenue and grant revenue. We recognize revenue from license agreements when the license is transferred to the customer and the customer is able to use and benefit from the license. For contracts that include sales-based royalties, we recognize revenue at the later of (i) when the related sales occur, or (ii) when the performance obligation to which some or all of the royalty has been allocated has been satisfied.

In March 2020, we entered into an agreement to settle intellectual property infringement claims, in which we received a $3.5 million payment in exchange for a perpetual license under certain Fluidigm intellectual property. The settlement is considered a multiple-element arrangement with each element accounted for individually. Accordingly, $3.1 million of the proceeds was recognized as license revenue and $0.4 million was offset against legal costs.

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.

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.

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. To reduce credit risk, we perform credit evaluations of our customers. We generally do not require collateral to support credit sales.

Inventories, net

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. 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.

Leases

We determine if an arrangement is a lease, or contains a lease, at inception. Operating leases are included in operating lease right-of-use (ROU) assets, net and current and non-current operating lease liabilities in our consolidated balance sheets. ROU

assets represent our right-to-use an underlying asset for the lease term and lease liabilities represent our obligation to make lease payments arising from the lease. Operating lease ROU assets and liabilities are recognized at the commencement date based on the present value of lease payments over the lease term. As most of our leases do not provide an implicit rate, we generally use our incremental borrowing rate based on the estimated rate of interest for collateralized borrowing over a similar term of the lease payments at commencement date. Significant judgment is required in determining the incremental collateralized borrowing rate. Lease expense for lease payments is recognized on a straight-line basis over the lease term.

We elected the short-term lease recognition exemption for all leases that qualify. 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 not to 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.

Business Combinations, Goodwill, Intangible Assets and Other Long-Lived Assets

We have completed acquisitions of businesses in the past and may acquire additional businesses or technologies in the future. The results of businesses acquired in a business combination are included in our consolidated financial statements from the date of acquisition. We allocate the purchase price, which is the sum of the consideration provided in a business combination, to the identifiable assets and liabilities of the acquired business at their acquisition date fair values. The excess of the purchase price over the amount allocated to the identifiable assets and liabilities, if any, is recorded as goodwill. Determining the fair value of assets acquired and liabilities assumed requires management to use significant judgment and estimates, including the selection of valuation methodologies and estimates of future revenue.

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, economic downturns and other macroeconomic events, including the current COVID-19 pandemic, 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 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 an impairment loss equal to the difference would be recorded to goodwill. There were no indications of impairment in 2020. 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 were not used in then current products and were not expected to be used in future product offerings.

Deferred Grant Income

In September 2020, we executed the NIH Contract. The NIH Contract has a total value of up to $34.0 million upon the achievement of certain milestones. Proceeds from the NIH Contract will be used primarily to expand production capacity for COVID-19 testing with Fluidigm microfluidics technology and, to a lesser extent, to offset applicable operating expenses.

Accounting for the NIH Contract does not fall under ASC 606, Revenue from Contracts with Customers, as the NIH will not benefit directly from our expansion or product development. As there is no authoritative guidance under U.S. GAAP on accounting for government assistance to for-profit business entities, we applied International Accounting Standards (IAS) 20, Accounting for Government Grants and Disclosure of Government Assistance, by analogy when accounting for the NIH Contract payments to Fluidigm.

The NIH Contract proceeds used for production capacity expansion meet the definition of grants related to assets as the primary purpose for the payments is to fund the purchase and construction of capital assets to scale up production capacity. Under IAS 20, government grants related to assets are presented in the statement of financial position either by setting up the grant as deferred income or by deducting the grant in arriving at the carrying amount of the asset. Either of these two methods of presentation of grants related to assets in financial statements are regarded as acceptable alternatives under IAS 20. We have elected to record the grants received as deferred income using the first method.

Under IAS 20, grant proceeds are recognized when there is reasonable assurance the conditions of the grant will be met and the grant will be received. With the NIH Contract, this occurs when either each milestone has been accepted by NIH or management concludes the conditions of the grant have been substantially met. Deferred income related to production capacity expansion will be amortized over the period of depreciation for the related assets as a reduction of depreciation expense. Deferred income related to reimbursement of operating expenses is recorded as a reduction of those expenses incurred to date.

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 represented 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 determined the fair value of the 2018 Notes using valuation techniques that required 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 represented 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, PSUs 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. 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.

Recent Accounting Changes and Accounting Pronouncements

Adoption of New Accounting Guidance

In August 2018, the FASB issued Accounting Standard Update (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 was effective for fiscal years beginning after December 15, 2019. The adoption of the new guidance did not 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 was effective for annual and interim goodwill impairment testing

performed for our fiscal year beginning January 1, 2020. The adoption of the new guidance did not 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 were effective for fiscal years beginning after December 15, 2019, and interim periods within those years. The modified retrospective method was required upon adoption. The new guidance was effective for fiscal years beginning after December 15, 2019. The adoption of the new guidance resulted in an adjustment of approximately $0.1 million to reduce the accumulated deficit component of stockholders' equity and decrease current assets by the same amount in our consolidated balance sheet.

Recent Accounting Pronouncements

In August 2020, the FASB issued ASU 2020-06 Debt-Debt with Conversion and Other Options (Subtopic 470-20) and Derivatives and Hedging-Contracts in Entity's Own Equity (Subtopic 815-40): Accounting for Convertible Instruments and Contracts in an Entity's Own Equity. The amendment to this ASU reduces the number of accounting models for convertible instruments and allows more contracts to qualify for equity classification, which is expected to result in more convertible instruments being accounted for as a single unit, rather than being bifurcated between debt and equity. The new guidance is effective for fiscal years beginning after December 15, 2021. We are currently evaluating the impact of adoption of the new guidance on our consolidated financial statements.

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 simplify GAAP for Topic 740 by clarifying and amending existing guidance for, among other items, 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. 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, 2020, 2019, and 2018, and as a percentage of total revenue for the respective years (in thousands):

	Year Ended December 31,					
	2020		2019		2018	
Revenue:						
Total revenue	$ 138,144	100 %	$ 117,243	100 %	$ 112,964	100 %
Costs and expenses:						
Cost of product revenue	47,527	34	45,461	39	44,861	39
Cost of service revenue	7,291	5	7,503	6	6,454	6
Research and development	36,461	26	31,640	27	30,030	27
Selling, general and administrative	97,901	71	84,478	72	79,783	71
Total costs and expenses	189,180	136	169,082	144	161,128	143
Loss from operations	(51,036)	(36)	(51,839)	(44)	(48,164)	(43)
Interest expense	(3,572)	(3)	(4,279)	(4)	(13,893)	(12)
Loss from extinguishment of debt	—	—	(12,020)	(10)	—	—
Other income, net	507	—	1,433	1	637	1
Loss before income taxes	(54,101)	(39)	(66,705)	(57)	(61,420)	(54)
Income tax benefit	1,081	1	1,915	2	2,407	2
Net loss	$ (53,020)	(38)%	$ (64,790)	(55)%	$ (59,013)	(52)%

Revenue

We generate revenue primarily from sales of our products and services, development agreements, license and royalty agreements, and grants. Our product revenue consists of sales of instruments and consumables. Consumables revenue 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 the sales and active installed base of our instruments as our service revenue primarily consists of post-warranty service contracts, preventive maintenance plans, instrument parts, installation and training. We sell our products to leading academic and government laboratories, as well as pharmaceutical, biotechnology, clinical, plant and animal research organizations and clinical laboratories worldwide.

Development Revenue. Effective March 31, 2020, we signed an OEM Supply and Development Agreement (Development Agreement) with a customer. Under the Development Agreement, Fluidigm will develop products based on our microfluidics technology. The Development Agreement provides up-front and periodic milestone payments of up to $11.7 million during the development stage. The development stage is expected to last approximately one year from the date of the Development Agreement. We recognized $8.8 million of development revenue from this agreement for the year ended December 31, 2020.

We recognize revenue under the Development Agreement using an input method based on our costs incurred relative to the total expected cost which determines the extent of our progress toward satisfaction of our obligations under the agreement. Costs associated with the Development Agreement are recorded in research and development expense.

Grant Revenue. We receive grants to perform research and development activities over contractually defined periods. Grant revenue in the current year is attributable to a grant agreement entered into in the second half of 2019, which is expected to end in the first half of 2021. Costs associated with grant agreements are recorded in research and development expense.

License and Royalty Revenue. In March 2020, we entered into an agreement to settle intellectual property infringement claims and received a $3.5 million payment in exchange for a perpetual license under certain of our intellectual property. The settlement is considered a multiple-element arrangement with each element accounted for individually. Accordingly, $3.1 million of the proceeds was recognized as license revenue and $0.4 million was offset against legal costs.

No single customer represented more than 10% of our total revenue for 2020, 2019, or 2018. Revenue from our five largest customers was 23% of total revenue for 2020 and 17% for both the years ended December 31, 2019 and 2018.

The following table presents our revenue by source for the years ended December 31, 2020, 2019, and 2018, and as a percentage of total revenue for the respective years (in thousands):

	Year Ended December 31,						Change	
	2020		2019		2018		2020	2019
Revenue:								
Instruments	$ 45,536	33 %	$ 50,004	43 %	$ 45,491	40 %	(9)%	10 %
Consumables	54,408	39	45,412	39	48,159	43	20 %	(6)%
Product revenue	99,944	72	95,416	82	93,650	83	5 %	2 %
Service revenue	22,579	16	21,277	18	19,314	17	6 %	10 %
Product and service revenue	122,523	88	116,693	100	112,964	100	5 %	3 %
Development revenue	8,865	6	—	—	—	—	NA	NA
Grant revenue	3,593	3	550	—	—	—	553 %	NA
License revenue	3,163	3	—	—	—	—	NA	NA
Total revenue	$ 138,144	100 %	$ 117,243	100 %	$ 112,964	100 %	18 %	4 %

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	
	2020		2019		2018		2020	2019
Americas	$ 74,586	54 %	$ 47,016	40 %	$ 51,172	46 %	59 %	(8)%
EMEA	37,776	27	40,024	34	36,617	32	(6)%	9 %
Asia-Pacific	25,782	19	30,203	26	25,175	22	(15)%	20 %
Total revenue	$ 138,144	100 %	$117,243	100 %	$112,964	100 %	18 %	4 %

The Americas revenue includes revenue generated in the United States of $72.0 million, $43.4 million, and $48.1 million for 2020, 2019 and 2018, respectively. Asia-Pacific revenue includes sales to customers in China of $11.1 million, $15.4 million and $14.0 million for 2020, 2019 and 2018, respectively. There was no foreign country or jurisdiction with sales in excess of 10% of total revenue in 2020. Except for China, no other foreign country or jurisdiction had sales in excess of 10% of our total revenue during the years 2019 and 2018.

The following section includes management discussion and analysis for the fiscal year ended December 31, 2020. Refer to Part I Item 7 of the Annual Report on Form 10-K for the fiscal year ended December 31, 2019, filed with the SEC on February 27, 2020, for a discussion of the comparative results for 2019 and 2018, which discussion of comparative results is incorporated by reference into this Form 10-K.

Total Revenue. Total revenue increased by $20.9 million or 18%, to $138.1 million for 2020 compared to $117.2 million for 2019. Americas revenue increased by 59%, driven by sales of our Advanta Dx SARS-CoV-2 RT-PCR test and related sales of microfluidics instruments; development revenue; and grant revenue; partially offset by lower mass cytometry product sales. COVID-19 microfluidics revenues only partially offset lower mass cytometry instrument revenues for EMEA, resulting in a 6% decline in EMEA revenues. Stronger European currencies in 2020 compared to 2019 added approximately 2% to EMEA's reported revenues. The 15% decrease in Asia-Pacific revenues is due to decreases in revenue in all product categories due to the pandemic and shelter-in-place orders. On a company-wide basis, stronger foreign exchange rates positively impacted revenues by less than 1% for 2020 compared to 2019.

Product and Service Revenue. The following tables present the split of product and service revenue between mass cytometry and microfluidic product categories and as a percentage of the respective category's total product and service revenue for each year presented (in thousands):

	Year Ended December 31,						Change	
	2020		2019		2018		2020	2019
Mass cytometry:								
Instruments	$ 28,484	46 %	$ 41,575	57 %	$ 34,308	58 %	(31)%	21 %
Consumables	18,023	29	17,850	24	14,962	25	1	19
Total product revenue	46,507	75	59,425	81	49,270	83	(22)	21
Service revenue	15,625	25	13,895	19	10,230	17	12	36
Total product and service revenue	$ 62,132	100 %	$ 73,320	100 %	$ 59,500	100 %	(15)%	23 %

	Year Ended December 31,						Change	
	2020		2019		2018		2020	2019
Microfluidics:								
Instruments	$ 17,053	28 %	$ 8,429	19 %	$ 11,183	21 %	102 %	(25)%
Consumables	36,384	60	27,562	64	33,197	62	32	(17)
Total product revenue	53,437	88	35,991	83	44,380	83	48	(19)
Service revenue	6,954	12	7,382	17	9,084	17	(6)	(19)
Total product and service revenue	$ 60,391	100 %	$ 43,373	100 %	$ 53,464	100 %	39 %	(19)%

The decline in mass cytometry instrument revenue was primarily attributable to lower volumes of instrument sales due to ordering delays created by lab closures in response to the COVID-19 pandemic and, to a lesser extent, the impact of lower average unit selling prices on mass cytometry instruments. Customers are also shifting their resources to COVID-19 related projects. Mass cytometry consumables revenues benefited from COVID-19 immune profiling studies.

Microfluidics revenues increased due to sales of our newly developed SARS-CoV-2 diagnostic test and related sales of instrument systems. Diagnostic revenue, comprised of both consumables and instruments was $22.4 million in 2020, and more than offset the decline in other microfluidics revenue caused by a pandemic-related slowdown in key account activity.

The COVID-19 pandemic is still ongoing, and although we expect it to dissipate in 2021 as vaccinations proliferate worldwide, the timing and pace of the recovery remain uncertain. Reallocations of research budgets to COVID-related projects that started in 2020 are still in place as we enter 2021, and these continuing budget reallocations and any other pandemic-related impacts may result in variability in sequential quarterly revenue growth.

Product and Service Cost, Product and Service Gross Profit, and Product and Service 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 product and service cost, product and service gross profit, and product and service margin for each year presented (in thousands):

	Year Ended December 31,			Change	Change
	2020	2019	2018	2020	2019
Cost of product revenue	$ 47,527	$ 45,461	$ 44,861	5 %	1 %
Cost of service revenue	7,291	7,503	6,454	(3)%	16 %
Cost of product and service revenue	$ 54,818	$ 52,964	$ 51,315	4 %	3 %
Product and service gross profit	$ 67,705	$ 63,729	$ 61,649	6 %	3 %
Product and service margin	55.3 %	54.6 %	54.6 %	0.7 ppts	— ppts.

Product and service margin increased by 0.7 percentage points during 2020 compared to 2019. The impact of spreading fixed depreciation and amortization over a higher revenue base contributed 0.6 percentage points of the improvement in margin. The impact of lower average unit selling prices on mass cytometry instruments was offset by lower service costs and lower production costs associated with mass cytometry consumables.

