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

FORM 10-Q

(Mark One)

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

For the quarterly period ended June 30, 2019

or

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

For the transition period from to

Commission file number: 001-34180

FLUIDIGM CORPORATION

(Exact name of registrant as specified in its charter)

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

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

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, par value $0.001 per share	**FLDM**	**Nasdaq Global Select Market**

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

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). Yes ☒ No ☐

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

Large accelerated filer	☐	Accelerated Filer	☒
Non-accelerated filer	☐	Smaller reporting company	☒
Emerging growth company	☐		

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

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

As of July 31, 2019, there were 69,403,581 shares of the Registrant's common stock, $0.001 par value per share, outstanding.

FLUIDIGM CORPORATION

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PART I. FINANCIAL INFORMATION

Item 1. Financial Statements

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

	June 30, 2019	December 31, 2018
ASSETS		
Current assets:		
Cash and cash equivalents	$ 24,046	$ 95,401
Short-term investments	44,815	—
Accounts receivable (net of allowances of $45 at June 30, 2019 and $126 at December 31, 2018)	19,262	16,651
Inventories	14,269	13,003
Prepaid expenses and other current assets	4,387	2,051
Total current assets	106,779	127,106
Property and equipment, net	8,298	8,825
Operating lease right-of-use asset, net	6,506	—
Other non-current assets	6,302	6,208
Developed technology, net	51,800	57,400
Goodwill	104,108	104,108
Total assets	$ 283,793	$ 303,647
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current liabilities:		
Accounts payable	$ 8,075	$ 4,027
Accrued compensation and related benefits	8,281	14,470
Operating lease liabilities, current	3,350	—
Other accrued liabilities	5,642	7,621
Deferred revenue, current	11,972	11,464
Total current liabilities	37,320	37,582
Convertible notes, net	49,833	172,058
Deferred tax liability, net	12,295	13,714
Operating lease liabilities, non-current	4,812	—
Deferred revenue, non-current	6,318	6,327
Other non-current liabilities	575	1,850
Total liabilities	111,153	231,531
Commitments and contingencies		
Stockholders' equity:		
Preferred stock, $0.001 par value, 10,000 shares authorized, no shares issued and outstanding at June 30, 2019 and December 31, 2018	—	—
Common stock, $0.001 par value, 200,000 shares authorized at June 30, 2019 and December 31, 2018; 69,400 and 49,338 shares issued and outstanding as of June 30, 2019 and December 31, 2018, respectively	69	49
Additional paid-in capital	771,263	631,605
Accumulated other comprehensive loss	(623)	(687)
Accumulated deficit	(598,069)	(558,851)
Total stockholders' equity	172,640	72,116
Total liabilities and stockholders' equity	$ 283,793	$ 303,647

See accompanying notes

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

	Three Months Ended June 30,		Six Months Ended June 30,	
	2019	2018	2019	2018
Revenue:				
Product revenue	$ 23,235	$ 21,777	$ 48,062	$ 42,254
Service revenue	4,961	4,651	10,245	9,422
Total revenue	28,196	26,428	58,307	51,676
Cost of revenue:				
Cost of product revenue	11,100	11,160	22,489	21,382
Cost of service revenue	1,733	1,680	3,465	3,278
Total cost of revenue	12,833	12,840	25,954	24,660
Gross profit	15,363	13,588	32,353	27,016
Operating expenses:				
Research and development	7,865	7,386	16,237	14,642
Selling, general and administrative	22,134	18,987	44,958	37,792
Total operating expenses	29,999	26,373	61,195	52,434
Loss from operations	(14,636)	(12,785)	(28,842)	(25,418)
Interest expense	(491)	(3,916)	(3,192)	(5,805)
Loss on extinguishment of debt	—	—	(9,000)	—
Other income, net	231	256	715	348
Loss before income taxes	(14,896)	(16,445)	(40,319)	(30,875)
Income tax benefit	1,143	204	1,101	1,387
Net loss	$ (13,753)	$ (16,241)	$ (39,218)	$ (29,488)
Net loss per share, basic and diluted	$ (0.20)	$ (0.42)	$ (0.61)	$ (0.76)
Shares used in computing net loss per share, basic and diluted	69,158	39,003	63,923	38,930

See accompanying notes

FLUIDIGM CORPORATION
CONDENSED CONSOLIDATED STATEMENTS OF COMPREHENSIVE LOSS
(In thousands)
(Unaudited)

	Three Months Ended June 30,		Six Months Ended June 30,	
	2019	2018	2019	2018
Net loss	$ (13,753)	$ (16,241)	$ (39,218)	$ (29,488)
Other comprehensive income (loss), net of tax:				
Foreign currency translation adjustment	(9)	26	(1)	69
Net change in unrealized gain on investments	63	2	65	1
Other comprehensive income, net of tax	54	28	64	70
Comprehensive loss	$ (13,699)	$ (16,213)	$ (39,154)	$ (29,418)

See accompanying notes

FLUIDIGM CORPORATION
CONDENSED CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY
(In thousands)
(Unaudited)

	Common Stock Shares	Common Stock Amount	Additional Paid-in Capital	Accumulated Other Comprehensive (Loss)/Income	Accumulated Deficit	Total Stockholders' Equity
Balance as of December 31, 2018	49,338	$ 49	$ 631,605	$ (687)	$ (558,851)	$ 72,116
Issuance of common stock on bond conversion	19,460	19	133,279	—	—	133,298
Issuance of restricted stock, net of shares withheld for taxes, and other	140	1	(177)	—	—	(176)
Issuance of common stock from option exercises	53	—	255	—	—	255
Stock-based compensation expense	—	—	2,207	—	—	2,207
Net loss	—	—	—	—	(25,465)	(25,465)
Other comprehensive income, net of tax	—	—	—	10	—	10
Balance as of March 31, 2019	68,991	69	767,169	(677)	(584,316)	182,245
Issuance of restricted stock, net of shares withheld for taxes, and other	183	—	(325)	—	—	(325)
Issuance of common stock from option exercises	130	—	793	—	—	793
Issuance of common stock under ESPP	96	—	641	—	—	641
Stock-based compensation expense	—	—	2,985	—	—	2,985
Net loss	—	—	—	—	(13,753)	(13,753)
Other comprehensive income, net of tax	—	—	—	54	—	54
Balance as of June 30, 2019	69,400	$ 69	$ 771,263	$ (623)	$ (598,069)	$ 172,640