Product and service margin was unchanged in 2019 compared to the prior year. Higher capacity utilization, as well as the impact of spreading fixed depreciation and amortization over a higher revenue base, was offset by higher inventory reserves, unfavorable product mix and lower average selling prices on mass cytometry products.

Operating Expenses

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

	Year Ended December 31,			Change	
	2020	2019	2018	2020	2019
Research and development	$ 36,461	$ 31,640	$ 30,030	15 %	5 %
Selling, general and administrative	97,901	84,478	79,783	16 %	6 %
Total operating expenses	$ 134,362	$ 116,118	$ 109,813	16 %	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. 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 also includes costs incurred in conjunction with research grants and development arrangements.

We have made substantial investments in research and development since our inception and expect to continue to do so. 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.

Research and development expense increased by $4.8 million, or 15%, to $36.5 million for 2020 compared to $31.6 million for 2019. Increases are primarily due to higher compensation costs, including higher employee incentive compensation and stock-based compensation costs, and outside service costs related to development and grant projects. Proceeds of the NIH Contract offset $1.4 million of research and development costs.

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, information technology, and general management, as well as professional services, such as legal and accounting services.

Selling, general and administrative expense increased by $13.4 million, or 16%, to $97.9 million for 2020 compared to $84.5 million for 2019. The increase in expense is primarily attributable to higher compensation costs, including higher employee incentive compensation and stock-based compensation, and higher legal costs. In addition, we incurred $4.9 million of increased facilities costs reflecting costs associated with our new lease, effective March 2020, for our corporate headquarters and related moving expenses. Lease rates had increased since entering into our previous, now expired, lease. Travel costs fell

$3.6 million compared to the prior period, while costs related to trade shows and other events fell $1.9 million due to the cancellation of in-person events in light of the COVID-19 pandemic.

Interest Expense, Loss from Extinguishment of Debt and Other Income, Net

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

	Year Ended December 31,			Change	
	2020	2019	2018	2020	2019
Interest expense	$ (3,572)	$ (4,279)	$ (13,893)	17 %	69 %
Loss from extinguishment of debt	—	(12,020)	—	(100)%	NA
Other income, net	507	1,433	637	65 %	(125)%
Total	$ (3,065)	$ (14,866)	$ (13,256)	79 %	(12)%

In November 2019, we issued $55.0 million aggregate principal amount of our 2019 Notes. Net proceeds of the 2019 Notes issuance were used primarily to retire $50.2 million aggregate principal amount of our 2014 Notes. The 2019 Notes have an effective interest rate of 6.2% compared to the 2014 Notes, which have an effective interest rate 3.0%.

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. The 2018 Notes had an effective interest rate of 12.3%. 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 recognized a loss of $9.0 million on the conversion of 2018 Notes, which was 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.

Interest expense of $3.6 million for the twelve months ended December 31, 2020 consists primarily of interest on $55.0 million of 2019 Notes, while interest expense of $4.3 million for the twelve months ended December 31, 2019 included both the interest on $51.3 million of 2014 Notes and a partial quarter of interest expense on $150.0 million of 2018 Notes, which accrued at an effective rate of 12.3%. The lower interest expense of $3.6 million for the twelve months ended December 31, 2020 compared to $4.3 million for the twelve months ended December 31, 2019 reflects the impact of higher debt balances and higher interest rates for the twelve months ended December 31, 2019 compared to the twelve months ended December 31, 2020.

Other income, net primarily consists of interest income and gains or losses on foreign exchange. Other income, net, of $0.5 million for 2020 is primarily attributable to $0.2 million of interest income, and $0.2 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 $1.1 million, or an effective tax rate benefit of 2.0%, for the year ended December 31, 2020. The tax benefit was principally due to the amortization of our acquisition-related deferred tax liabilities, partially offset by a provision from our foreign operations.

Liquidity and Capital Resources

Sources of Liquidity

As of December 31, 2020, our principal sources of liquidity consisted of $68.5 million of cash and cash equivalents, as well as $1.0 million of restricted cash and $15.0 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,		
	2020	2019	2018
Cash flow summary:			
Net cash used in operating activities	$ (15,417)	$ (35,210)	$ (25,201)
Net cash provided by (used in) investing activities	39,975	(39,301)	4,719
Net cash provided by financing activities	20,857	2,790	57,660
Net increase (decrease) in cash, cash equivalents and restricted cash	45,800	(71,665)	37,345

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 2020 was $15.4 million and consisted of net loss of $53.0 million less non-cash adjustments of $35.2 million, and a net increase in assets and liabilities of $2.4 million. Non-cash items include stock-based compensation expense of $14.5 million, amortization of developed technology of $11.9 million, depreciation and amortization of $4.0 million, and lease amortization of $2.0 million. Increases in inventories and accounts receivable balances represent working capital increases due to higher revenues. Higher incentive compensation and other accruals largely offset these increases.

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 $43.2 million, and a net increase in assets and liabilities of $13.6 million. Non-cash items primarily included a loss from extinguishment of debt of $12.0 million, amortization of developed technology of $11.2 million, stock-based compensation expense of $11.4 million, and depreciation and amortization of $4.6 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 $37.4 million, and a net reduction in assets and liabilities of $3.6 million. Non-cash items primarily included amortization of developed technology of $11.2 million, stock-based compensation 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 Provided by (Used in) Investing Activities. Our primary investing activities consist of purchases, sales, and maturities of our short-term investments and capital expenditures for manufacturing, laboratory, computer equipment and software to support our infrastructure and workforce. We expect to continue to incur costs for capital expenditures to improve manufacturing efficiencies and strengthen information technology and network security. However, we may choose to decrease or defer certain capital expenditures and development activities, while further optimizing our organization.

Net cash provided by investing activities in 2020 was $40.0 million and includes $36.8 million of proceeds from the sales and maturities of investments as well as $21.0 million of proceeds from the NIH Contract, reflecting the portion of the proceeds from the NIH Contract attributable to the capacity expansion. These inflows were partially offset by capital expenditures of $12.7 million, including $10.2 million of capital expenditures funded by the NIH Contract to expand our Singapore manufacturing facility, and $5.2 million of net cash paid for the InstruNor acquisition.

Total proceeds from the NIH Contract are expected to be $34.0 million, of which we received $25.4 million in 2020. We expect to incur the balance of the capital expenditures for the manufacturing capacity expansion and receive the remaining proceeds from the NIH, subject to satisfactory completion of all remaining milestones, in 2021.

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

Net cash provided by investing activities in 2018 was $4.7 million, which included proceeds from maturities of investments of $6.5 million, partially 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 Financing Activities. We generated cash from financing activities of $20.9 million during 2020. Proceeds from our ATM equity offering were $20.2 million, net of commissions and offering costs. Proceeds from our ESPP program and stock options exercises were largely offset by payments of debt issuance costs and income tax withholding related to net share settlement of equity awards.

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, and 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.

Capital Resources. At December 31, 2020 and December 31, 2019, our working capital, excluding deferred revenues and restricted cash, was $76.9 million and $74.0 million, respectively, including cash and cash equivalents of $68.5 million and $21.7 million, respectively, and short-term investments of $37.0 million at December 31, 2019.

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 $1.1 million of aggregate principal amount of our 2014 Notes outstanding. The remaining cash proceeds from the issuance of the 2019 Notes were 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 $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 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.

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 our Revolving Credit Facility with SVB, with a maturity date of August 2, 2020. The Revolving Credit Facility is collateralized by substantially all our property, other than intellectual property. Outstanding loans

under the Revolving Credit Facility bear interest, at the greater of (i) prime rate plus 0.50% or (ii) 5.50%. Amounts drawn under the Revolving Credit Facility will be used for working capital and general corporate purposes.

On April 21, 2020, we entered into the Third Amendment to Loan and Security Agreement with SVB (the Amendment), which amends the Revolving Credit Agreement. The Amendment extends the maturity date by two years, to August 2, 2022. We also amended the interest rate to be the greater of (i) prime rate (as customarily defined), plus 0.50%, floating, and (ii) 5.25%. Interest on any outstanding loans continues to be due and payable monthly and the principal balance is due at maturity though loans can be prepaid at any time without penalty. Annual administration fees are unchanged. The Amendment also includes various administrative changes.

As of December 31, 2020, total availability under the Revolving Credit Facility was $15.0 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 Revolving Credit Agreement governing the Revolving Credit Facility. See Note 9 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, and our ability to raise additional capital may be adversely impacted by potential worsening global economic conditions and the recent disruptions to and volatility in the credit and financial markets in the United States and worldwide resulting from the COVID-19 pandemic. 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, 2020 (in thousands):

	Payments Due by Period				
	Total	Less than 1 Year	1-3 Years	3-5 Years	Thereafter
Debt obligations	$ 67,851	$ 3,411	$ 5,807	$ 57,920	$ 713
Operating lease obligations, net	68,272	7,565	14,205	14,594	31,908
Purchase obligations	12,928	12,928	—	—	—
Total	$ 149,051	$ 23,904	$ 20,012	$ 72,514	$ 32,621

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. In addition, 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 2014 Notes plus accrued and unpaid interest. On February 6, 2021, holders of $0.5 million

of the 2014 Notes caused us to repurchase their notes in accordance with this provision. This repayment is reflected in the above commitments schedule as due in less than one year. See Note 9 to our consolidated financial statements for additional information regarding the terms of the Notes.

Our operating lease obligations primarily relate to leases for our corporate headquarters and leases for manufacturing and office space for our foreign subsidiaries. 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 $9.7 million, $6.1 million and $5.0 million, for 2020, 2019, and 2018 respectively.

Purchase obligations consist of contractual and legally binding commitments to purchase goods and services. The majority of our contracts are cancellable with little or no notice or penalty. However, once a vendor has incurred costs to fulfill a contract with us, and which costs cannot be otherwise deployed, we are liable for those costs upon cancellation. For example, if a supplier has purchased raw materials to produce a good for us, and those goods cannot be returned or otherwise used by our vendor, we are obligated to reimburse them for the costs they incurred. Purchase obligations also includes $10.4 million for capital expenditures related to the NIH Contract.

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, 2020, we had a foreign currency gain of $0.2 million compared to a foreign currency gain 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 $68.5 million as of December 31, 2020 These amounts were held primarily in cash on deposit with banks and money market funds which are short-term. 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, 2020 and 2019, 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, 2020, 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, 2020, 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, 2020 and 2019, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2020 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, 2020, 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.

National Institutes of Health (NIH) Contract Accounting

As described in Notes 2 and 4 to the consolidated financial statements, in September 2020, the Company executed a definitive contract with the National Institutes of Health (NIH) for a project under the NIH Rapid Acceleration of Diagnostics (RADx) program, which has a total value of up to $34.0 million upon the achievement of certain conditional milestones. As there is no authoritative guidance under U.S. GAAP on accounting for government assistance to for-profit business entities, management applied International Accounting Standards (IAS) 20, Accounting for Government Grants and Disclosure of Government Assistance by analogy when accounting for the NIH contract payments to the Company. Management has elected to record the grants received as deferred income with grant proceeds recognized when there is reasonable assurance the conditions of the grant will be met and the grant will be received. With the NIH contract, this occurs when either each milestone has been accepted by NIH or management concludes the conditions of the grant have been substantially met. As of December 31, 2020, a total $23.9 million has been recorded as deferred grant income.

The principal considerations for our determination that performing procedures relating to the NIH contract accounting is a critical audit matter are (i) the significant judgment by management when determining the applicable accounting model and determining which milestones are reasonably assured, including consideration of conditional contract provisions and NIH termination rights; and (ii) a high degree of auditor judgment, subjectivity and effort in performing procedures and evaluating audit evidence relating to the accounting policy selection and assumptions associated with conclusions of which milestones are reasonably assured.

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 the NIH contract, including controls over the determination of the appropriate accounting model, and which grant milestones met the reasonable assurance criteria for recognition. These procedures also included, among others (i) reading the executed agreement and correspondence with NIH, (ii) evaluating compliance with the contract requirements, including conditional provisions and NIH termination rights, (iii) evaluating management's accounting analysis, and (iv) evaluating the assumptions associated with recognition of deferred income for milestones determined to be reasonably assured by management.

/s/ PricewaterhouseCoopers LLP

San Jose, California
February 25, 2021

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

FLUIDIGM CORPORATION

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

	December 31,	
	2020	**2019**
ASSETS		
Current assets:		
Cash and cash equivalents	$ 68,520	$ 21,661
Short-term investments	—	36,978
Accounts receivable (net of allowances of $356 and $6, at December 31, 2020 and 2019, respectively)	25,423	18,981
Inventories, net	19,689	13,884
Prepaid expenses and other current assets	4,031	4,592
Total current assets	117,663	96,096
Property and equipment, net	17,531	8,056
Operating lease right-of-use asset, net	38,114	4,860
Other non-current assets	4,680	5,492
Developed technology, net	40,206	46,200
Goodwill	106,563	104,108
Total assets	$ 324,757	$ 264,812
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current liabilities:		
Accounts payable	$ 9,220	$ 5,152
Accrued compensation and related benefits	13,787	5,160
Operating lease liabilities, current	2,973	1,833
Other accrued liabilities	14,794	8,873
Deferred revenue, current	13,475	11,803
Total current liabilities	54,249	32,821
Convertible notes, net	54,224	53,821
Deferred tax liability	8,697	11,494
Operating lease liabilities, non-current	38,178	4,323
Deferred revenue, non-current	7,990	8,168
Deferred grant income, non-current	21,036	—
Other non-current liabilities	1,333	573
Total liabilities	185,707	111,200
Commitments and contingencies (Note 17)		
Stockholders' equity:		
Preferred stock, $0.001 par value, 10,000 shares authorized, no shares issued and outstanding at either December 31, 2020 or 2019	—	—
Common stock: $0.001 par value, 200,000 shares authorized at December 31, 2020 and 2019; 74,543 and 69,956 shares issued and outstanding at December 31, 2020 and 2019, respectively	75	70
Additional paid-in capital	815,624	777,765
Accumulated other comprehensive loss	112	(582)
Accumulated deficit	(676,761)	(623,641)
Total stockholders' equity	139,050	153,612
Total liabilities and stockholders' equity	$ 324,757	$ 264,812

See accompanying notes

FLUIDIGM CORPORATION

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

	Year Ended December 31,		
	2020	2019	2018
Revenue:			
Product revenue	$ 99,944	$ 95,416	$ 93,650
Service revenue	22,579	21,277	19,314
Development revenue	8,865	—	—
Other revenue	6,756	550	—
Total revenue	138,144	117,243	112,964
Costs and expenses:			
Cost of product revenue	47,527	45,461	44,861
Cost of service revenue	7,291	7,503	6,454
Research and development	36,461	31,640	30,030
Selling, general and administrative	97,901	84,478	79,783
Total costs and expenses	189,180	169,082	161,128
Loss from operations	(51,036)	(51,839)	(48,164)
Interest expense	(3,572)	(4,279)	(13,893)
Loss from extinguishment of debt	—	(12,020)	—
Other income, net	507	1,433	637
Loss before income taxes	(54,101)	(66,705)	(61,420)
Income tax benefit	1,081	1,915	2,407
Net loss	$ (53,020)	$ (64,790)	$ (59,013)
Net loss per share, basic and diluted	$ (0.74)	$ (0.97)	$ (1.49)
Shares used in computing net loss per share, basic and diluted	72,044	66,779	39,652