	Common Stock Shares	Common Stock Amount	Additional Paid-in Capital	Accumulated Other Comprehensive (Loss)/Income	Accumulated Deficit	Total Stockholders' Equity
Balance as of December 31, 2017	38,787	$ 39	$ 531,666	$ (574)	$ (500,196)	$ 30,935
Issuance of restricted stock, net of shares withheld for taxes, and other	105	—	(69)	—	—	(69)
Issuance of common stock from option exercises	16	—	72	—	—	72
Conversion option on convertible debt	—	—	29,292	—	—	29,292
Closing cost related to conversion option	—	—	(556)	—	—	(556)
Cumulative-effect of new accounting standard for Topic 606 Revenue	—	—	—	—	358	358
Stock-based compensation expense	—	—	1,747	—	—	1,747
Net loss	—	—	—	—	(13,247)	(13,247)
Other comprehensive income, net of tax	—	—	—	42	—	42
Balance as of March 31, 2018	38,908	39	562,152	(532)	(513,085)	48,574
Issuance of restricted stock, net of shares withheld for taxes, and other	125	—	(106)	—	—	(106)
Issuance of common stock from option exercises	3	—	7	—	—	7
Issuance of common stock under ESPP	119	—	562	—	—	562
Stock-based compensation expense	—	—	2,007	—	—	2,007
Net loss	—	—	—	—	(16,241)	(16,241)
Other comprehensive income, net of tax	—	—	—	28	—	28
Balance as of June 30, 2018	39,155	$ 39	$ 564,622	$ (504)	$ (529,326)	$ 34,831

See accompanying notes

FLUIDIGM CORPORATION
CONDENSED CONSOLIDATED STATEMENTS OF CASH FLOWS
(In thousands)
(Unaudited)

	Six Months Ended June 30,	
	2019	**2018**
Operating activities		
Net loss	$ (39,218)	$ (29,488)
Adjustments to reconcile net loss to net cash used in operating activities:		
Depreciation and amortization	2,351	2,932
Stock-based compensation expense	5,263	3,754
Amortization of developed technology	5,600	5,600
Amortization of debt discounts, premium and issuance costs	2,037	3,083
Loss on extinguishment of debt	9,000	—
Loss on disposal of property and equipment	29	—
Other non-cash items	(88)	(41)
Changes in assets and liabilities:		
Accounts receivable, net	(2,420)	(1,814)
Inventories	(1,486)	(571)
Prepaid expenses and other current assets	(1,269)	(1,016)
Other non-current assets	304	821
Accounts payable	3,439	2,445
Deferred revenue	476	368
Other current liabilities	(6,466)	99
Other non-current liabilities	(2,695)	(6,671)
Net cash used in operating activities	(25,143)	(20,499)
Investing activities		
Purchases of investments	(44,614)	(1,451)
Proceeds from maturities and sales of investments	—	5,541
Purchases of property and equipment	(685)	(154)
Net cash provided by (used in) investing activities	(45,299)	3,936
Financing activities		
Payment of debt issuance costs	(15)	(2,638)
Proceeds from exercise of stock options	1,048	79
Proceeds from stock issuance from ESPP	641	562
Payments for taxes related to net share settlement of equity awards	(487)	(155)
Net cash provided by (used in) financing activities	1,187	(2,152)
Effect of foreign exchange rate fluctuations on cash and cash equivalents	(25)	83
Net decrease in cash, cash equivalents and restricted cash	(69,280)	(18,632)
Cash, cash equivalents and restricted cash at beginning of period	95,401	58,056
Cash, cash equivalents and restricted cash at end of period	$ 26,121	$ 39,424

See accompanying notes

1. Description of Business

Fluidigm Corporation (we, our, or us) was incorporated in the State of California in May 1999 to commercialize microfluidic technology initially developed at the California Institute of Technology. In July 2007, we were reincorporated in Delaware. Our headquarters are located in South San Francisco, California.

We create, manufacture, and market innovative technologies and life science tools, including preparatory and analytical instruments for Mass Cytometry, PCR, Library Prep, Single Cell Genomics, and consumables, including integrated fluidic circuits (IFCs), assays, and reagents. Our focus is on the most pressing needs in translational and clinical research, including cancer, immunology and immunotherapy. We use proprietary CyTOF® and microfluidics technologies to develop innovative end-to-end solutions that have the flexibility required to meet the needs of translational research and the robustness to support high-impact clinical research studies. We sell our instruments to leading academic research institutions, translational research and medicine centers, cancer centers, clinical research laboratories, and biopharmaceutical, biotechnology and plant and animal research companies.

2. Summary of Significant Accounting Policies

Basis of Presentation

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 June 30, 2019, we had wholly owned subsidiaries in Singapore, Canada, the Netherlands, Japan, France, the United Kingdom, China, and Germany. All subsidiaries, except for Singapore, use their local currency as their functional currency. The Singapore subsidiary uses the U.S. dollar as its functional currency. All intercompany transactions and balances have been eliminated in consolidation.

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

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, options to purchase common stock, and shares associated with the potential conversion of our convertible notes 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 computation of diluted net loss per share for the three and six months ended June 30, 2019, and 2018 because including them would have been anti-dilutive (in thousands):

	Three Months Ended June 30,		Six Months Ended June 30,	
	2019	2018	2019	2018
Stock options, restricted stock units and performance awards	4,541	4,586	4,541	4,586
2018 Convertible Notes	—	19,036	—	19,036
2018 Convertible Notes potential make-whole shares	—	1,204	—	1,204
2014 Convertible Notes	916	916	916	916
Total	5,457	25,742	5,457	25,742

Accumulated Other Comprehensive Loss

The components of accumulated other comprehensive loss, net of tax, for the three and six months ended June 30, 2019, are as follows (in thousands):

	Foreign Currency Translation Adjustment	Net Unrealized Gain on Securities	Accumulated Other Comprehensive Loss
Balance at December 31, 2018	$ (687)	$ —	$ (687)
Other comprehensive income	8	2	10
Balance at March 31, 2019	(679)	2	(677)
Other comprehensive income (loss)	(9)	63	54
Balance at June 30, 2019	$ (688)	$ 65	$ (623)

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 derived from the sale of instrument service contracts, repairs, installation, training and other specialized product support services. Revenue is reported net of any sales, use and value-added taxes we collect from customers as required by government authorities.

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

Product Revenue

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

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

Service Revenue

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

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

Contract Costs

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

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 condensed 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.

Goodwill, Intangible Assets, and Other Long-lived Assets

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

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

We evaluate our long-lived assets, including finite-lived intangibles, for indicators of possible impairment when events or changes in circumstances indicate the carrying amount of an asset may not be recoverable. If any 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. We did not recognize any impairment of long-lived assets for any of the periods presented herein.

Convertible Notes

In February 2014, we closed an underwritten public offering 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 new 2.75% Exchange Convertible Senior Notes due 2034 (2018 Notes). Following the exchange, approximately $51.3 million in aggregate principal amount of the 2014 Notes was outstanding in addition to $150.0 million in aggregate principal amount of the 2018 Notes. In the first quarter of 2019, the 2018 Notes were converted into 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.

See Note 6 Convertible Notes and Credit Facility for the accounting treatment of the transactions and additional information about the exchange.

Recent Accounting Changes and Accounting Pronouncements

Adoption of New Accounting Guidance

In February 2016, the FASB established Topic 842, Leases, by issuing Accounting Standards Update (ASU) No. 2016-02, which requires lessees to recognize operating leases on the balance sheet and disclose key information about leasing arrangements. Topic 842 was subsequently amended by ASU No. 2018-01, Land Easement Practical Expedient for Transition to

Topic 842; ASU No. 2018-10, Codification Improvements to Topic 842, Leases; and ASU No. 2018-11, Targeted Improvements. The new standard establishes a right-of-use (ROU) model that requires a lessee to recognize a ROU asset and lease liability on the balance sheet for all leases with a term longer than 12 months. Leases are classified as finance or operating; the classification will impact the expense recognition in the income statement.

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

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

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

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

Recent Accounting Pronouncements

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

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

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 timelier recording of credit losses on loans and other financial instruments held by financial institutions and other organizations. ASU 2018-19 clarifies that receivables arising from operating leases are not within the scope of the credit losses standard, but rather, should be accounted for in accordance with the leasing standard. These ASUs are effective for fiscal years beginning after December 15, 2019, and interim periods within those years, with early adoption permitted. We are evaluating the effect that ASU 2016-13 and ASU 2018-19 will have on our consolidated financial statements and related disclosures.

3. Revenue

Disaggregation of Revenues

The following table disaggregates our revenue for the three and six months ended June 30, 2019, and 2018, respectively, by geographic area and by product and service (in thousands):

	Three Months Ended June 30,		Six Months Ended June 30,	
	2019	2018	2019	2018
Geographic Markets:				
Americas	$ 11,120	$ 12,520	$ 24,091	$ 23,354
Europe	11,217	9,109	19,373	17,582
Asia Pacific	5,859	4,799	14,843	10,740
Total revenue	$ 28,196	$ 26,428	$ 58,307	$ 51,676
Product and Service:				
Instruments	$ 12,201	$ 10,421	$ 25,041	$ 17,941
Consumables	11,034	11,356	23,021	24,313
Product revenue	23,235	21,777	48,062	42,254
Service	4,961	4,651	10,245	9,422
Total revenue	$ 28,196	$ 26,428	$ 58,307	$ 51,676

Performance Obligations

We reported $17.8 million of deferred revenue on our December 31, 2018 consolidated balance sheet. During the six months ended June 30, 2019, $6.8 million of the opening balance was recognized as revenue and $7.3 million of net additional advance payments were received from customers, primarily associated with instrument service contracts. At June 30, 2019, we reported $18.3 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 June 30, 2019 (in thousands):

	Expected Revenue [1]
2019 (remainder of the year)	$ 6,344
2020	6,764
2021	3,917
Thereafter	2,479
	$ 19,504

[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 that are expected to be delivered within one year.

Contract Costs

We reported $0.4 million of capitalized commission costs from instrument service contracts at June 30, 2019 and December 31, 2018 in the condensed consolidated balance sheets.

4. Goodwill and Intangible Assets, net

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

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

	June 30, 2019			
	Gross Amount	Accumulated Amortization	Net	Weighted-Average Amortization Period
Developed technology	$ 112,000	$ (60,200)	$ 51,800	10.0 years
Patents and licenses	$ 11,274	$ (7,378)	$ 3,896	7.8 years

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

Amortization of intangibles was $3.1 million for each of the three months ended June 30, 2019, and 2018, respectively. Amortization of intangibles was $6.2 million and $6.2 million for the six months ended June 30, 2019, and 2018, respectively.

Based on the carrying value of intangible assets, net, as of June 30, 2019, the annual amortization expense is expected to be as follows (in thousands):

Fiscal Year	Developed Technology Amortization Expense	Patents and Licenses Amortization Expense	Total
2019 (remainder of the year)	$ 5,600	$ 522	$ 6,122
2020	11,200	1,042	12,242
2021	11,200	887	12,087
2022	11,200	804	12,004
2023	11,200	634	11,834
Thereafter	1,400	7	1,407
Total	$ 51,800	$ 3,896	$ 55,696

5. Balance Sheet Details

Cash, Cash Equivalents and Restricted Cash

Cash, cash equivalents and restricted cash consisted of the following (in thousands):

	June 30, 2019	December 31, 2018
Cash and cash equivalents	$ 24,046	$ 95,401
Restricted cash	2,075	—
Cash, cash equivalents and restricted cash	$ 26,121	$ 95,401

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

Inventories

Inventories consisted of the following (in thousands):

	June 30, 2019	December 31, 2018
Raw materials	$ 7,023	$ 5,996
Work-in-process	553	650
Finished goods	6,693	6,357
Total inventories, net	$ 14,269	$ 13,003

Property and Equipment, net

Property and equipment, net, consisted of the following (in thousands):

	June 30, 2019	December 31, 2018
Computer equipment and software	$ 4,322	$ 4,201
Laboratory and manufacturing equipment	19,391	18,780
Leasehold improvements	7,526	7,173
Office furniture and fixtures	1,810	1,506
Property and equipment, gross	33,049	31,660
Less accumulated depreciation and amortization	(24,845)	(22,855)
Construction-in-progress	94	20
Property and equipment, net	$ 8,298	$ 8,825

Warranty

We accrue for estimated warranty obligations once revenue is recognized. Management periodically reviews the estimated fair value of its warranty liability and records adjustments based on the terms of warranties provided to customers, as well as historical and anticipated warranty claim experience. Activity for our warranty accrual for the three and six months ended June 30, 2019, and 2018, which is included in other accrued liabilities, is summarized below (in thousands):

	Three Months Ended June 30,		Six Months Ended June 30,	
	2019	2018	2019	2018
Beginning balance	$ 930	$ 591	$ 863	$ 699
Accrual for warranties	371	401	657	738
Warranty costs incurred	(210)	(383)	(429)	(828)
Ending balance	$ 1,091	$ 609	$ 1,091	$ 609

6. 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 2.75% Senior Convertible Notes due 2034 (2014 Notes), pursuant to an underwriting agreement dated January 29, 2014. The 2014 Notes accrue interest at a rate of 2.75% per year, payable semi-annually in arrears on February 1 and August 1 of each year. Interest on the 2014 Notes accrued from February 4, 2014. The 2014 Notes will mature on February 1, 2034, unless earlier converted, redeemed, or repurchased in accordance with the terms of the 2014 Notes.