See accompanying notes

FLUIDIGM CORPORATION

CONSOLIDATED STATEMENTS OF COMPREHENSIVE LOSS
(In thousands)

	Year Ended December 31,		
	2020	2019	2018
Net loss	$ (53,020)	$ (64,790)	$ (59,013)
Other comprehensive income (loss), net of tax			
Foreign currency translation adjustment	730	69	(112)
Net change in unrealized gain (loss) on investments	(36)	36	(1)
Other comprehensive income (loss), net of tax	694	105	(113)
Comprehensive loss	$ (52,326)	$ (64,685)	$ (59,126)

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, 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
Issuance of common stock from at-the-market offering, net of commissions	2,480	2	20,224	—	—	20,226
Issuance of restricted stock, net of shares withheld for taxes, and other	1,050	1	(460)	—	—	(459)
Issuance of common stock under ESPP	476	1	1,322	—	—	1,323
Issuance of common stock from stock option exercises	96	—	451	—	—	451
Equity issuance costs	—	—	(176)	—	—	(176)
Cumulative effect of new accounting standard for Topic 326 Credit Losses	—	—	—	—	(100)	(100)
Stock-based compensation expense	—	—	14,450	—	—	14,450
Acquisition of InstruNor AS	485	1	2,048	—	—	2,049
Net loss	—	—	—	—	(53,020)	(53,020)
Other comprehensive income (loss), net of taxes	—	—	—	694	—	694
Balance as of December 31, 2020	74,543	$ 75	$ 815,624	$ 112	$ (676,761)	$ 139,050

See accompanying notes

FLUIDIGM CORPORATION

CONSOLIDATED STATEMENTS OF CASH FLOWS
(In thousands)

	Year Ended December 31,		
	2020	**2019**	**2018**
Operating activities			
Net loss	$ (53,020)	$ (64,790)	$ (59,013)
Adjustments to reconcile net loss to net cash used in operating activities:			
Depreciation and amortization	4,014	4,605	5,372
Stock-based compensation expense	14,451	11,393	11,023
Amortization of developed technology	11,910	11,200	11,200
Lease amortization	2,017	(516)	—
Amortization of debt discounts, premiums and issuance costs	545	1,936	8,379
Impairment of intangible asset	—	443	—
Loss from extinguishment of debt	—	12,020	—
Loss on disposal of property and equipment	212	89	141
Provision for excess and obsolete inventory	1,614	1,807	1,090
Other non-cash items	426	200	175
Changes in assets and liabilities:			
Accounts receivable, net	(7,628)	(2,075)	(1,788)
Inventories, net	(8,636)	(3,047)	398
Prepaid expenses and other assets	(877)	(1,400)	178
Accounts payable	3,356	787	(294)
Deferred revenue	2,111	2,129	2,574
Other liabilities	14,088	(9,991)	(4,636)
Net cash used in operating activities	(15,417)	(35,210)	(25,201)
Investing activities			
Proceeds from NIH Contract	21,036	—	—
Acquisition, net of cash acquired	(5,154)	—	—
Purchases of investments	—	(62,370)	(1,450)
Proceeds from sale of investments	5,010	—	—
Proceeds from maturities of investments	31,800	25,600	6,541
Purchases of property and equipment	(12,717)	(2,531)	(372)
Net cash provided by (used in) investing activities	39,975	(39,301)	4,719
Financing activities			
Proceeds from issuance of common stock, net of commissions	20,226	—	59,469
Proceeds from debt issuance	—	55,000	—
Repayment of long-term debt	—	(51,826)	—
Payments of debt and equity issuance cost	(684)	(1,888)	(2,862)
Proceeds from exercise of stock options	451	1,058	208
Proceeds from stock issuance from ESPP	1,323	1,075	1,203
Payments for taxes related to net share settlement of equity awards and other	(459)	(629)	(358)
Net cash provided by financing activities	20,857	2,790	57,660
Effect of foreign exchange rate fluctuations on cash and cash equivalents	385	56	167
Net increase (decrease) in cash, cash equivalents and restricted cash	45,800	(71,665)	37,345
Cash, cash equivalents and restricted cash at beginning of period	23,736	95,401	58,056
Cash, cash equivalents and restricted cash at end of period	$ 69,536	$ 23,736	$ 95,401
Supplemental disclosures of cash flow information			
Cash paid for interest	$ 3,089	$ 3,542	$ 5,534
Cash paid for income taxes, net of refunds	$ 521	$ 205	$ 321
Non-cash right-of-use assets and lease liabilities	$ 36,225	$ 10,402	$ 0
Unpaid debt and equity issuance costs	$ —	$ 534	$ 375
Asset retirement obligations	$ 325	$ 312	$ 314

See accompanying notes

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS
December 31, 2020

1. Description of Business

Fluidigm Corporation (the Company, Fluidigm, we, our or us) improves life by driving meaningful insights in health and disease. Our innovative technologies explore the biological complexities of disease to advance human health through research, diagnostics and clinical applications. We create, manufacture, and market a range of products and services, including instruments, consumables, reagents and software that are used by researchers and clinical labs worldwide. Our customers are leading academic and government laboratories, as well as pharmaceutical, biotechnology, plant and animal research organizations, and clinical laboratories worldwide. 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, 2020, we had wholly owned subsidiaries in Singapore, Canada, the Netherlands, Japan, France, the United Kingdom, China, Germany and Norway. 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 balance sheet and 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. The full extent to which the COVID-19 pandemic impacts our business, results of operations and financial condition will depend on numerous evolving factors including, but not limited to, the magnitude and duration of the pandemic, the extent to which it will impact worldwide macroeconomic conditions, including the speed of recovery, and governmental and business reactions to the pandemic. We assessed certain accounting matters that generally require consideration of forecasted financial information, including the unknown impact of COVID-19 as of December 31, 2020. These accounting matters included, but were not limited to, our allowance for doubtful accounts and credit losses, inventory and related reserves and the carrying value of goodwill and other long-lived assets. 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 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 primarily derived from the sale of instrument service contracts, repairs, installation, training and other specialized product support services. We also generate revenue from development agreements, license and royalty agreements and grants. Revenue is reported net of any sales, use and value-added taxes we collect from customers as required by government authorities. Research and development cost includes costs associated with development and grant revenue.

We adopted ASU 2014-09 Revenue from Contracts with Customers (Topic 606) on January 1, 2018, using the modified retrospective method applied to those contracts with unrecognized revenue on the adoption date. 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.

Development Revenue

The Company has entered and may continue to enter into development agreements with third parties that provide for up-front and periodic milestone payments. Our development agreements may include more than one performance obligation. At the inception of the contract, we assess whether each obligation represents a separate performance obligation or whether such obligations should be combined as a single performance obligation. The transaction price for each development agreement is determined based on the amount of consideration we expect to be entitled to for satisfying all performance obligations within the agreement.

We assess the nature of the combined performance obligation to determine whether the combined performance obligation is satisfied over time or at a point in time and, if over time, the appropriate method of measuring progress for purposes of recognizing revenue. In arrangements where we satisfy performance obligation(s) over time, we recognize development revenue typically using an input method based on our costs incurred relative to the total expected cost which determines the extent of our progress toward completion. As part of the accounting for these arrangements, we must develop estimates and assumptions that require judgment to determine the transaction price and progress towards completion. We review our estimate of the transaction price and progress toward completion based on the best information available to recognize the cumulative progress toward completion as of the end of each reporting period, and make revisions to such estimates as necessary.

We also generate revenue from development or collaboration agreements that do not include upfront or milestone-based payments and generally recognize revenue on these types of agreements based on the timing of development activities.

Other Revenue

Other revenue consists of license and royalty revenue and grant revenue. We recognize revenue from license agreements when the license is transferred to the customer and the customer is able to use and benefit from the license. For contracts that include sales-based royalties, we recognize revenue at the later of (i) when the related sales occur, or (ii) when the performance obligation to which some or all of the royalty has been allocated has been satisfied.

In March 2020, we entered into an agreement to settle intellectual property infringement claims, in which we received a $3.5 million payment in exchange for a perpetual license under certain Fluidigm intellectual property. The settlement is considered a multiple-element arrangement with each element accounted for individually. Accordingly, $3.1 million of the proceeds was recognized as license revenue and $0.4 million was offset against legal costs.

We receive grants from various entities to perform research and development activities over contractually defined periods. Grant revenue is not accounted for under ASC 606 Revenue from Contracts with Customers, as the grant agreement is not with a customer. As there is no authoritative U.S. GAAP guidance for grants awarded to for-profit entities, we have applied the guidance in ASC 958 Not-for-Profit Entities by analogy. Revenue is generally recognized provided that the conditions under which the grants were provided have been met and any remaining performance obligations are perfunctory.

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 2020, 2019, or 2018, and no single customer represented more than 10% of total accounts receivable at December 31, 2020, or 2019.

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, net

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. 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.

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, 2020, 2019, and 2018 was $3.1 million, $3.6 million, and $4.2 million, respectively.

Leases

We adopted Accounting Standards Update (ASU) 2016-02, Leases (Topic 842) on January 1, 2019 using the modified retrospective method. In accordance with Topic 842, we determine if an arrangement is a lease, or contains a lease, at inception. Operating leases are included in operating lease right-of-use (ROU) assets, net and current and non-current operating lease liabilities in our consolidated balance sheets. ROU assets represent our right-to-use an underlying asset for the lease term and lease liabilities represent our obligation to make lease payments arising from the lease. Operating lease ROU assets and liabilities are recognized at the commencement date based on the present value of lease payments over the lease term. As most of our leases do not provide an implicit rate, we generally use our incremental borrowing rate based on the estimated rate of interest for collateralized borrowing over a similar term of the lease payments at commencement date. Significant judgment is required in determining the incremental collateralized borrowing rate. Lease expense for lease payments is recognized on a straight-line basis over the lease term.

We elected the short-term lease recognition exemption for all leases that qualify. 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 not to 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.

Business Combinations, Goodwill, Intangible Assets and Other Long-Lived Assets

We have completed acquisitions of businesses in the past and may acquire additional businesses or technologies in the future. The results of businesses acquired in a business combination are included in our consolidated financial statements from the date of acquisition. We allocate the purchase price, which is the sum of the consideration provided in a business combination, to the identifiable assets and liabilities of the acquired business at their acquisition date fair values. The excess of the purchase price over the amount allocated to the identifiable assets and liabilities, if any, is recorded as goodwill. Determining the fair value of assets acquired and liabilities assumed requires management to use significant judgment and estimates, including the selection of valuation methodologies and estimates of future revenue.

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, economic downturns and other macroeconomic events, including the current COVID-19 pandemic, 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 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 an impairment loss equal to the difference would be recorded to goodwill. There were no indicators of impairment in 2020. 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 were not used in then current products and were not expected to be used in future product offerings.

Deferred Grant Income

In September 2020, we executed a definitive contract with the National Institutes of Health (NIH) for a project under the NIH Rapid Acceleration of Diagnostics (RADx) program. The definitive contract, which amended the letter contract we entered into with the NIH in July 2020 (collectively, the NIH Contract), has a total value of up to $34.0 million upon the achievement of certain milestones. Proceeds from the NIH Contract will be used primarily to expand production capacity.

Accounting for the NIH Contract does not fall under ASC 606, Revenue from Contracts with Customers, as the NIH will not benefit directly from our expansion or product development. As there is no authoritative guidance under U.S. GAAP on accounting for government assistance to for-profit business entities, we applied International Accounting Standards (IAS) 20, Accounting for Government Grants and Disclosure of Government Assistance, by analogy when accounting for the NIH Contract payments to Fluidigm.

The NIH Contract proceeds used for production capacity expansion meet the definition of grants related to assets as the primary purpose for the payments is to fund the purchase and construction of capital assets to scale up production capacity. Under IAS 20, government grants related to assets are presented in the statement of financial position either by setting up the grant as deferred income or by deducting the grant in arriving at the carrying amount of the asset. Either of these two methods of presentation of grants related to assets in financial statements are regarded as acceptable alternatives under IAS 20. We have elected to record the grants received as deferred income using the first method.

Under IAS 20, grant proceeds are recognized when there is reasonable assurance the conditions of the grant will be met and the grant will be received. With the NIH Contract, this occurs when either each milestone has been accepted by NIH or management concludes the conditions of the grant have been substantially met. Deferred income related to production capacity expansion will be amortized over the period of depreciation for the related assets as a reduction of depreciation expense. Deferred income related to reimbursement of operating expenses is recorded as a reduction of those expenses incurred to date.

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 for the 2018 Notes, which was recorded in additional paid-in-capital and which 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 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 at conversion in the first quarter of 2019. We determined the fair value of the 2018 Notes using valuation techniques that required 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 in the fourth quarter of 2019. This amount represented 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 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.

See Note 9 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, 2020 and 2019. The convertible notes are presented at their carrying value, with fair value disclosures made in Note 11. 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 and investments in treasury securities are classified as Level I because they are valued using quoted market prices. Our convertible notes are not regularly traded and it is difficult to estimate a reliable and accurate market price for these securities. The estimated fair values for these securities

represent Level III valuations because a fair value for these securities cannot be determined by using readily observable inputs or measures, such as market prices. Fair values were estimated using pricing models and risk-adjusted value ranges.

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 $1.6 million, $3.4 million and $2.2 million during 2020, 2019, and 2018, respectively.

Stock-Based Compensation

We account for stock options, restricted stock units (RSU) and performance stock units (PSU) granted to employees and directors and stock purchases under ESPP based on the fair value of the awards at the date of grant. 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.

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.

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, 2020, 2019, and 2018 are as follows (in thousands):

	Foreign Currency Translation Adjustment	Unrealized Gain (Loss) on Investments	Accumulated Other Comprehensive Income (Loss)
Ending balance at December 31, 2018	$ (687)	$ —	$ (687)
Change during the year	69	36	105
Ending balance at December 31, 2019	(618)	36	(582)
Change during the year	730	(36)	694
Ending balance at December 31, 2020	$ 112	$ —	$ 112

Immaterial amounts of unrealized gains and losses have been reclassified into the consolidated statement of operations for the years ended December 31, 2020, 2019 and 2018.

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,		
	2020	2019	2018
Stock options, restricted stock units and performance stock units	7,507	5,189	4,354
2019 Convertible Notes	18,966	18,966	—
2019 Convertible Notes potential make-whole shares	837	3,182	—
2018 Convertible Notes	—	—	19,035
2018 Convertible Notes potential make-whole shares	—	—	757
2014 Convertible Notes	19	19	916
Total	27,329	27,356	25,062

Recent Accounting Changes and Accounting Pronouncements

Adoption of New Accounting Guidance

In August 2018, the U.S.-based Financial Accounting Standards Board (FASB) issued Accounting Standards Update (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 became effective for fiscal years beginning after December 15, 2019. The adoption of the new guidance did not 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 became effective for annual and interim goodwill impairment testing performed for our fiscal year beginning January 1, 2020. The adoption of the new guidance did not 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 lease standard. These ASUs were 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 resulted in an adjustment of approximately $0.1 million to reduce the accumulated deficit component of stockholders' equity and decrease current assets by the same amount in our consolidated balance sheet.