The initial conversion rate of the 2014 Notes is 17.8750 shares of our common stock, par value $0.001 per share, per $1,000 principal amount of 2014 Notes (which is equivalent to an initial conversion price of approximately $55.94 per share). The conversion rate will be subject to adjustment upon the occurrence of certain specified events, including upon a conversion in connection with a fundamental change, as defined in the indenture governing the 2014 Notes or, subject to certain conditions, redemption of the 2014 Notes by the Company.

Holders may surrender their 2014 Notes for conversion at any time prior to the stated maturity date. On or after February 6, 2018, and prior to February 6, 2021, we may redeem any or all of the 2014 Notes in cash if the closing price of our common stock exceeds 130% of the conversion price for a specified number of days, and on or after February 6, 2021, we may redeem any or all of the 2014 Notes in cash without any such condition. The redemption price of the 2014 Notes will equal 100% of the principal amount of the 2014 Notes plus accrued and unpaid interest. Holders may require us to repurchase all or a portion of their 2014 Notes on each of February 6, 2021, February 6, 2024, and February 6, 2029, at a repurchase price in cash equal to 100% of the principal amount of the 2014 Notes plus accrued and unpaid interest. If we undergo a fundamental change, as defined in the indenture governing the 2014 Notes, holders may require us to repurchase the 2014 Notes in whole or in part for cash at a repurchase price equal to 100% of the principal amount of the 2014 Notes plus accrued and unpaid interest.

In February 2014, we received $195.2 million, net of underwriting discounts, from the issuance of the 2014 Notes and incurred approximately $1.1 million in offering-related expenses. The underwriting discount of $6.0 million and the debt issuance costs of $1.1 million were recorded as offsets to the proceeds.

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 new convertible notes (2018 Notes). The 2018 Notes were subsequently retired in the first quarter of 2019 as discussed below.

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 amortized over the expected term of the 2018 Notes using the effective interest method through the first note holder put date of February 6, 2023.

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

The 2018 Notes accrued interest at a rate of 2.75%, payable semi-annually in arrears on February 1 and August 1 of each year. Interest on the 2018 Notes accrued from February 1, 2018. The 2018 Notes were set 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. One of those specified events was that Holders who converted their 2018 Notes voluntarily prior to our exercise of the Issuer's Conversion Option were entitled, under certain circumstances, to a make-whole premium in the form of an increase in the conversion rate determined by reference to a make-whole table set forth in the indenture governing the 2018 Notes. Any time prior to the maturity of the 2018 Notes, we had the ability to convert the 2018 Notes, in whole but not in part, into cash, shares of our common stock, or combination thereof, if the closing price of our common stock equaled or exceeded 110% of the conversion price then in effect for a specified number of days (Issuer’s Conversion Option). On or after February 6, 2022, we would have been able to elect to redeem all or any portion of the 2018 Notes at a redemption price equal to 100% of the accreted principal amount of the 2018 Notes on the redemption date of the 2018 Notes, plus accrued and unpaid interest.

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

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.

Offering-related costs for the 2018 Notes were approximately $2.8 million and were paid in the first and second quarters of 2018. 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 are 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. Offering-related costs of $0.6 million were accounted for as equity issuance costs, recorded as an offset to additional paid-in capital, and are 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 the Trustee 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, 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.

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

	June 30, 2019	December 31, 2018
2.75% 2014 Notes due 2034		
Principal amount	$ 51,250	$ 51,250
Unamortized debt discount	(1,199)	(1,232)
Unamortized debt issuance cost	(218)	(224)
	$ 49,833	$ 49,794
2.75% 2018 Notes due 2034		
Principal amount	$ —	$ 149,999
Premium accretion	—	3,755
Unamortized debt discount	—	(29,558)
Unamortized debt issuance cost	—	(1,932)
	$ —	$ 122,264
	$ 49,833	$ 172,058

2018 Revolving Credit Facility

In August 2018, the Company 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, the Company may make and repay borrowings from time to time until the maturity of the revolving credit facility. As of June 30, 2019, availability under the revolving credit facility was $12.5 million. There were no borrowings outstanding under the Revolving Credit Facility at June 30, 2019.

The Revolving Credit Facility matures on August 2, 2020 and is collateralized by substantially all the Company's property, other than intellectual property. Loans under the Revolving Credit Facility will bear interest, at the greater of (i) prime rate plus 0.50% or (ii) 5.50%. Interest on any outstanding loans is due and payable monthly and the principal balance is due at maturity though loans can be prepaid at any time without penalty. In addition, the Company pays a quarterly unused revolving line facility fee of .75% per annum on the average unused facility.

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

The Company incurred approximately $335,000 of debt issuance costs in connection with the facility, including $225,000 in commitment fees. Half of the commitment fee was paid at the inception of the facility with the remainder due on the earliest of (i) August 2, 2019, (ii) the date on which the Company terminates this Agreement or (iii) the occurrence and continuance of an event of default. Debt issuance costs were capitalized and are being amortized to interest expense over the life of the Revolving Credit Facility.

The Revolving Credit Facility contains customary affirmative and negative covenants which, unless waived by the bank, limit the Company's 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 the Company 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. The Company was in compliance with all the terms and conditions of the Revolving Credit Facility at June 30, 2019.

7. Leases

We have operating leases for buildings, equipment and vehicles. Existing leases have remaining terms of less than 1 year to 8 years. Some leases contain options to extend the lease, usually for up to 5 years, and termination options.

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

	June 30, 2019		
	Gross Amount	Accumulated Amortization	Net
Operating lease right-of-use buildings	$ 7,600	$ (1,438)	$ 6,162
Operating lease right-of-use equipment	76	(21)	55
Operating lease right-of-use vehicles	357	(68)	289
Total	$ 8,033	$ (1,527)	$ 6,506

In the first half of 2019, we entered into a new operating lease for our corporate headquarters in South San Francisco, California which is expected to commence in late 2019 or early 2020. The lease term is 10.25 years. We expect to recognize a right-of-use asset and lease liabilities of approximately $46.7 million, based on our current incremental collateralized borrowing rate, as a result of this lease.