Recent Accounting Pronouncements

In August 2020, the FASB issued ASU 2020-06 Debt-Debt with Conversion and Other Options (Subtopic 470-20) and Derivatives and Hedging-Contracts in Entity's Own Equity (Subtopic 815-40): Accounting for Convertible Instruments and Contracts in an Entity's Own Equity. The amendment to this ASU reduces the number of accounting models for convertible instruments and allows more contracts to qualify for equity classification, which is expected to result in more convertible instruments being accounted for as a single unit, rather than being bifurcated between debt and equity. The new guidance is effective for fiscal years beginning after December 15, 2021. We are currently evaluating the impact of adoption on our consolidated financial statements.

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 simplify U.S. GAAP for Topic 740 by clarifying and amending existing guidance for, among other items, 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. The adoption of the new guidance is not expected to have a significant impact on our financial results.

3. Business Combination

On January 17, 2020, we completed the acquisition of all of the outstanding shares of InstruNor AS, a privately held Norwegian company (InstruNor). InstruNor is a provider of the only fully integrated sample preparation system for flow and mass cytometry. The acquisition of InstruNor supports our entry into the sample preparation market for cytometry analysis and expands our capabilities to include fully automated sample preparation for flow and mass cytometry. The purchase price of $7.2 million included approximately $5.2 million in cash and 485,451 shares of our common stock valued at the closing price on the effective date of $4.22.

The acquisition was accounted for in accordance with ASC 805, Business Combinations. The assets acquired and liabilities assumed were recorded at their estimated fair values at the InstruNor acquisition date. Developed technology was valued using a discounted cash flow model for which the most sensitive assumption was revenue growth rate. There have been no measurement period adjustments recognized since the acquisition date. Non-tax deductible goodwill of $2.2 million was calculated as the purchase price less the fair value of the net assets acquired as follows (in thousands):

Purchase price:		
Cash consideration paid on closing to former equity holders	$	5,165
Non-cash consideration common shares		2,049
Total purchase price	$	7,214
Assets acquired:		
Cash and cash equivalents	$	11
Accounts receivable		32
Other receivables		13
Inventories, net		153
Developed technology		5,380
Liabilities assumed:		
Accounts payable		14
Other current liabilities		15
Deferred tax liability, net		566
Fair value of identifiable net assets acquired	$	4,994
Goodwill acquired on acquisition	$	2,220

4. NIH Contract

In September 2020, we executed a contract with the NIH (the NIH Contract) for a project under the RADx program. The RADx program provides grants to support a range of new lab-based and point-of-care tests that could significantly increase the number, type and availability of COVID-19 tests. The NIH Contract has a total value of up to $34.0 million upon the achievement of certain milestones. Proceeds from the NIH Contract will be used primarily to expand production capacity and, to a lesser extent, to offset applicable operating expenses. We expect to complete the contract in 2021.

The NIH has the right to terminate the contract for convenience. In the event of termination for convenience, Fluidigm will be paid a percentage of the contract price reflecting the percentage of the work performed prior to the notice of termination, plus reasonable charges. In the event of termination for cause due to our default, NIH is not liable for supplies or services not accepted.

If we fail to deliver within the time specified in the contract and the delay is due to Fluidigm's fault or negligence, we are required to pay liquidated damages in the amount of 33% of the amount(s) already disbursed to date under the contract within six months from the date of termination. We do not currently expect to pay any liquidated damages and are in compliance with the terms of the contract. We are working with the NIH continuously to ensure we are in compliance with the contract requirements and milestones.

The following table summarizes the activity under the NIH Contract through December 31, 2020 (in thousands):

Total grant proceeds reasonably assured	$	25,436
Amounts applied against research and development expenses		1,488
Total deferred grant income	$	23,948
Short-term deferred grant income	$	2,912
Long-term deferred grant income		21,036
Total deferred grant income	$	23,948
Funding received	$	25,436

Short-term deferred grant income represents future research and development costs expected to be funded by the NIH Contract over the next year, and it is included in other accrued liabilities on the balance sheet at December 31, 2020. The long-term deferred grant income represents the portion of the funding received in 2020 attributable to manufacturing capacity expansion, of which we have incurred $10.2 million of capital expenditures through December 31, 2020. The majority of this amount is included in construction-in-progress, which is included in property and equipment, net in the consolidated balance sheet as of December 31, 2020 (see Note 8).

5. Development Agreement

Effective March 31, 2020, we signed an OEM Supply and Development Agreement (Development Agreement) with a customer. Under the Development Agreement, Fluidigm will develop products based on our microfluidics technology. The Development Agreement provides up-front and periodic milestone payments of up to $11.7 million during the development stage. The development stage is expected to last approximately one year from the date of the agreement. We recognized $8.8 million of development revenue from this agreement for the year ended December 31, 2020.

6. Revenue

Disaggregation of Revenue

The following table presents our revenue for the year ended December 31, 2020, 2019, and 2018, respectively, based on geographic area and by source (in thousands):

	Year Ended December 31,		
	2020	2019	2018
Geographic Markets:			
Americas	$ 74,586	$ 47,016	$ 51,172
EMEA	37,776	40,024	36,617
Asia-Pacific	25,782	30,203	25,175
Total	$ 138,144	$ 117,243	$ 112,964

	Year Ended December 31,		
	2020	2019	2018
Source:			
Instruments	$ 45,536	$ 50,004	$ 45,491
Consumables	54,408	45,412	48,159
Product revenue	99,944	95,416	93,650
Service revenue	22,579	21,277	19,314
Development revenue	8,865	—	—
Other revenue:			
License and royalty revenue	3,163	—	—
Grant revenue	3,593	550	—
Total other revenue	6,756	550	—
Total	$ 138,144	$ 117,243	$ 112,964

Unfulfilled Performance Obligations

We reported $20.0 million of deferred revenue on our December 31, 2019 consolidated balance sheet. During the twelve months ended December 31, 2020, $10.7 million of the opening balance was recognized as revenue and $12.2 million of net additional advance payments were received from customers, primarily associated with instrument service contracts. At December 31, 2020, we reported $21.5 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, 2020 (in thousands):

Fiscal Year	Expected Revenue [1]
2021	$ 12,492
2022	6,734
2023	3,285
Thereafter	1,634
Total	$ 24,145

(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.

7. Goodwill and Intangible Assets, net

In connection with our acquisition of DVS in February 2014, we recognized goodwill of $104.1 million and $117.7 million of developed technology. In the first quarter of 2020, we recognized $2.2 million (Euro 2.0 million) of goodwill from the InstruNor acquisition and $5.4 million (Euro 4.9 million) of developed technology (see Note 3). As the goodwill and developed technology from the InstruNor acquisition are recorded in the functional currency of our European operations, which is the Euro, these balances are revalued each period and the U.S. dollar value of these assets will fluctuate as foreign exchange rates change. We are amortizing InstruNor developed technology over 8.0 years.

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. Qualitative assessment includes assessing significant events and circumstances such as our current results, assumptions regarding future performance, strategic initiatives and overall economic factors, including the ongoing global COVID-19 pandemic and macroeconomic developments to determine the existence of potential indicators of impairment and assess if it is more likely than not that the fair value of our reporting unit or intangible assets is less than their carrying value. If indicators of impairment are identified, a quantitative impairment test is performed.

During the first quarter of fiscal 2020, the Company assessed whether the current and potential future impact of the COVID-19 pandemic represented an event which necessitated an impairment review. No impairment was recorded as a result of the quantitative assessment performed. In addition, the Company performed its annual impairment assessment and there were no indicators of impairment identified.

Intangible assets also include other patents and licenses, which are included in other non-current assets. Intangible assets, net, were as follows (in thousands):

	December 31, 2020			
	Gross Amount	Accumulated Amortization and Translation	Net	Weighted-Average Amortization Period
Developed technology	$ 117,658	$ (77,452)	$ 40,206	9.9 years
Patents and licenses	$ 11,256	$ (9,238)	$ 2,018	7.5 years

	December 31, 2019			
	Gross Amount	Accumulated Amortization and Translation	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

Total amortization expense for the years ended December 31, 2020, December 31, 2019, and December 31, 2018 was $12.8 million, $12.2 million and $12.3 million, respectively.

Based on the carrying value of intangible assets, net, as of December 31, 2020, the annual amortization expense is expected to be as follows (in thousands):

Fiscal Year	Developed Technology Amortization Expense	Patents and Licenses Amortization Expense	Total
2021	$ 11,944	$ 761	$ 12,705
2022	11,944	678	12,622
2023	11,944	572	12,516
2024	2,144	7	2,151
2025	744	—	744
Thereafter	1,486	—	1,486
Total	$ 40,206	$ 2,018	$ 42,224

8. Balance Sheet Details

Cash, Cash Equivalents and Restricted Cash

Cash, cash equivalents and restricted cash consisted of the following as of December 31, 2020 and 2019 (in thousands):

	December 31,	
	2020	2019
Cash and cash equivalents	$ 68,520	$ 21,661
Restricted cash	1,016	2,075
Total cash, cash equivalents, and restricted cash	$ 69,536	$ 23,736

Short-term restricted cash of approximately $16 thousand 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 as of December 31, 2020.

Inventories, net

Inventories, net consisted of the following as of December 31, 2020 and 2019 (in thousands):

	December 31,	
	2020	2019
Raw materials	$ 8,292	$ 6,133
Work-in-process	1,214	659
Finished goods	10,183	7,092
Total inventories, net	$ 19,689	$ 13,884

Property and Equipment, net

Property and equipment, net consisted of the following as of December 31, 2020 and 2019 (in thousands):

	December 31,	
	2020	2019
Computer equipment and software	$ 4,240	$ 3,997
Laboratory and manufacturing equipment	18,107	19,325
Leasehold improvements	7,203	7,788
Office, furniture and fixtures	1,994	1,824
Property and equipment, gross	31,544	32,934
Less accumulated depreciation and amortization	(23,989)	(24,954)
Construction-in-progress	9,976	76
Property and equipment, net	$ 17,531	$ 8,056

Accrued Compensation and Related Benefits

Accrued compensation and related benefits consisted of the following as of December 31, 2020 and 2019 (in thousands):

	Year Ended December 31,	
	2020	2019
Accrued incentive compensation	$ 7,842	$ 1,589
Accrued vacation	3,367	2,249
Accrued payroll taxes and other	2,578	1,322
Accrued compensation and related benefits	$ 13,787	$ 5,160

Warranties

Activity for our warranty accrual for the years ended December 31, 2020 and 2019, which is included in other accrued liabilities, is summarized below (in thousands):

	Year Ended December 31,	
	2020	2019
Beginning balance	$ 1,390	$ 863
Accrual for current period warranties	1,028	1,386
Warranty costs incurred	(755)	(859)
Ending balance	$ 1,663	$ 1,390

9. Convertible Notes and Credit Facility

2014 Senior Convertible Notes (2014 Notes)

In February 2014, we closed an underwritten public offering of $201.3 million aggregate principal amount of our 2014 Notes. 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 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 approximately 3.0%. 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 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. We have retired the majority of the 2014 Notes through the issuance of the 2018 Notes and 2019 Notes, as discussed below. As of December 31, 2020, there was $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.

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 were to mature 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.

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. $51.8 million of the proceeds of the 2019 Notes were used to retire $50.2 million aggregate principal amount of our 2014 Notes, leaving $1.1 million of the 2014 Notes outstanding. 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 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 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 capitalized as debt issuance costs and are recorded as an offset to the carrying value of the 2019 Notes. The debt issuance costs are amortized over the expected term of the 2019 Notes using the effective interest method through the maturity date of December 1, 2024. The effective rate on the 2019 Notes is 6.2%.

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

	December 31,	
	2020	2019
2.75% 2014 Notes due 2034		
Principal amount	$ 1,079	$ 1,079
Unamortized debt discount	(16)	(18)
Unamortized debt issuance cost	(4)	(4)
	$ 1,059	$ 1,057
5.25% 2019 Notes due 2024		
Principal amount	$ 55,000	$ 55,000
Unamortized debt issuance cost	(1,835)	(2,236)
	$ 53,165	$ 52,764
Net carrying value of all Notes	$ 54,224	$ 53,821

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, 2020 under the Revolving Credit Facility was $15.0 million. There were no borrowings outstanding under the Revolving Credit Facility at December 31, 2020.

The Revolving Credit Facility is collateralized by substantially all our property, other than intellectual property. Until an amendment in April 2020, the Revolving Credit Facility was set to mature on August 2, 2020. The interest rate on outstanding loans under the Revolving Credit Facility was 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. Effective April 21, 2020, the Revolving Credit Facility was amended to extend the maturity date to August 2, 2022. In addition, we pay a quarterly unused revolving line facility fee of 0.75% per annum on the average unused facility. The quarterly unused line fee, which was previously based on the Maximum Amount, will now be based on the Borrowing Base. The annual commitment fee of $112,500 is unchanged.

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 as of December 31, 2020.

10. Leases

We have operating leases for buildings, equipment and vehicles. Existing leases have remaining terms of less than one year to ten 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, 2020	December 31, 2019
Operating lease right-of-use buildings	$ 41,132	$ 6,234
Operating lease right-of-use equipment	89	69
Operating lease right-of-use vehicles	679	355
Total operating lease right-of-use assets, gross	41,900	6,658
Accumulated amortization	(3,786)	(1,798)
Total operating lease right-of-use assets, net	$ 38,114	$ 4,860
Operating lease liabilities, current	$ 2,973	$ 1,833
Operating lease liabilities, non-current	38,178	4,323
Total operating lease liabilities	$ 41,151	$ 6,156
Weighted average remaining lease term (in years)	8.6 years	4.7 years
Weighted average discount rate	11.9 %	5.0 %

A new operating lease for our corporate headquarters in South San Francisco, California commenced in March 2020. We recorded a ROU asset of $35.7 million at the inception of the lease and an operating lease liability of $35.3 million. The lease term is approximately ten years. Future minimum lease payments over the life of the lease were discounted at a rate of 12.6%, which was our estimated incremental collateralized borrowing rate for the term of the lease at the inception of the lease.

The following table presents the components of lease expense for the year-ended December 31, 2020 and 2019, respectively (in thousands):

(in thousands)	Twelve months ended December 31, 2020	Twelve months ended December 31, 2019
Operating lease cost (including variable costs)	$ 9,682	$ 6,093
Variable costs including non-lease component	$ 2,336	$ 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	$ 5,265	$ 4,008

Future minimum lease payments under commenced non-cancelable operating leases are as of December 31, 2020 as follows (in thousands):

Fiscal Year	Minimum Lease Payments for Operating Leases
2021	$ 7,565
2022	7,161
2023	7,044
2024	7,196
2025	7,398
Thereafter	31,908
Total future minimum payments	$ 68,272
Less: imputed interest	(27,121)
Total	$ 41,151

11. 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, 2020						
	Amortized Cost	Gross Unrealized Gain	Gross Unrealized Loss	Fair Value	Cash and Cash Equivalents	Short-Term Marketable Securities	Restricted Cash
Assets:							
Cash	$ 47,818	$ —	$ —	$ 47,818	$ 47,818	$ —	$ —
Cash-restricted	1,016	—	—	1,016	—	—	1,016
Total cash and restricted cash	$ 48,834	$ —	$ —	$ 48,834	$ 47,818	$ —	$ 1,016
Available-for-sale:							
Level I:							
Money market funds	$ 20,702	$ —	$ —	$ 20,702	$ 20,702	$ —	$ —
Subtotal	$ 20,702	$ —	$ —	$ 20,702	$ 20,702	$ —	$ —
Total	$ 69,536	$ —	$ —	$ 69,536	$ 68,520	$ —	$ 1,016

	December, 31, 2019						
	Amortized Cost	Gross Unrealized Gain	Gross Unrealized Loss	Fair Value	Cash and Cash Equivalents	Short-Term Marketable Securities	Restricted Cash
Assets:							
Cash	$ 16,614	$ —	$ —	$ 16,614	$ 16,614	$ —	$ —
Cash-restricted	2,075	—	—	2,075	—	—	2,075
Total cash and restricted 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

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, 2020, and 2019.