(in thousands)	Six Months Ended June 30, 2019
Operating lease cost (including variable costs)	$ 3,056
Variable costs including non-lease component	$ 1,303
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	$ 2,061

	June 30, 2019
Weighted average remaining lease term (in years)	4.3
Weighted average discount rate	5.3%

Future minimum lease payments and minimum sublease income under non-cancelable operating leases as of June 30, 2019, were as follows (in thousands):

Fiscal Year	Minimum Lease Payments for Operating Leases	Minimum Sublease Income	Net Amount
2019 (remainder of the year)	$ 2,077	$ (306)	$ 1,771
2020	2,259	(111)	2,148
2021	1,290	—	1,290
2022	947	—	947
2023	730	—	730
Thereafter	1,825	—	1,825
Total future minimum payments (income)	$ 9,128	$ (417)	$ 8,711
Less: imputed interest	(966)		
Total	$ 8,162		

June 30, 2019	
Operating lease liabilities, current	$ 3,350
Operating lease liabilities, non-current	4,812
Total	$ 8,162

Disclosures related to periods prior to adoption of ASC 842

Operating lease rent expense, net of amortization of lease incentives and sublease income was $1.0 million and $2.2 million for the three and six months ended June 30, 2018, respectively for the prior year comparative period before the adoption of ASC 842.

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

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

8. Fair Value of Financial Instruments

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

	June 30, 2019						
	Carrying Amount	Gross Unrealized Gain	Gross Unrealized Loss	Fair Value	Cash and Cash Equivalents	Short-Term Marketable Securities	Cash- Restricted
Assets:							
Cash- non-restricted	$ 15,928	$ —	$ —	$ 15,928	$ 15,928	$ —	$ —
Cash- restricted	2,075	—	—	2,075	—	—	2,075
Total cash	$ 18,003	$ —	$ —	$ 18,003	$ 15,928	$ —	$ 2,075
Available-for-sale:							
Level I:							
Money market funds	$ 8,118	$ —	$ —	$ 8,118	$ 8,118	$ —	$ —
U.S. treasury securities	44,750	65	—	44,815	—	44,815	—
Subtotal	$ 52,868	$ 65	$ —	$ 52,933	$ 8,118	$ 44,815	$ —
Total	$ 70,871	$ 65	$ —	$ 70,936	$ 24,046	$ 44,815	$ 2,075

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

There were no transfers between Level I and Level II measurements during the six months ended June 30, 2019, and December 31, 2018, and there were no changes in the valuation techniques used.

Convertible Notes

The estimated fair value of the 2014 and 2018 Notes is based on a market approach and represents a Level II valuation. When determining the estimated fair value of our long-term debt, we used a commonly accepted valuation methodology and market-based risk measurements that are indirectly observable, such as credit risk.

The following table summarizes the par value, carrying value and the estimated fair value of the 2014 and 2018 Notes at June 30, 2019 and December 31, 2018, respectively (in thousands):

	June 30, 2019			December 31, 2018		
	Par Value	Carrying Value	Fair Value	Par Value	Carrying Value	Fair Value
2014 Notes	$ 51,250	$ 49,833	$ 49,559	$ 51,250	$ 49,794	$ 43,665
2018 Notes	—	—	—	149,999	122,264	171,843
Total	$ 51,250	$ 49,833	$ 49,559	$ 201,249	$ 172,058	$ 215,508

9. Shareholders' Equity

Conversion of 2018 Notes

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

10. Stock-Based Plans

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 stock units (RSU) and performance-based awards under our other equity incentive plans. Our board of directors determines the number of shares subject to award grants and also sets vesting criteria.

In general, our RSUs vest on a quarterly basis over a period of four years from the date of grant at a rate of 25% on the first anniversary of the grant date and ratably each quarter over the remaining 12 quarters, subject to the recipient employee's continued employment. We may grant RSU awards with different vesting terms from time to time.

Incentive stock options and non-statutory stock options granted under the 2011 Plan have a term of no more than ten years from the date of grant and an exercise price of at least 100% of the fair market value of the underlying common stock on the date of grant. If a participant owns stock representing more than 10% of the voting power of all classes of our stock on the grant date, an incentive stock option awarded to the participant will have a term of no more than five years from the date of grant and an exercise price of at least 110% of the fair market value of the underlying common stock on the date of grant. Generally, our 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

In January 2011, our board of directors adopted the 2011 Equity Incentive Plan (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.

2009 Equity Incentive Plan and 1999 Stock Option Plan

Our 2009 Equity Incentive Plan (2009 Plan) terminated on the date the 2011 Plan was adopted. Options granted and 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

In January 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 provided for the grant of equity-based awards and its terms were substantially similar to the 2011 Plan. In accordance with Rule 5635(c)(4) of the Nasdaq Listing Rules, awards under the Inducement Plan could only be made to individuals not previously our employees or non-employee members of our board of directors (or following such individuals' bona fide period of non-employment), as an inducement material to the individuals' 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 upon such termination 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. 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 is valued using the fair market value of our common stock on the grant date.

Activity under the 2011 Plan, the 2009 Plan, the 1999 Plan, and the Inducement Plan is as follows:

Restricted Stock Units:

	Number of Units (in 000s)	Weighted-Average Grant Date Fair Value per Unit
Balance as of December 31, 2018	1,812	$ 7.09
RSU granted	662	$ 10.90
RSU released	(360)	$ 8.66
RSU forfeited	(224)	$ 8.14
Balance as of June 30, 2019	1,890	$ 8.01

As of June 30, 2019, the unrecognized compensation costs related to outstanding unvested RSUs under our equity incentive plans were $12.6 million. We expect to recognize these costs over a weighted average period of 3 years.

***Stock Options*:**

	Number of Options (000s)	Weighted-Average Exercise Price per Option	Weighted-Average Remaining Contractual Life (in Years)	Aggregate Intrinsic Value in (000s)
Balance as of December 31, 2018	2,385	$ 7.56	7.8	$ 5,991
Options granted	41	$ 13.41		
Options exercised	(184)	$ 5.75		$ 1,147
Options forfeited	(138)	$ 6.5		
Balance as of June 30, 2019	2,104	$ 7.8	7.3	$ 11,453
Vested as of June 30, 2019	1,159	$ 9.16	6.3	$ 5,556
Expected to vest as of June 30, 2019	945	$ 6.13	8.5	$ 5,897

The grant date fair value of options granted in 2019 was $7.36. As of June 30, 2019, the unrecognized compensation costs related to outstanding unvested options under our equity incentive plans were $3.2 million. We expect to recognize these costs over a weighted average period of 2.1 years.

Performance-based Awards:

Performance Stock Units

During the three and six months ended June 30, 2019, we granted 25,500 and 400,839 performance stock units, respectively, 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 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 should be 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 with a weighted-average fair value of $16.90 per unit.

Activity under the performance stock units is as follows:

	Number of Units (in 000s)	Weighted-Average Grant Date Fair Value per Unit
Balance as of December 31, 2018	155	$ 10.09
PSU granted	401	$ 16.90
PSU released	—	$ —
PSU forfeited	(9)	$ 10.09
Balance as of June 30, 2019	547	$ 15.09

As of June 30, 2019, the unrecognized compensation costs related to these awards were $6.8 million. We expect to recognize these costs over a weighted average period of 2.5 years.

2017 Employee Stock Purchase Plan

Our ESPP offers U.S. and some non-U.S. employees the right to purchase shares of our common stock. Prior to June 2019, our ESPP 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 was amended to offer a twelve-month offering period with two six-month purchase periods beginning on each of May 31 and November 30. Under the updated plan, 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 lowest of the fair value of the common stock on the first day of the offering period, the last day of the offering period or the fair value of the common stock at the beginning of the second purchase period. Employees are eligible under the amended plan 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.

Share-based Compensation

We recognized share-based compensation expense as follows (in thousands):

	Three Months Ended June 30,		Six Months Ended June 30,	
	2019	2018	2019	2018
Options and Restricted Stock Units	$ 2,848	$ 1,888	$ 4,993	$ 3,514
Employee Stock Purchase Plan	144	119	270	240
Total Share-based Compensation	$ 2,992	$ 2,007	$ 5,263	$ 3,754

11. Income Taxes

The Company’s quarterly provision for income taxes is based on an estimated effective annual income tax rate. The Company’s quarterly provision for income taxes also includes the tax impact of certain unusual or infrequently occurring items, if any, including changes in judgment about valuation allowances and effects of changes in tax laws or rates, in the interim period in which they occur.

The Company recorded a tax benefit of $1.1 million for both the three and six months ended June 30, 2019. We recorded a tax benefit of $0.2 million and $1.4 million for the three and six months ended June 30, 2018. The benefit for all periods was primarily attributable to the tax benefit from the amortization of our acquisition-related deferred tax liability, partially offset by a provision from our foreign operations.

The Company's tax benefit for income taxes for the periods presented differs from the 21% U.S. Federal statutory rate for the three and six months ended June 30, 2019 and 2018, respectively, primarily due to maintaining a valuation allowance for deferred tax assets, which primarily consist of net operating loss carryforwards.

Tax positions taken by the Company are subject to audits by multiple tax jurisdictions. The Company believes that it has provided adequate reserves for its uncertain tax positions for all tax years still open for assessment. The Company also believes that it does not have any tax position that will significantly increase or decrease within the next year. For the six months ended June 30, 2019, the Company did not recognize any material interest or penalties related to uncertain tax positions.

Recording 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 deferred tax assets have been offset by valuation allowances. In the future we may release valuation allowances and recognize deferred tax assets in certain of our foreign subsidiaries depending on the achievement of future profitability in the relevant jurisdictions. Any release of valuation allowances could have the effect of decreasing the income tax provision in the period the valuation allowance is released. We continue to monitor the likelihood that we will be able to recover our deferred tax assets, including those for which a valuation allowance is recorded. There can be no assurance that we will generate profits in the future periods enabling us to fully realize our deferred tax assets. The timing of recording a valuation allowance or the reversal of such valuation allowance is subject to objective and subjective factors that cannot be readily predicted in advance.

12. Information about Geographic Areas

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

A summary table of our total revenue by geographic areas of our customers and by product and service for the three and six months ended June 30, 2019 and 2018 is included in Note 3 to the condensed consolidated financial statements of this quarterly report on Form 10-Q.

Sales to customers in the United States represented $9.9 million or 35%, and $22.4 million or 38% of total revenues for the three and six months ended June 30, 2019, respectively. Sales to customers in the United States represented $12.0 million or 46% and $22.2 million or 43% of total revenues for the three and six months ended June 30, 2018, respectively.

Sales to customers in China represented $4.0 million or 14% and $7.5 million or 13% of total revenues for the three and six months ended June 30, 2019, respectively. Sales to customers in China represented $2.3 million or 9% and $5.6 million or 11% of total revenues for the three and six months ended June 30, 2018, respectively. Except for China, no other foreign country or jurisdiction had sales in excess of 10% of our total revenue during the three and six months ended June 30, 2019 and 2018.

No individual customer represented more than 10% of our total revenues for the three and six months ended June 30, 2019, and 2018, respectively.

13. Commitments and Contingencies

Indemnification

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

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

Item 2. Management's Discussion and Analysis of Financial Condition and Results of Operations

The following discussion and analysis should be read together with our condensed consolidated financial statements and the notes to those statements included elsewhere in this Form 10-Q. This Form 10-Q contains forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended (the 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 section entitled "Risk Factors" and this 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 Part II, Item 1A, "Risk Factors," elsewhere in this quarterly report on Form 10-Q, and in our annual report on Form 10-K filed with the Securities and Exchange Commission (SEC). Given these uncertainties, you should not place undue reliance on these forward-looking statements. Also, forward-looking statements represent our management's beliefs and assumptions only as of the date of this Form 10-Q.

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-Q completely and with the understanding that our actual future results may be materially different from what we expect.

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

Overview

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

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

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

efforts related to operational excellence and improving efficiencies, we are consolidating our North American production activities into our Canadian facility.

Our total revenue for the six months ended June 30, 2019 was $58.3 million compared to $51.7 million for the six months ended June 30, 2018. Our total revenue was $113.0 million in 2018, $101.9 million in 2017, and $104.4 million in 2016. We have incurred significant net losses since our inception in 1999 and, as of June 30, 2019, our accumulated deficit was $598.1 million.