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, 2020, 2019, and 2018. 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

The estimated fair values for these securities represent Level III valuations since a fair value for these securities cannot be determined by using readily observable inputs or measures, such as market prices. 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 and 2019 Notes at December 31, 2020 and 2019, respectively (in thousands):

	December 31, 2020			December 31, 2019		
	Par Value	Carrying Value	Fair Value	Par Value	Carrying Value	Fair Value
2014 Notes	$ 1,079	$ 1,059	$ 1,122	$ 1,079	$ 1,057	$ 1,122
2019 Notes	55,000	53,165	117,899	55,000	52,764	73,975
Total	$ 56,079	$ 54,224	$ 119,021	$ 56,079	$ 53,821	$ 75,097

12. Shareholders' Equity

2020 At-the-Market Offering

In March 2020, we entered into an Open Market Sale Agreement (Sale Agreement) with Jefferies LLC (Jefferies) to sell shares of our common stock having aggregate sales proceeds of up to $50 million, from time to time, through an "at-the-market" equity offering program under which Jefferies acts as sales agent. During the third quarter of 2020, we sold 2.5 million shares of our common stock pursuant to the Sale Agreement, for aggregate gross proceeds of $20.9 million. Our net proceeds from the sale of such shares of common stock were approximately $20.1 million, after deducting related expenses, including commissions of approximately $0.6 million and issuance costs of approximately $0.2 million.

InstruNor Acquisition

In January 2020, we completed the acquisition of all of the outstanding shares of InstruNor (see Note 3). The purchase price was approximately $7.2 million, consisting of $5.2 million in cash and 485,451 shares of our common stock.

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 9). 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.

At December 31, 2020, we had reserved shares of common stock for future issuance under equity compensation plans as follows:

(in 000s)	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	19	—	—
2011 Equity Incentive Plan	1,397	5,685	3,273
DVS Sciences Inc. 2010 Equity Incentive Plan	12	—	—
2017 Inducement Award Plan	207	187	—
2017 Employee Stock Purchase Plan	—	—	2,925
	1,635	5,872	6,198

13. Stock-Based Plans

Our board of directors sets the terms, conditions, and restrictions related to our 2017 Employee Stock Purchase Plan (ESPP) and the grant of stock options, RSUs and PSUs awards under our various stock-based plans. Our board of directors determines the number of awards to grant and also sets vesting criteria.

Generally, 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, or ratably over 16 quarters, both subject to the employees' continued employment. In May 2020, we granted 1.8 million retention RSUs that vest over 3 years with 50% of the RSUs vesting after one year and 25% of the RSUs vesting each year thereafter.

Incentive stock options and non-statutory stock options granted under the 2011 Equity Incentive Plan (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 .1 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 1.1 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 Plan under which incentive stock options, non-statutory stock options, 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. In May 2020, our board of directors authorized, and in June 2020, our stockholders approved, an increase in the number of shares reserved for issuance under the 2011 Plan of 1.4 million shares.

2009 Equity Incentive 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,		
	2020	2019	2018
Stock options			
Weighted average expected volatility	79.0 %	69.5 %	68.4 %
Weighted average expected term	3.8 years	4.3 years	4.7 years
Weighted average risk-free interest rate	2.6 %	1.9 %	2.7 %
Dividend yield	—	—	—
Weighted-average fair value per share	$ 2.60	$ 7.17	$ 3.45

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 various plans was as follows:

Restricted Stock Units:

	Number of Units (in 000s)	Weighted-Average Grant Date Fair Value per Unit
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
RSU granted	3,788	$ 4.06
RSU released	(1,139)	$ 7.04
RSU forfeited	(338)	$ 6.24
Balance at December 31, 2020	4,862	$ 4.98

The total intrinsic value of RSUs vested and released during the year ended December 31, 2020, 2019 and 2018 were approximately $8.0 million, $5.8 million and $6.8 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, 2020, the unrecognized compensation costs related to outstanding unvested RSUs under our equity incentive plans were $20.0 million. We expect to recognize those costs over a weighted average period of 2.6 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 some or all of 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.

***Stock Options*:**

	Number of Options (in 000s)	Weighted-Average Exercise Price per Option	Weighted-Average Remaining Contractual Life (in Years)	Aggregate Intrinsic Value(1) in (000s)
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
Options forfeited	(211)	$ 8.73		
Balance at December 31, 2019	2,027	$ 7.78	6.8	
Options granted	117	$ 4.05		
Options exercised	(100)	$ 4.84		$ 359
Option forfeited	(409)	$ 9.22		
Balance at December 31, 2020	1,635	$ 7.33	6.2	$ 834
Vested at December 31, 2020	1,358	$ 7.66	5.9	$ 644
Unvested awards at December 31, 2020	277	$ 5.71	7.8	$ 190

(1) Aggregate intrinsic value as of December 31, 2020 was calculated as the difference between the closing price per share of our common stock on the last trading day of 2020, which was $6.00, and the exercise price of the options, multiplied by the number of in-the-money options.

As of December 31, 2020, the unrecognized compensation costs related to outstanding unvested options under our equity incentive plans were $0.8 million. We expect to recognize those costs over a weighted average period of 1.4 years.

Performance-based Awards

Performance Stock Units with Market Conditions. Beginning in 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.

	Number of Units (in 000s)	Weighted-Average Grant Date Fair Value per Unit
Balance as 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
PSU granted	509	$ 4.82
PSU released	—	—
PSU forfeited	(94)	$ 14.26
Balance at December 31, 2020	962	$ 9.74

As of December 31, 2020, the unrecognized compensation costs related to these awards were $3.8 million. We expect to recognize those costs over a weighted average period of 1.4 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, the latest of which is December 31, 2021. As of December 31, 2020, there were approximately 48 thousand units of these awards outstanding with a weighted-average grant date fair value of $6.46 per unit.

2017 Employee Stock Purchase Plan

On August 1, 2017, our stockholders approved our 2017 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 had 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 was amortized over the remaining offering period.

In April 2020, our board of directors authorized, and in June 2020, our stockholders approved, an amendment and restatement of the ESPP that increased the number of shares reserved for issuance by an additional 3.0 million shares and made various other changes. Effective June 2020, our ESPP program was amended to offer a six-month offering period, with a new offering and purchase period commencing on the first trading day on or after May 31 and November 30 of each year. Employees are eligible under the amended program to participate through payroll deductions of up to 10% of their compensation. Employees may not purchase more than $25 thousand of stock for any calendar year. The purchase price of the shares sold under the ESPP is 85% of the lower of 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.

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

	For the Year Ended December 31,		
	2020	2019	2018
2018 retention bonus program	$ —	$ —	$ 2,809
Options, restricted stock units and performance share units	13,428	10,555	7,716
Employee stock purchase plan	1,023	838	498
Total stock-based compensation	$ 14,451	$ 11,393	$ 11,023

14. Income Taxes

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

	Year Ended December 31,		
	2020	2019	2018
Domestic	$ (46,277)	$ (59,900)	$ (47,600)
International	(7,824)	(6,805)	(13,820)
Loss before income taxes	$ (54,101)	$ (66,705)	$ (61,420)

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

	Year Ended December 31,		
	2020	2019	2018
Current:			
Federal	$ —	$ —	$ (27)
State	(31)	(31)	(19)
Foreign	(2,314)	(568)	(32)
Total current tax (expense) benefit	(2,345)	(599)	(78)
Deferred:			
State	—	—	—
Foreign	3,426	2,514	2,485
Total deferred benefit	3,426	2,514	2,485
Total benefit for income taxes	$ 1,081	$ 1,915	$ 2,407

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,		
	2020	2019	2018
Tax benefit at federal statutory rate	21.0 %	21.0 %	21.0 %
State tax expense, net of federal benefit	1.7	0.9	2.3
Foreign tax benefit (expense)	(0.9)	(0.1)	(1.1)
Change in valuation allowance	(11.4)	(6.0)	(19.2)
Federal research and development credit	1.1	0.7	1.5
Unrecognized tax benefit	(0.1)	(0.1)	(0.2)
Non-deductible interest/premium	(1.1)	(7.9)	—
Global Intangible Low-Tax Income (GILTI)	(3.9)	(5.6)	—
Net operating loss expiration	(3.3)	—	—
Other, net	(1.1)	—	(0.4)
Effective tax rate	2.0 %	2.9 %	3.9 %

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,	
	2020	2019
Deferred tax assets:		
Net operating loss carryforwards	$ 103,948	$ 105,702
Reserves and accruals	5,242	3,567
Depreciation and amortization	3,656	3,715
Tax credit carryforwards	18,268	17,267
Stock-based compensation	3,168	2,501
Right-of-use lease liability	9,451	1,097
Total gross deferred tax assets	143,733	133,849
Valuation allowance on deferred tax assets	(131,232)	(130,084)
Total deferred tax assets, net of valuation allowance	12,501	3,765
Deferred tax liabilities:		
Fixed assets and intangibles	(12,272)	(14,183)
Right-of-use asset	(8,694)	(783)
Total deferred tax liabilities	(20,966)	(14,966)
Net deferred tax liability	$ (8,465)	$ (11,201)

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 $1.1 million and $4.0 million during 2020 and 2019, respectively, and increased by $6.9 million during 2018. The changes in valuation allowance during 2020 and 2019 are mainly due to significant taxable losses and an increase in tax attributes. The changes 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 in 2019.

The valuation allowances of $131.2 million and $130.1 million as of December 31, 2020 and 2019, 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, 2020, 2019, and 2018 is as follows (in thousands):

	Valuation Allowance
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
Charges to earnings	—
Charges to other accounts	1,142
December 31, 2020	$ 131,226

As of December 31, 2020, we had net operating loss carryforwards for U.S. federal income tax purposes of $461.6 million, which expire beginning in 2021, and U.S. federal research and development tax credits of $9.6 million, which expire in beginning in 2021 through 2040. As of December 31, 2020, we had net operating loss carryforwards for state income tax purposes of $176.5 million, which expire beginning in 2021 through 2040, and California research and development tax credits of $12.5 million, which do not expire. As of December 31, 2020, we had $3.8 million of foreign net operating loss carryforwards which do not expire.

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 2020, we continued the Section 382 analysis as historically performed through December 31, 2020 and determined that an ownership change did not occur during the current year.

The aggregate changes in the balance of our gross unrecognized tax benefits during 2020, 2019, and 2018 were as follows (in thousands):

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
Increases in balances related to tax positions during a prior period		756
Increases in balances related to tax positions taken during current period		441
Decreases in balances related to tax positions taken during prior period		(144)
December 31, 2020	$	8,886

Accrued interest and penalties related to unrecognized tax benefits were included in the income tax provision and are immaterial as of December 31, 2020 and 2019. The uncertain taxes payable are recorded as a long-term liability on the balance sheet.

As of December 31, 2020, there were $1.6 million of 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.

On March 27, 2020, the Coronavirus Aid, Relief and Economic Security (CARES) Act was signed into law. The CARES Act includes provisions relating to refundable payroll tax credits, net operating loss carryback periods, alternative minimum tax credit refunds, modifications to the net interest deduction limitations and technical corrections to the tax depreciation methods for qualified improvement property. The CARES Act has an immaterial impact on our income taxes.

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 2012 are open to examination in various foreign countries.

15. 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 were $0.6 million for the years ended December 31, 2020 and 2019, and $0.4 million for the year ended December 31, 2018.

16. Information About Geographic Areas

We operate in one reporting segment that creates, manufactures, and markets a range of products and services, including instruments, consumables, reagents and software that are used by researchers and clinical labs worldwide. 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, 2020, 2019 and 2018 is included in Note 6 to the consolidated financial statements.

Sales to customers in the United States represented $72.0 million, or 52%, of total revenues for the year ended December 31, 2020. Sales to customers in the United States represented $43.4 million, or 37%, of total revenues for the year ended December 31, 2019 and $48.1 million, or 43%, for the year ended December 31, 2018.

Sales to customers in China were less than 10% of total revenues for the year ended December 31, 2020. Sales to customers in China represented $15.4 million, or 13%, of total revenues for year ended December 31, 2019, and $14.0 million, or 12%, of total revenues for 2018. Except for China, no other foreign country or jurisdiction had sales in excess of 10% of our total revenue during the years 2020, 2019 and 2018.

No individual customer represented more than 10% of our total revenues for the fiscal years ended December 31, 2020, 2019, and 2018 respectively. Revenues from our five largest customers were 23% for the year ended December 31, 2020 and 17% for both the years ended December 31, 2019 and 2018.

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

	December 31,	
	2020	2019
United States	$ 35,188	$ 907
Singapore	12,195	3,618
Canada	6,456	7,474
Asia-Pacific	1,048	243
EMEA	758	674
Total	$ 55,645	$ 12,916

The increase in the long-lived assets for the United States as of December 31, 2020 compared to the prior year end is due to a new ten-year lease for our South San Francisco headquarters (see Note 10). The increase in long-lived assets in Singapore is attributable to capital expenditures funded by the NIH Contract (see Note 4).

17. Commitments and Contingencies

Commitments

In the normal course of business, we enter into various contractual and legally binding purchase commitments. As of December 31, 2020, these commitments were approximately $12.9 million.

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.

Contingencies

In September 2020, a putative class action complaint alleging violations of the federal securities laws was filed against the Company (also naming our Chief Executive Officer and Chief Financial Officer as defendants) in the U.S. District Court for the Northern District of California (Reena Saintjermain, et al. v. Fluidigm Corporation, et al). The Court appointed a lead plaintiff and lead counsel in December 2020, and an amended complaint was filed on February 19, 2021. The complaint, as amended, seeks unspecified damages on behalf of a purported class of persons and entities who acquired our common stock between

February 7, 2019 and November 5, 2019 and alleges securities laws violations based on statements and alleged omissions made by the Company during such period. The Company intends to file a motion to dismiss the complaint, which motion is currently due to be filed in early April 2021. We believe the claims alleged in the complaint lack merit and we intend to defend this action vigorously.

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. We have not recorded any such liabilities. 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.

18. Quarterly Results of Operations (Unaudited)

Selected quarterly results of operations for the years ended December 31, 2020 and 2019 are as follows (in thousands, except for per share amounts):

2020	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Total revenue	$ 27,617	$ 26,058	$ 39,861	$ 44,608
Product and service gross profit	$ 13,002	$ 11,825	$ 20,799	$ 22,079
Net loss	$ (15,980)	$ (13,015)	$ (5,999)	$ (18,026)
Net loss per share, basic and diluted	$ (0.23)	$ (0.18)	$ (0.08)	$ (0.24)

2019	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Total revenue	$ 30,111	$ 28,196	$ 26,496	$ 32,440
Product and service gross profit	$ 16,990	$ 15,363	$ 13,838	$ 17,538
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)

19. Subsequent Event

On February 19, 2021, we and the National Institutes of Health entered into a modification of the NIH Contract (see Note 4) (the Modification). The Modification revised the milestones under the NIH Contract to include, in addition to the Advanta Dx SARS-CoV-2 RT-PCR Assay, the development and manufacture of a cartridge-based COVID-19 assay designed to provide a more integrated sample-to-answer workflow. The Modification also extended the period of performance under the NIH Contract through September 30, 2021. The Modification did not change the total NIH Contract value of up to approximately $34.0 million based upon our achievement of milestones.

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, 2020. 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, 2020, 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, 2020. 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, 2020.

The effectiveness of our internal control over financial reporting as of December 31, 2020 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, 2020 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 19, 2021, we and the National Institutes of Health (NIH) entered into a modification (the Modification) of our contract under the NIH Rapid Acceleration of Diagnostics program dated July 30, 2020 and amended September 28, 2020 (the NIH Contract). The Modification revised the milestones under the NIH Contract to include, in addition to the Advanta Dx SARS-CoV-2 RT-PCR Assay, the development and manufacture of a cartridge-based COVID-19 assay designed to provide a more integrated sample-to-answer workflow. The Modification also extended the period of performance under the NIH Contract through September 30, 2021. The Modification did not change the total NIH Contract value of up to approximately $34.0 million based upon our achievement of milestones.

The foregoing description of the Modification does not purport to be complete and is qualified in its entirety by reference to the Modification, which will be filed as an exhibit to the Company's Quarterly Report on Form 10-Q for the quarter ending March 31, 2021.

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, 2020				
Accounts receivable allowance	$ 6	$ 356	$ (6)	$ 356
Year ended December 31, 2019				
Accounts receivable allowance	$ 126	$ 179	$ (299)	$ 6
Year ended December 31, 2018				
Accounts receivable allowance	$ 391	$ 162	$ (427)	$ 126

	In thousands			
	Balance at Beginning of Period	Additions/ Charged to Expense	Deductions	Balance at End of Period
Year ended December 31, 2020				
Warranty allowance	$ 1,390	$ 1,028	$ (755)	$ 1,663
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

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, 2020 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.

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	Description of Securities.	Filed herewith		
4.3	Indenture, dated February 4, 2014, by and between Fluidigm Corporation and U.S. Bank National Association.	8-K	4.1	2/4/2014
4.4	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
4.5	Form of Global Note (included in Exhibit 4.4).	8-K	4.3	2/4/2014
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 4.6).	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
10.2B	Second Amendment to Lease between AP3-SF3 CT North, LLC and Fluidigm Corporation, dated February 25, 2020.	Filed herewith		
10.3†	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
10.4	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
10.5	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
10.6	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
10.7#	2009 Equity Incentive Plan of Fluidigm Corporation, as amended.	S-1	10.3	12/3/2010
10.7A#	Forms of agreements under the 2009 Equity Incentive Plan.	S-1	10.3A	12/3/2010
10.8#	Fluidigm Corporation 2011 Equity Incentive Plan, as amended effective June 23, 2020.	8-K	10.2	6/24/2020
10.8A#	Forms of agreements under the 2011 Equity Incentive Plan.	S-1/A	10.4A	1/28/2011
10.8B#	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
10.8C#	Forms of U.S. agreements under the 2011 Equity Incentive Plan.	SC TO-I	(d)(2)	8/23/2017
10.8D	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
10.8E	Rules of the Fluidigm Corporation 2011 Equity Incentive Plan for Options Granted to French Participants.	SC TO-I	(d)(4)	8/23/2017
10.8F	UK Sub-plan to the Fluidigm Corporation 2011 Equity Incentive Plan.	SC TO-I	(d)(5)	8/23/2017
10.8G#	Form of Restricted Stock Unit Agreement-Non-U.S. under the 2011 Equity Incentive Plan.	SC TO-I	(d)(6)	8/23/2017
10.8H#	Form of Stock Option Agreement-Non-U.S. under the 2011 Equity Incentive Plan.	SC TO-I	(d)(7)	8/23/2017
10.9#	Fluidigm Corporation 2017 Inducement Award Plan and related form agreements.	8-K	10.1	1/11/2017
10.10#	Fluidigm Corporation 2017 Employee Stock Purchase Plan, as amended and restated effective June 23, 2020.	8-K	10.1	6/24/2020
10.11#	Executive Bonus Plan.	10-K	10.25	3/28/2011
10.12†	Second Amended and Restated License Agreement between California Institute of Technology and the registrant, effective as of May 1, 2004.	10-Q	10.2	11/9/2020
10.12A†	First Addendum, effective as of March 29, 2007, to Second Amended and Restated License Agreement between California Institute of Technology and the registrant effective as of May 1, 2004.	10-Q	10.2A	11/9/2020
10.13†	Co-Exclusive License Agreement between President and Fellows of Harvard College and the registrant effective as of October 15, 2000.	10-Q	10.3	11/9/2020
10.13A†	First Amendment to Co-Exclusive License Agreement between President and Fellows of Harvard College and the registrant effective as of October 15, 2000.	10-Q	10.3A	11/9/2020
10.14†	Co-Exclusive License Agreement between President and Fellows of Harvard College and the registrant effective as of October 15, 2000.	10-Q	10.4	11/9/2020
10.15†	Co-Exclusive License Agreement between President and Fellows of Harvard College and the registrant effective as of October 15, 2000.	10-Q	10.5	11/9/2020
10.16†	Letter Agreement between President and Fellows of Harvard College and the registrant dated December 22, 2004.	10-Q	10.6	11/9/2020

Exhibit Number	Description	Incorporated by Reference From Form	Incorporated by Reference From Exhibit Number	Date Filed
10.17†	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
10.18†	Sublicense Agreement between DVS Sciences Inc. and Fluidigm Corporation, dated January 28, 2014.	10-Q/A	10.4	9/15/2014
10.19	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
10.19A	Default Waiver and First Amendment to Loan and Security Agreement, dated September 1, 2018, between the Company and Silicon Valley Bank.	10-K	10.13A	2/27/2020
10.19B	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
10.19C	Third Amendment to Loan and Security Agreement, dated April 21, 2020, between the Company and Silicon Valley Bank.	8-K	10.1	4/22/2020
10.20	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
10.21	Open Market Sale Agreement, dated as of March 4, 2020, between Fluidigm Corporation and Jefferies LLC.	8-K	1.1	3/5/2020
10.22†	Contract by and between the National Institutes of Health and the registrant effective as of July 30, 2020, as amended September 28, 2020.	10-Q	10.1	11/9/2020
10.23#	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
10.24#	Fluidigm Corporation 2020 Change of Control and Severance Plan.	10-Q	10.5	8/7/2020
10.25#	Endorsement Split-Dollar Life Insurance Agreement.	10-Q	10.5	11/7/2017
10.26#	Offer Letter to Stephen Christopher Linthwaite, dated July 14, 2016.	10-Q	10.1	5/8/2018
10.27#	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
10.28#	Offer Letter to Vikram Jog dated January 29, 2008.	S-1	10.17	12/3/2010
10.29#	Offer Letter to Bradley A. Kreger dated February 13, 2018.	10-K	10.18	3/18/2019
10.30#	Offer Letter to Colin McCracken dated April 12, 2019.	Filed herewith		
10.31#	Offer Letter to Nick Khadder dated April 6, 2020.	Filed herewith		
21.1	Subsidiaries of Fluidigm Corporation.	Filed herewith		
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		

Exhibit Number	Description	Incorporated by Reference From Form	Incorporated by Reference From Exhibit Number	Date Filed
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 Financial 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 this exhibit have been redacted in compliance with Regulation S-K Item 601(b)(10)(iv) or 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 25, 2021

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 **Stephen Christopher Linthwaite**	President and Chief Executive Officer (Principal Executive Officer); Director	February 25, 2021
/s/ Vikram Jog **Vikram Jog**	Chief Financial Officer (Principal Financial and Accounting Officer)	February 25, 2021
/s/ Carlos V. Paya **Carlos V. Paya**	Chairman of the Board of Directors	February 25, 2021
/s/ Nicolas M. Barthelemy **Nicolas M. Barthelemy**	Director	February 25, 2021
/s/ Gerhard F. Burbach **Gerhard F. Burbach**	Director	February 25, 2021
/s/ Laura M. Clague **Laura M. Clague**	Director	February 25, 2021
/s/ Bill W. Colston **Bill W. Colston**	Director	February 25, 2021
/s/ Ana K. Stankovic **Ana K. Stankovic**	Director	February 25, 2021

Exhibit 4.2

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

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 10.2B

CONFIRMATION AND SECOND AMENDMENT TO LEASE

This CONFIRMATION AND SECOND AMENDMENT TO LEASE ("**Confirmation/Second Amendment**") is made and entered into effective as of February 25, 2020, by and between AP3-SF3 CT NORTH, LLC, a Delaware limited liability company ("**Landlord**") and FLUIDIGM CORPORATION, a Delaware corporation ("**Tenant**").

R E C I T A L S:

A. Landlord and Tenant entered into that certain Lease dated as of March 20, 2019 (the "**Original Lease**"), as amended by that certain First Amendment to Lease dated April 26, 2019 ("**First Amendment**") which expanded the premises by 10,183 rentable square feet on the remainder of the eighteenth (18th) floor, for a total of 77,929 rentable square feet in Suite 2100 (the "**Premises**") of that certain building located at Two Tower Place, South San Francisco, California 94080 (the "**Building**"). The Original Lease, First Amendment and this Confirmation/Second Amendment shall hereinafter be referred to as the "**Lease**".

B. Except as otherwise set forth herein, all capitalized terms used in this Confirmation/Second Amendment shall have the same meaning as such terms have in the Lease.

C. Landlord and Tenant desire to amend the Lease to (i) confirm the commencement and expiration dates of the Lease Term, and (ii) adjust the Base Rent and Tenant's Share of Operating Expenses and add the Monthly ATIA Rent which Tenant has opted to exercise pursuant to the Tenant Work Letter attached to the Original Lease as **Exhibit B**, as hereinafter provided.

NOW, THEREFORE, in consideration of the foregoing Recitals and the mutual covenants contained herein, and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties hereto agree as follows:

A G R E E M E N T:

1. Confirmation of Dates. The parties hereby confirm that (a) the Premises are Ready for Occupancy, and (b) the term of the Lease commenced as of January 17, 2020 for a term of one hundred twenty-three (123) months ending on April 30, 2030 (unless sooner terminated as provided in the Lease). Tenant shall commence to pay rent on January 17, 2020 ("**Rent Commencement Date**").

2. Base Rent. Notwithstanding anything to the contrary in the Lease and effective as of the date hereof, Section 3 of the First Amendment, which replaced Section 8 of the Summary of the Lease, is deemed deleted in its entirety and replaced with the following:

Lease Period	Date	Monthly Installment of Base Rent**	Monthly Rental Rate per Rentable Square Foot***
****1 - 8*	1/17/2020 - 09/30/2020	$349,941.79	$5.99
9 - 12	10/01/2020 - 01/31/2021	$466,794.71	$5.99
13 - 24	02/01/2021 - 01/31/2022	$483,132.52	$6.20
25 - 36	02/01/2022 - 01/31/2023	$500,042.16	$6.42
37 - 48	02/01/2023 - 01/31/2024	$517,543.64	$6.64
49 - 60	02/01/2024 - 01/31/2025	$535,657.67	$6.87
61 - 72	02/01/2025 - 01/31/2026	$554,405.68	$7.11
73 - 84	02/01/2026 - 01/31/2027	$573,809.88	$7.36
85 - 96	02/01/2027 - 01/31/2028	$593,893.23	$7.62
97 - 108	02/01/2028 - 01/31/2029	$614,679.49	$7.89
109 - 120	02/01/2029 - 01/31/2030	$636,193.27	$8.16
121 - 123	02/01/2030 - 04/30/2030	$658,460.04	$8.45

* Prorated Initial Month 0 based on full month rate.

** The initial monthly installment of Base Rent amount was calculated by multiplying the initial monthly Base Rent rate per rentable square foot amount by the number of rentable square feet of space in the Premises, and the annual Base Rent amount was calculated by multiplying the initial monthly installment of Base Rent amount by twelve (12). In all subsequent Base Rent payment periods during the Lease Term commencing on the first (1st) day of the full calendar month

that is Lease month 13, the calculation of each monthly installment of Base Rent amount reflects an annual increase of three and one-half percent (3-1/2%) and each annual Base Rent amount was calculated by multiplying the corresponding monthly installment of Base Rent amount by twelve (12).
*** The amount identified in the column entitled "Monthly Rental Rate per Rentable Square Foot" are rounded amounts provided for informational purposes only.
**** Subject to abatement as provided in Article 3 below. The Base Rent for this eight (8) month period is calculated based on 58,421 rentable square feet in the Premises notwithstanding that Tenant is leasing the entire Premises (consisting of 77,929 rentable square feet); provided, however, that Tenant shall pay Tenant's Share of Operating Expenses, Tax Expenses and Utilities Costs based on 77,929 rentable square feet in the Premises for the entire Lease Term. **[per First Amendment]**

3. Recalculation of Allowance, Additional Allowance and Amortization Rent. Section 9 of the First Amendment is hereby deleted in its entirety and replaced with the following:

"9. Recalculation of Allowance, Additional Allowance and Amortization Rent. Effective as of the date hereof, (i) the reference to the Allowance in Section 3 of **Exhibit B** is deemed revised to be equal to $16,163,729.00 (based on 77,929 rentable square feet in the Premises), and (ii) the reference to the Additional Allowance in Section 3 of **Exhibit B** is deemed revised to be equal to $0.00, and (iii) the Amortization Rent in the example in Section 3 of **Exhibit B** is deemed equal to $0.00."

4. No Further Modification. Except as set forth in this Confirmation/Second Amendment, all of the terms and provisions of the Lease shall remain unmodified and in full force and effect.

5. Lender Consent. Landlord represents that it has obtained the consent to this Confirmation/Second Amendment of any lender having a security interest in the Building.

[Remainder of Page Intentionally Left Blank; Signatures Follow]

IN WITNESS WHEREOF, this Confirmation/Second Amendment has been executed as of the day and year first above written.

"**Landlord**":

AP3-SF3 CT NORTH, LLC,
a Delaware limited liability company

By: /s/ Michael Gerrity
Name: Michael Gerrity
Its: President

"**Tenant**":

FLUIDIGM CORPORATION,
a Delaware corporation

By: /s/ Bradley Kreger
Name: Bradley Kreger
Its: SVP, Global Operations

Exhibit 10.30

April 12, 2019

Personal and Confidential
By E-mail

Colin McCracken
Paddock View. Pettoch Farm
Low Coylton
KA6 6HD
United Kingdom
Dear Colin:

RE: Conditional Offer of Employment

On behalf of Fluidigm Canada Inc. (the "**Company**"), we are very pleased to offer you continued full-time employment with the Company. This letter provides the details of our offer and the procedure for returning your acceptance. Please read it carefully, and let us know if you have any questions.