At the end of 2016, we began reallocating our resources based on revenue contribution and growth expectations across our target markets, including a reorganization of our sales team and commercial leadership. We implemented certain operational efficiencies and cost-savings initiatives beginning in the first quarter of 2017 intended to align our resources with our product strategy, reduce our operating expenses, and manage our cash flows. In 2017 and 2018, we grew our revenues, increased gross margins, reduced operating expenses, streamlined our manufacturing operations, and rationalized our headcount and facilities. These activities have resulted in lower net losses, improving from $76.0 million in 2016 to $59.0 million in 2018. We have also strengthened our balance sheet through the issuance of common stock and reduction of debt. In August 2017, we sold 9.1 million shares of common stock for aggregate net proceeds of approximately $28.8 million; in December 2018, we sold approximately 9.4 million shares of common stock for aggregate net proceeds of $59.1 million. In March 2018, we refinanced $150 million of our 2014 Notes with the issuance of our 2018 Notes, which effectively extended the maturity of the debt while providing us with additional financing flexibility. The 2018 Notes were subsequently converted into 19.5 million shares of our common stock during the first quarter of 2019. The conversion is described in Note 6 of our June 30, 2019 condensed consolidated financial statements.

Critical Accounting Policies, Significant Judgments and Estimates

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

Except for the adoption of ASC 842 disclosed below, there have been no material changes in our critical accounting policies and estimates in the preparation of our condensed consolidated financial statements during the six months ended June 30, 2019, compared to those disclosed in our annual report on Form 10-K for the year ended December 31, 2018, as filed with the SEC on March 18, 2019.

Recent Accounting Pronouncements

Adoption of New Accounting Guidance

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

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

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

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

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

See Note 2 — "Summary of Significant Accounting Policies" in the notes to our condensed consolidated financial statements in this quarterly report on Form 10-Q for recent accounting changes and pronouncements.

Results of Operations

The following table presents our historical condensed consolidated statements of operations data for the three and six months ended June 30, 2019, and 2018, and as a percentage of total revenue for the respective periods (in thousands):

	Three Months Ended June 30,				Six Months Ended June 30,			
	2019		2018		2019		2018	
Revenue	$ 28,196	100 %	$ 26,428	100 %	$ 58,307	100 %	$ 51,676	100 %
Cost of revenue	12,833	46	12,840	48	25,954	45	24,660	48
Gross profit	15,363	54	13,588	52	32,353	55	27,016	52
Operating expenses:								
Research and development	7,865	28	7,386	28	16,237	28	14,642	28
Selling, general and administrative	22,134	78	18,987	72	44,958	77	37,792	73
Total operating expenses	29,999	106	26,373	100	61,195	105	52,434	101
Loss from operations	(14,636)	(52)	(12,785)	(48)	(28,842)	(50)	(25,418)	(49)
Interest expense	(491)	(1)	(3,916)	(15)	(3,192)	(5)	(5,805)	(12)
Loss on extinguishment of debt	—	—	—	—	(9,000)	(15)	—	—
Other income, net	231	1	256	1	715	1	348	1
Loss before income taxes	(14,896)	(52)	(16,445)	(62)	(40,319)	(69)	(30,875)	(60)
Income tax benefit	1,143	4	204	1	1,101	2	1,387	3
Net loss	$ (13,753)	(48)%	$ (16,241)	(61)%	$ (39,218)	(67)%	$ (29,488)	(57)%

Revenue

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

We sell our instruments to leading academic research institutions, translational research and medicine centers, cancer centers, clinical research laboratories, and biopharmaceutical, biotechnology, and plant and animal research companies. No single customer represented more than 10% of our total revenue for the three and six months ended June 30, 2019, and 2018. Total revenue from our five largest customers comprised 30% and 22% of our total revenue for the three months ended June 30, 2019, and 2018, respectively. Total revenue from our five largest customers comprised 20% and 17% of our total revenue for the six months ended June 30, 2019, and 2018, respectively.

The following table presents our revenue by source for the three and six months ended June 30, 2019, and 2018 (in thousands):

	Three Months Ended June 30,					Six Months Ended June 30,				
	2019		2018		Year- Over-Year Change	2019		2018		Year- Over-Year Change
Instruments	$ 12,201	43%	$ 10,421	39%	17 %	$ 25,041	43%	$ 17,941	35%	40 %
Consumables	11,034	39	11,356	43	(3)%	23,021	39	24,313	47	(5)%
Product revenue	23,235	82	21,777	82	7 %	48,062	82	42,254	82	14 %
Service revenue	4,961	18	4,651	18	7 %	10,245	18	9,422	18	9 %
Total revenue	$ 28,196	100%	$ 26,428	100%	7 %	$ 58,307	100%	$ 51,676	100%	13 %

The following table presents our total revenue by geographic area of our customers and as a percentage of total revenue for the three and six months ended June 30, 2019, and 2018 (in thousands):

	Three Months Ended June 30,					Six Months Ended June 30,				
	2019		2018		Year-Over-Year Change	2019		2018		Year-Over-Year Change
Americas	$ 11,120	39%	$ 12,520	48%	(11)%	$ 24,091	42%	$ 23,354	45%	3%
EMEA	11,217	40	9,109	34	23 %	19,373	33	17,582	34	10%
Asia-Pacific	5,859	21	4,799	18	22 %	14,843	25	10,740	21	38%
Total	$ 28,196	100%	$ 26,428	100%	7 %	$ 58,307	100%	$ 51,676	100%	13%

The Americas revenue includes revenue generated in the United States of $9.9 million and $12.0 million for the three months ended June 30, 2019, and 2018, respectively. The Americas revenue includes revenues generated in the United States of $22.4 million and $22.2 million for the six months ended June 30, 2019 and 2018, respectively.

Total Revenue

Total revenue increased by $1.8 million, or 7%, for the three months ended June 30, 2019 compared to the three months ended June 30, 2018. The increase was attributable to a $1.5 million, or 7%, increase in product revenue and a $0.3 million, or 7%, increase in service revenue. The increase in revenue was driven by increased unit sales of mass cytometry instruments and related consumables, partially offset by lower sales of microfluidics products.

Revenue in the Americas decreased 11% for the three months ended June 30, 2019, compared to the three months ended June 30, 2018. The decrease in the Americas was primarily due to lower sales of mass cytometry instruments and weakness in microfluidics sales, partially offset by higher mass cytometry consumables sales. Revenues grew 23% in Europe driven by higher mass cytometry instrument and consumables revenues, partially offset by lower service revenues. Unfavorable foreign exchange rates negatively impacted EMEA revenues by 4%. The 22% growth in Asia-Pacific was driven by increased sales of both microfluidics and mass cytometry instruments and higher service revenues, partially offset by lower microfluidics consumable sales. On a company-wide basis, weaker foreign exchange rates negatively impacted revenues by 1% for the second quarter of 2019, compared to the same period in the prior year.