Once you have signed and returned this letter, it will become a binding agreement between you and the Company (referred to herein as the "**Agreement**"). Please keep a copy of this Agreement for your own records. For certainty, the terms of this Agreement shall supersede and replace any and all prior agreements or arrangements in respect of your employment with the Company and any of its affiliates including, for certainty, your offer letter dated November 30, 2018 with Fluidigm UK Limited.

Please note that this offer of continued employment is conditional upon you obtaining the appropriate work permit or other necessary approvals so that you are eligible to work in Canada. If this condition is not met on the date that is immediately prior to your Start Date for any reason, then this offer of continued employment will be null and void, and you will not become an employee of the Company, even if you have already executed this Agreement. In that circumstance, you will continue to be employed by Fluidigm UK Limited.

1. **Position and Start Date.** You will be employed in the position of Chief Commercial Officer starting on September 1, 2019 or such other date as mutually agreed-upon (the "**Start Date**"). In your position, you will report directly to Christopher Linthwaite, President and CEO of Fluidigm Corporation, and perform the duties as outlined in the attached job description. It is to be expected that your responsibilities will adjust with the growth of the Company. For certainty, the Company shall recognize your prior period of service with Fluidigm UK Limited commencing on March 4, 2019 for purposes relating to your employment with the Company. Prior to your Start Date, you undertake that you will provide proof of your eligibility to work in Canada upon the request of the Company.

2. **Base Salary.** Your starting annual salary with the Company shall be paid to you in Canadian dollars, and shall be set at the equivalent amount to USD $335,000.00, which shall be converted into Canadian dollars at the posted exchange rate at which the Royal Bank of Canada would buy USD on your Start Date. This amount, once converted into Canadian dollars, shall be your "**Base Salary**". Your Base Salary will be payable to you by direct deposit in equal bi-monthly instalments, and these instalments will be subject to all applicable tax, statutory withholdings and other deductions.

3. **Bonus.** You will be eligible to participate in the Company's bonus program, in accordance with its terms (the "**Program**"). The payment of a bonus and the bonus amounts are within the Company's discretion; they are not guaranteed and may fluctuate depending upon Company and individual performance. All payments, rights or entitlements under the Program will be governed by the terms of the formal documents or policies establishing the Program and your rights on termination of employment with respect to bonus will be governed by the termination provisions of this Agreement.

4. **Relocation**. As previously agreed, your relocation package will include the following:

   (a) Up to USD $88,000 (coverted into Canadian dollars as described in Section 2 above) of relocation expenses (either directly or indirectly through a third-party relocation company), which will be re-paid by you to the Company if your employment is terminated either by you, or by the Company other than for Cause (as defined in The Fluidigm Corporation Change of Control and Severance Plan (the "Plan")), as follows: (i) 100% during the first 12 months after you relocate from the United Kingdom to Canada; or (ii) if such termination occurs in the second 12-month period after your relocation, 1/12th of the total amount of the relocation expenses multiplied by the number months remaining in such second 12-month period;

   (b) Reimbursement to you, for up to two (2) years following your relocation from the United Kingdom to Canada, of up to USD $5,700 (converted into Canadian dollars as described in Section 2 above) per month for vehicle and other living expenses incurred in Canada; and

   (c) Reimbursement to you for the purchase of airline tickets for premium economy seats for all members of your immediate family who have relocated to Canada with you, for up to two (2) trips to the United Kingdom from Canada during each of the two (2) consecutive 12-month periods following your relocation to Canada.

   Upon expiration of the reimbursement periods stated in subsections 4(b) and (c) above, Company and you may enter into discussions to extend such periods.

5. **Group Insurance Plans.** Upon your Start Date, you will be eligible to enrol in the Company's group-insured employee benefit plans, including medical and dental (the "**Group Insurance Plan**"). If a provider (e.g., an insurance company) refuses for any reason (whether under its own interpretation of the terms of the relevant insurance policy or otherwise) to provide the relevant benefit(s) to you under the applicable Group Insurance Plan, then the Company shall not be liable to provide such benefit(s), or provide you with any additional compensation in lieu of such benefit(s). Any payments, rights or entitlements under the Group Insurance Plan will be governed by the terms of the formal plan documents or policies establishing the benefit in issue. Your rights on termination of employment to continued participation in the Group Insurance Plan will be governed by the termination provisions of this Agreement.

   In addition, Company agrees to bridge your current life insurance policy of four (4) times your Base Salary during the term of your employment in Canada.

6. **Company Group RRSP.** Upon your Start Date, you will be eligible to enrol in the Company's Group RRSP plan (the "**Group RRSP Plan**"). The Company will match your contributions, up to a maximum of 5% of your Base Salary, subject to the terms and conditions of the Group RRSP plan and the annual maximum contribution limit established by the Canada Revenue Agency. Your rights on termination of employment to continued participation in the Group RRSP will be governed by the termination provisions of this Agreement.

7. **Vacations, Public Holidays and Leaves.** You will be eligible for twenty eight (28) days of vacation time per calendar year, with vacation pay to be provided to you in accordance with the *Employment Standards Act* of Ontario, as amended from time to time (the "**ESA**"). All of your compensation under this Agreement includes vacation pay. You may take vacation at such time or times as you and the Company mutually agree in writing. Your vacation time will accrue at a rate of 2.33 days per month of service. Note that while service continues to accrue for purposes of calculating entitlement to vacation time during any statutory unpaid leave of absence, vacation pay does not accrue during this time. The Company encourages you to use all earned vacation each year but requires that you take your minimum statutory entitlement every year. In the event that you do not take all vacation time in any given year, you will be permitted to carry over any additional days above your statutory entitlement, to be used by no later than December 31st of the following calendar year. Subject only to any requirements under the ESA, any vacation carried over from a previous year that is not used by this date shall be forfeited by you. You will also be entitled to all public holidays and unpaid leaves of absence as per the requirements of the ESA.

8. **Company Expectations.** You agree to provide and perform your duties and services to the Company in a faithful and diligent manner, to the best of your ability, on a full-time basis, and to devote all of your working time, attention, skill and effort to the Company's business. You agree that you will not be employed or engaged in any capacity in any other business without the prior written permission of the General Counsel. You agree that in carrying out your obligations pursuant to this Agreement, you shall act at all times in accordance with all applicable laws and regulations and government policies. You also agree that you will adhere to all Company policies, rules, regulations, systems and procedures (collectively the "**Policies**") that are in place from time to time.

   You agree that during your employment with the Company, you will not improperly use, disclose, or induce the Company to use any proprietary information or trade secrets of any former employer or other person or entity with which you have an obligation to keep such items in confidence. You further agree that you have not, and will not, bring onto the Company's premises or transfer onto the Company's technology systems any unpublished document, proprietary information or trade secrets belonging to any such third party unless disclosure to, and use by, the Company has been consented to in writing by such third party.

   You represent and warrant that you have no other agreements, relationships, or commitments to any other person or entity that conflict with the provisions of this Agreement, your obligations to the Company under this Agreement, or your ability to become employed and perform the services for which you are being hired by the Company. You further agree that if you have signed a confidentiality agreement, non-solicitation or non-competition agreement, or any similar type of agreement and/or covenant, with any former employer or other entity, you will comply with the terms of any such agreement/covenant(s). You represent and warrant that after undertaking a careful search (including searches of your computers, cell phones, electronic devices, and documents), you have returned all property and confidential information belonging to all prior employers (and/or other third parties you have performed services for in accordance with the terms of your applicable agreement). Moreover, you agree to fully indemnify the Company, its directors, officers, agents, employees, investors, shareholders, administrators, affiliates, divisions, subsidiaries, predecessor and successor

corporations, and assigns for all verdicts, judgments, settlements, and other losses incurred by any of them resulting from your breach of my obligations under any agreement with a third party to which you are a party or obligation by which you are bound, as well as any reasonable attorneys' fees and costs if the plaintiff is the prevailing party in such an action, except as prohibited by law.

9. **Privacy.** You understand and consent that the Company and its affiliates may collect, use, store or disclose personal information about you or any of your dependents or beneficiaries (the "**Employee Personal Information**") as required for those purposes necessary for, or beneficial to, the conduct of the employment relationship (including benefits administration as well as for the maintenance and administration of the Company's compliance hotline). You also understand that the Company may disclose your Employee Personal Information to a third party administrator for the purpose of administering your employment relationship with the Company or to service providers (such as legal, finance and accounting, information technology and human resources advisors and/or similar consultants and advisors), law enforcement or government authorities as necessary to comply with legal requirements or in the course of a legal action, and to legitimate recipients of communications under applicable laws, where required by law or necessary for the purpose of, or in connection with, any legal proceedings or in order to maintain or administer the Company's compliance hotline and you hereby consent to such disclosure.

   You acknowledge and consent to the storage and maintenance of your Employee Personal Information on a Company/worldwide Human Resources system in the United States. By signing this Agreement you are confirming your acceptance of this situation and authorizing the collection, use and transfer of your personal data, including your sensitive personal data, from the Company to its parent company in the United States.

10. **Changes.** Things change over time. As circumstances change, the Company may also make changes to certain terms and conditions of your employment. For example, we may change your reporting relationships, your duties or responsibilities, or the location of your employment. In addition, we reserve the right to unilaterally change the terms and conditions of any Policies, as well as any benefit plan or program, and bonus incentive or other compensation program. However, we agree that we will only make such changes after providing you with sixty (60) days of advance written notice in writing (unless the change(s) are not material, or are permitted to be made without advance notice under applicable law), and you agree that this prior notice shall constitute reasonable notice of any such change. You understand and agree that any such changes shall not constitute a constructive dismissal of your employment. (For purposes of this paragraph, reference to change also means discontinuance).

11. **Termination of Employment.** It is always difficult to consider termination, just when a new relationship is beginning; however, we believe it is important that you be aware of and agree to our termination policy. All of the termination provisions set out below will apply throughout your employment with the Company, even if your position, duties and responsibilities or compensation change significantly while you are with us.

    (a) **Voluntary Termination/Resignation.** You may terminate your employment at any time by giving the Company two (2) weeks' prior written notice; however, it is understood and agreed that the Company shall be entitled to waive all or part of that notice and accept your resignation at an earlier effective date. If we do so, you will be paid only to the date upon which we waive your notice.

    (b) **Termination for Cause.** The Company may terminate your employment for just cause, at any time, without any notice or pay in lieu of notice or benefit continuation whatsoever, subject only to any further or other minimum entitlements that you have under the ESA, if

any. For the purposes of this Agreement, "**Cause**" shall mean (i) an act of dishonesty in connection with your responsibilities as an employee, (ii) your conviction of an indictable criminal offence or any other criminal conviction relating to fraud, embezzlement or any other act of moral turpitude, (iii) your gross misconduct, (iv) your unauthorized use or disclosure of any proprietary information or trade secrets of the Company or any other party to whom you owe an obligation of non-disclosure as a result of your relationship with the Company, (v) your wilful breach of any any obligation under any written agreement or covenant with the Company, (vi) your continued failure to perform your employment duties after you have a received a written demand of performance from the Company which specifically sets forth the factual basis for the Company's belief that you have not substantially performed your duties and have failed to cure such non-performance to the Company's satisfaction within ten (10) business days after receiving such notice, and (vii) any other misconduct or omission which would constitute just cause at law. The failure by the Company to rely on this provision in any given instance or instances shall not constitute a precedent or be deemed a waiver.

(c) **Without Cause Termination.** You are eligible to participate in the Plan, subject to local laws and regulations. You acknowledge that any notice, pay in lieu of such notice, severance pay or continued benefits that are provided under the Plan are inclusive of any and all statutory entitlements that you have, or may have, under the ESA or at common law. Subject only to any further or other entitlements that you have, or may have, under the ESA, you agree to accept the termination benefits that are provided by the Plan in full and final satisfaction of any claims or entitlements that you have arising from the termination of your employment without cause..

(d) **Frustration of Employment.** You agree that in the event that the Company determines that your employment relationship has become frustrated at law, then your employment with the Company shall immediately cease. If your employment ceases due to frustration of employment, then the Company shall only provide you with the minimum notice of termination or pay in lieu of such notice, severance pay (if applicable) and continued benefits coverage as is required by the ESA. Frustration includes, but is not limited to, your failing to maintain legal authorization to work in Canada throughout your employment, which is solely your responsibility.

(e) **Provisions applicable to any Termination (whether Voluntary, For Cause or Without Cause or Frustration)**

(i) Except as provided herein, you will have no claim whatsoever against the Company, its affiliates, or any of its or their officers, directors or employees, for damages, wages, bonus, incentives or other compensation, termination pay, severance pay and/or pay in lieu of notice, arising out of the termination of your employment, whether arising pursuant to the ESA or the common law.

(ii) In all cases, your rights and entitlements under any equity and bonus, incentive or other compensation program shall terminate effective your last day of active employment with the Company. For certainty, your last day of active employment shall be your last day of work with the Company or, if applicable, the last day of your statutory notice of termination period as is required by the ESA. Further, you will not be entitled to any prorated payments under any such program for that part of the year in which you were actively at work. In the event of any inconsistency between this provision and the language of the applicable equity and, bonus, incentive or other compensation program, this provision will prevail.

(iii) Upon the termination of your employment, regardless of the reason, you agree to promptly return to the Company all of the property belonging to the Company in your possession.

(iv) Upon the termination of your employment, regardless of the reason, you agree that you will not, directly or indirectly, verbally or in writing, criticize, disparage, speak negatively of, or make any harmful statement about, the Company, its affiliates, or its or their respective employees, products or services (including without limitation on any social media). Further, you will immediately cease to represent yourself as being in any way connected with, or interested in, the Company, and will immediately update any social media (including without limitation any blogs or social networking sites) to reflect this.

(v) You acknowledge that the termination provisions contained in this Section 11 are intended to provide a greater right or benefit than would otherwise be required by the ESA. However, to the extent that any provision in this Agreement would provide you with less than your minimum statutory entitlements under the ESA, then such provision shall be deemed to be severed from this Agreement, and you shall instead be entitled to receive only your minimum statutory entitlements as are required under the ESA, which you agree to accept in full and final satisfaction of any entitlement that you have or may have.

12. **Conditions.** This offer of employment is contingent on the following conditions being met. If you do not meet these conditions, the Company may ask for additional information and, after consideration, will advise you if it is prepared to continue to offer you employment.

(a) You signing and returning the enclosed Confidential Information and Invention Assignment Agreement and the Job Description;

(b) You providing evidence confirming your lawful right to work for the Company in Canada at our Markham location for at least twelve (12) months.

(c) Your affirmation, by signing and returning this Agreement, that:

(i) you are not a party to any non-competition or non-solicitation agreement with any other employer. If you have such an agreement, you must provide a copy to the Company for review. The Company will then advise you if it is prepared to continue to offer you employment; and

(ii) you have no outstanding agreements or obligations, contracts, arrangements, understandings or otherwise, which in any way directly or indirectly, would preclude you from performing the duties of your employment and/or complying with the terms of this Agreement.

13. **Other Provisions.** This Agreement and the enclosures contain our entire understanding with respect to your employment with the Company and can be amended only in writing signed by a member of the Company's management team. You specifically acknowledge that no promises, representations or commitments have been made to you that are not set forth in this Agreement. In the event that any provision or part of this Agreement is deemed void or invalid by a court, the remaining provisions or parts will remain in full force and effect. The rights which accrue to the Company under this Agreement shall pass to its successors or assigns, and by your signature on this Agreement you expressly consent to such assignment. Your rights under this Agreement are not assignable or transferable in any manner.

14. **Governing law.** This Agreement shall be governed by and construed in accordance with the laws of the Province of Ontario, without reference to conflicts of laws, and you hereby attorn to the exclusive jurisdiction of the courts of that province for the determination of any matter or issue arising from, or relating to, the interpretation or application of this Agreement.

15. **Opportunity to Consider.** You acknowledge and agree that you have taken the necessary time to consider this Agreement and have obtained (or, as a freely taken decision, chosen not to obtain) independent legal advice concerning the interpretation and effect of this Agreement.

* * *

Colin, if you are prepared to accept regular full-time employment with the Company in accordance with the terms and conditions outlined above, please sign the Employee's Acceptance below, along with the policies and documents outlined above which require employee acknowledgment and return all of the signed documents to me. The extra copies are for your own personal files.

I ask that you review this offer and confirm your acceptance by April 15, 2019 no later than 5:00 p.m. ET, after which time this offer will automatically expire.

I am confident that you will be an invaluable addition to the team. In return, I believe that this position will provide you with an opportunity to further develop your skills and help achieve your professional and personal goals. We look forward to having you join our Company and to an excellent relationship.

Yours very truly,

FLUIDIGM CANADA INC.

/s/ Dmitry Bandura

Dmitry Bandura
General Manager & SVP Canadian Operations

Encls. Confidential Information and Invention Assignment Agreement
Job Description

EMPLOYEE'S ACCEPTANCE

I have read, understood and agree with the foregoing terms of this Agreement. I have had a reasonable opportunity to consider this Agreement, the enclosures and the matters set out therein. I accept employment with the Company on the terms and conditions set out in this Agreement and enclosures and agree that the terms and conditions set out in this Agreement and enclosures constitute a binding agreement between me and the Company.

I also acknowledge that my acceptance of this offer is conditional upon my obtaining the required work permit and/or necessary approvals so that I am eligible to work in Canada and, if this condition is not met for any reason, then I understand that this offer will be null and void and I will not become employed by the Company, even if I have already signed and returned this Agreement.

I agree to accept the notice (or pay in lieu of such notice), severance pay, if any, and the continuation of the Group Insurance Plan and the Group RRSP Plan, all as stipulated in this Agreement, in full satisfaction of any and all claims that I may have upon the termination of my employment without cause, including my rights under the ESA, and any rights which I may have at common law. I hereby waive any claim to any other payments or benefits from the Company, subject only to any further or other minimum statutory entitlements that are required under the ESA.

I specifically understand and agree that upon termination of my employment without cause, I will be eligible to receive notice (or pay in lieu of such notice), severance pay and any other payments or benefits in excess of the minimum requirements of the ESA only if I have signed and returned to the Company a full and final release in a form satisfactory to it. If I do not provide such a release, I understand and agree that I will only be entitled to that minimum notice (or pay in lieu of such notice), severance pay, if any, and any benefits continuation required by the ESA, in full satisfaction of any entitlements that I may have upon termination of employment.

Receipt of a copy of this Agreement and enclosures is hereby acknowledged.

/s/ Colin McCracken	April 14, 2019
Colin McCracken	Date

JOB DESCRIPTION

This position description is not an exhaustive list of the duties or functions to be performed in this role. You will be required to perform all acts, duties and obligations and comply with such orders as may be designated by the Company and which are reasonably consistent with the role, including as it evolves.

Title: Senior Vice President, Chief Commercial Officer

Date: September 1, 2019

Grade: 13

Reports to: Christopher Linthwaite

Summary:

The Chief Commercial Officer will be responsible for revenue growth within the organization, reporting to the CEO. The CCO will advocate and understand the voice of the customer and take a global perspective on market opportunities while continuing to build a commercialization infrastructure and organization to drive market adoption of Fluidigm products.

The CCO will lead in the assessment and prioritization of geographic as well as clinical market segments. This is a highly strategic role, requiring a senior commercial leader who is insightful, intelligent, creative and motivated to be part of the future of translational and clinical research.

The successful CCO will possess high energy, team-building skills and outstanding business acumen. This is an extraordinary opportunity to join an exceptional team with an exciting mission.

KEY ACCOUNTABILITIES & RESPONSIBILITIES

- Leadership: Define Fluidigm's commercial path to growth and profitability and establish an effective growth process and infrastructure. Develop collaborative working relationships within the organization in pursuit of the company's overall business goals.
- Marketing: Lead development and oversight of the company's marketing strategy, with an emphasis on developing and executing on global product marketing strategy for all product lines. This includes strategy development, product roadmap design, investment strategy, product and pricing strategy, competitive positioning/differentiation and competitor tracking, and management of on-market product/s.
- Sales: Develop and execute on the company's sales strategy across key market segments to ensure that the company identifies and optimizes a clear path to aggressive growth. Responsible for leading the development and implementation of the strategic plan for worldwide field service, service operations, service logistics and sales operations.
- Business Development: Collaborate with Business Development and provide leadership for enterprise-wide business development opportunities. Originate and

manage business development opportunities that are consistent with the company's strategy for revenue growth.

- Global Service and Support: Ensure that Fluidigm provides industry-leading technology and tools to enable customers through best-in-class service plans and a broad menu of options. This includes embracing innovation to deliver exceptional installation, repair and other services that contribute to a superior customer experience.

This role requires a senior commercial leader who is intelligent, creative and motivated to contribute significantly to Fluidigm's success.

EXPERIENCE & EXPERTISE

- 10+ years of commercial leadership experience
- Strong leadership skills
- Demonstrated experience in developing AND executing successful commercialization strategies for life science tools companies
- Strong and demonstrated strategic thinking skills
- Ability to think creatively and develop non-traditional solutions to complex business challenges
- Outstanding sales management skill
- Strong negotiation and analytical skills
- Ability to be hands-on and strategic
- In-depth knowledge of the biopharmaceutical industry and the immuno-oncology market
- In-depth understanding of the clinical market, including FDA and CMS regulations
- Demonstrated track record of strategic collaborations with biopharma
- Excellent verbal and written communication skills; a demonstrated executive presence
- Ability to be independent, resourceful and self-directed

In terms of the performance and personal competencies required for the position, we would highlight the following:

Commercial Acumen

Understands the customer needs and how to serve them; exceptional relationship-building skills; works effectively with the sales organization to drive revenue and fundamental marketing metrics such as Product definition, Pricing, Promotion and Placement (4Ps). Experienced in managing various channels, avoiding channel conflict, setting incentive plans for sell-through models and co-marketing agreements. Is good at learning new industry, company and product trends. Stays abreast of constant shifts and changes of the business and competition. Adheres to the highest professional standards to earn the client's trust and respect while consistently applying honesty, fairness and candor.

Strategic Marketing

Sees ahead clearly; can anticipate future consequences and trends accurately; has broad knowledge and perspective; is future-oriented; can articulately paint credible pictures and visions of possibilities and likelihoods; can create competitive and breakthrough strategies and plans. Ability to develop effective, actionable growth strategies and adapt to market situation and competitive landscape.

Life Science Expertise
Domain Knowledge: Ability to understand markets and technology. Relevant Experience: Has led a multifunction business (R&D, product management, market development), at scale, with multiple segments; global experience with reagents and instruments.

Global Mindset
Recognizes and addresses issues that are outside national perspective. Issues are viewed without biases or limitations. Possesses a mindset informed by global experience; considers problems and opportunities from a global perspective. Is culturally aware and can conduct business in local terms.

Authentic Leader in Developing People and Teams
Able to move the needle on employee engagement. Experienced manager of people, programs and ideas. Proactive and results-oriented in a highly matrixed environment. Can attract, hire and retain great talent; develops strong teams; builds trust, loyalty and inspiration. Has ability to navigate ambiguity and to make tough calls when needed. Leads by example; self-aware of own strengths and opportunities.

Setting Strategy
- An entrepreneurial and creative approach to developing new, innovative ideas that will stretch the organization and push the boundaries within the industry.
- The ability to effectively balance the desire/need for broad change with an understanding of how much change the organization is capable of handling, to create realistic goals and implementation plans that are achievable and successful.
- The inclination to seek and analyze data from a variety of sources to support decisions and to align others with the organization's overall strategy.

Executing for Results
- The ability to set clear and challenging goals while committing the organization to improved performance; tenacious and accountable in driving results.
- A risk-taker who seeks data and input from others to foresee possible threats or unintended circumstances from decisions; someone who takes smart risks.
- A leader who is viewed by others as having a high degree of integrity and forethought in his/her approach to making decisions; has ability to act in a transparent and consistent manner while always taking into account what is best for the organization.

Relationships and Influence
- Naturally connects and builds strong relationships with others, demonstrating strong emotional intelligence and an ability to communicate clearly and persuasively.
- An ability to inspire trust and followership in others through compelling influence, powerful charisma, passion in his/her beliefs and active drive.
- Creates a sense of purpose/meaning for the team that generates followership beyond his/her own personality and engages others to the greater purpose for the organization.

Exhibit 10.31

April 6, 2020

Nicholas Khadder
2836 Johnson Ave.
Alameda, CA 94501

Dear Nick:

We are pleased to offer you the position of SVP & General Counsel with Fluidigm Corporation, reporting to Chris Linthwaite, CEO, at our South San Francisco, location.

It is an extraordinary time for Fluidigm. Our technology is empowering customers to improve life through comprehensive health insight. We invite you to join a leading provider of indispensable life sciences tools that is accelerating global research on multiple frontiers of human health.

At Fluidigm we are also building a positive culture where our people can do the best work of their careers, informed and influenced by our core values:

- Create what customers need next.
- Drive to make a difference.
- Collaborate and learn.
- Step up.

We hope you are as excited about this opportunity as we are delighted to have you on our team.

The following is a summary of the terms and conditions of this offer, which will apply to your employment with Fluidigm:

Start Date: April 27, 2020

Compensation:
You will receive an initial salary of $14,477.92 per pay period. We are on a semi-monthly pay schedule with two pay periods per calendar month which generally fall on the 15th and the last day of the month. This equates to a base compensation of $347,471.00 on an annual basis, less deductions as required by law, which will be paid in accordance with the Company's normal payroll procedures. This is an exempt position.

Bonus Target:
You will be eligible to participate in the Company's Employee Bonus Plan. The bonus will be subject to achievement of performance objectives with the actual bonus amount to be determined by the Company in its discretion and will be pro-rated based upon your hire date. To earn a bonus, you must remain employed with the Company through the date bonuses are paid, as well as having commenced your employment on or prior to September 30 of the corresponding bonus plan's performance year. For purposes of calculating any bonus payout you earn, your target bonus amount will initially be 50% of your annual base salary.

Equity Award:
We will recommend to our Board of Directors or one of its committees after commencement of your employment with the Company that you receive an on-hire grant of 65,000 Restricted Stock Units. Your grant will be subject to the approval of the Board of Directors or its committee, the terms of our equity incentive plan, and our policies governing grants of equity incentive awards.

Benefits:
You are eligible to receive the Company's standard benefits package which currently includes medical, dental, vision, life and disability insurance benefits. Benefits will be effective on your date of hire. Additional benefits, as the Company may make generally available to its employees from time to time, will be made available to you. Your service anniversary date will be bridged back to your original hire date. You will be entitled to accrue up to 3 weeks paid vacation each year and such paid holidays as the Company gives to its employees generally, in accordance with company policies.

Workers' Compensation Insurance:
The Company provides a comprehensive workers' compensation insurance program at no cost to employees. This program covers any injury or illness sustained in the course of employment that requires medical, surgical or hospital treatment. Insurance carrier: Preferred Employers Group - PO BOX 85838, San Diego, CA 92186, phone number (866) 472-9602.

Confidentiality and Company Policies:
It is important to protect our confidential information and proprietary material. Therefore, as a condition of employment you will be required to sign the Company's standard At-Will Employment, Confidential Information, Invention Assignment, and Arbitration Agreement.

Background and reference checks: This offer is contingent upon successfully passing your background and reference checks.

Employment Authorization:
For purposes of federal immigration law, you will be required to provide to the Company documentary evidence of your identity and eligibility for employment in the United States. Such documentation must be provided to us within 3 business days of your date of hire, or our employment relationship may be terminated.

Other:
This offer of employment and its related terms will expire on **April 9, 2020**.

This letter shall be interpreted under California law. You should be aware that your employment with the Company is for no specified period and constitutes "at will" employment. As a result, you are free to resign at any time, for any reason or for no reason. Similarly, the Company is free to conclude its employment relationship with you at any time,
with or without cause. In addition, the Company may change your compensation, duties, assignments, responsibilities, location of your position, or any other terms and conditions of employment at any time to adjust to the changing needs of our dynamic Company.

In the event of any dispute or claim relating to or arising out of our employment relationship, you and the Company agree that all such disputes shall be fully and finally resolved by binding arbitration conducted by the Judicial Arbitration & Mediation Services ("JAMS") in Santa Clara County California. The current JAMS employment arbitration rules & procedures can be found at http://www.jamsadr.com/rules-employment-arbitration/. The JAMS employment arbitration rules & procedures may, however, be amended by JAMS. You acknowledge that you are waiving your right to a jury trial.

To indicate your acceptance of the Company's offer, please sign and date this letter in the space provided below and return it via Adobe Sign to our Talent Acquisition Team.

This letter, along with the agreement relating to proprietary rights between you and the Company, set forth the terms of your employment with the Company and supersede any prior representations or agreements, whether written or oral. This letter may not be modified or amended except by a written agreement, signed by the Company and by you.

We look forward to you joining and being part of Fluidigm! I am certain we can build a great company together.

Sincerely,

/s/ Angela Peters

Angela Peters
Vice President, Global Human Resources
Fluidigm Corporation

ACCEPTED AND AGREED TO:

/s/ Nicholas Khadder

Nicholas Khadder **Date April 7, 2020**

Exhibit 21.1

SUBSIDIARIES OF FLUIDIGM CORPORATION

Subsidiaries of Fluidigm Corporation (Delaware):

Fluidigm Sciences Inc. (Delaware)

Fluidigm (Shanghai) Instrument Technology Company Limited (China)

Fluidigm K.K. (Japan)

Fluidigm Europe B.V. (Netherlands)

Fluidigm Singapore Pte. Ltd. (Singapore)

Subsidiaries of Fluidigm Europe B.V. (Netherlands):

Fluidigm France SARL (France)

Fluidigm GmbH (Germany)

Fluidigm Italy S.r.l. (Italy)

InstruNor AS (Norway)

Fluidigm UK Limited (United Kingdom)

Subsidiaries of Fluidigm Sciences Inc. (Delaware):

Fluidigm Canada Inc. (Ontario, Canada)

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 (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, 333-239810), and Form S-8/S-3 (No. 333-194084) of Fluidigm Corporation of our report dated February 25, 2021 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 25, 2021

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 25, 2021

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 25, 2021

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, 2020 (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 25, 2021

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, 2020 (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 25, 2021

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