Total revenue increased by $6.6 million, or 13% for the six months ended June 30, 2019 compared to the six months ended June 30, 2018. The year-on-year increase is attributable to increases in mass cytometry instrument and consumables sales, partially offset by lower microfluidics sales. In the Americas, instrument sales grew 24%, partially offset by lower microfluidics consumable sales. In Europe, both instruments and consumable revenues grew, despite unfavorable foreign exchange rates which had a negative 6% impact on revenues. The 38% increase in Asia-Pacific revenues is due to increases in mass cytometry instruments, consumables and service revenue, partially offset by lower microfluidics sales. On a company-wide basis, weaker foreign exchange rates negatively impacted revenues by 1% for the first half of 2019, compared to the same period in the prior year.

Product Revenue

Product revenue increased by $1.5 million, or 7%, for the three months ended June 30, 2019 compared to the three months ended June 30, 2018. Instrument sales increased by $1.8 million, or 17%, for the three months ended June 30, 2019 compared to the three months ended June 30, 2018. The increase was primarily attributable to higher unit sales of mass cytometry instruments. Consumables revenue decreased by $0.3 million, or 3%, for the three months ended June 30, 2019 compared to the three months ended June 30, 2018, driven by lower sales of microfluidics consumables, partially offset by higher mass cytometry consumables sales.

Product revenue increased by $5.8 million, or 14% for the six months ended June 30, 2019 compared to the prior year period. Higher revenues from mass cytometry instruments and consumables was partially offset by lower microfluidics consumables sales.

We expect the average selling prices and volumes of our products to fluctuate over time based on market conditions, product mix, and currency fluctuations. We cannot provide assurance concerning future revenue growth, if any.

Service Revenue

Service revenue increased by $0.3 million, or 7%, for the three months ended June 30, 2019 compared to the three months ended June 30, 2018. Service revenue increased by $0.8 million or 9% for the six months ended June 30, 2019 compared to the six months ended June 30, 2018. Increases in service revenues for both the quarter and year-to-date periods reflect higher revenues from service plans and preventive maintenance.

Cost of Revenue, Gross Profit and Gross Margin

The following table presents our costs of product and service revenue, gross profit and gross margin for the three and six months ended June 30, 2019, and 2018 (in thousands):

	Three Months Ended June 30,			Six Months Ended June 30,		
	2019	2018	Year-Over-Year Change	2019	2018	Year-Over-Year Change
Cost of product revenue	$ 11,100	$ 11,160	(1)%	$ 22,489	$ 21,382	5%
Cost of service revenue	1,733	1,680	3 %	3,465	3,278	6%
Total cost of revenue	$ 12,833	$ 12,840	— %	$ 25,954	$ 24,660	5%
Gross profit	$ 15,363	$ 13,588	13 %	$ 32,353	$ 27,016	20%
Gross margin	54.5%	51.4%	3.1 ppts	55.5%	52.3%	3.2 ppts

Cost of product revenue includes manufacturing costs incurred in the production process, including component materials, labor and overhead, 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.

Gross margin increased by 3.1 percentage points for the three months ended June 30, 2019, compared to the three months ended June 30, 2018. Higher instrument capacity utilization, as well as the impact of spreading fixed depreciation and amortization over a higher revenue base, contributed to the improvement in gross margin, partially offset by lower instrument pricing.

For the six months ended June 30, 2019, gross margin increased by 3.2 percentage points compared to the six months ended June 30, 2018. Higher instrument capacity utilization, as well as the impact of spreading fixed depreciation and amortization over a higher revenue base, contributed to the improvement in gross margin, partially offset by product mix and lower instrument pricing. Product mix negatively impacted gross margins, as a larger percentage of our revenues came from instruments sales, which tend to have a lower gross margin than consumables.

Operating Expenses

The following table presents our operating expenses for the three and six months ended June 30, 2019, and 2018 (in thousands):

	Three Months Ended June 30,		Year-Over-Year Change	Six Months Ended June 30,		Year-Over-Year Change
	2019	2018		2019	2018	
Research and development	$ 7,865	$ 7,386	6%	$ 16,237	$ 14,642	11%
Selling, general and administrative	22,134	18,987	17%	44,958	37,792	19%
Total	$ 29,999	$ 26,373	14%	$ 61,195	$ 52,434	17%

Research and Development

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

Research and development expense increased by $0.5 million, or 6%, for the three months ended June 30, 2019 compared to the three months ended June 30, 2018, primarily due to higher levels of laboratory supplies and equipment associated with product development.

Research and development expense increased by $1.6 million, or 11%, for the six months ended June 30, 2019, compared to the same period a year ago. Approximately $1.0 million of the increase is due to higher levels of laboratory supplies and equipment. The majority of the remaining increase in research and development costs is due to higher headcount costs compared to the year ago period.

Selling, General and Administrative

Selling, general and administrative expense consists primarily of personnel costs for our sales and marketing, business development, finance, legal, human resources, and general management, as well as professional services, such as legal and accounting services.

Selling, general and administrative expense increased $3.1 million, or 17%, for the three months ended June 30, 2019, compared to the three months ended June 30, 2018. Stock-based compensation increased $1.2 million from the year ago period, reflecting the impact of an executive retirement and additions to the senior executive team. Other compensation-related costs contributed $1.9 million to the increase in expense for the quarter, reflecting a 13% increase in average headcount.

Selling, general and administrative expense increased $7.2 million, or 19%, for the six months ended June 30, 2019 compared to the six months ended June 30, 2018. Compensation-related costs contributed $3.0 million of the increase, reflecting an 11% increase in headcount, including several senior executives. Stock-based compensation increased $1.7 million, primarily due to the impact of an executive retirement and additions to the senior executive team. Business development and legal expenses increased $1.9 million, along with a $0.9 million increase in advertising and promotional costs.

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

The following table presents these items for the three and six months ended June 30, 2019, and 2018 (in thousands):

	Three Months Ended June 30,		Year-Over-Year Change	Six Months Ended June 30,		Year-Over-Year Change
	2019	2018		2019	2018	
Interest expense	$ 491	$ 3,916	(87)%	$ 3,192	$ 5,805	(45)%
Loss on extinguishment of debt	—	—	NA	9,000	—	NA
Other income, net	(231)	(256)	(10)%	(715)	(348)	105 %
Total	$ 260	$ 3,660	(93)%	$ 11,477	$ 5,457	110 %

In February 2014, we issued $201.3 million aggregate principal amount of our 2.75% 2014 Notes due 2034 (2014 Notes). In March 2018, we entered into privately negotiated transactions with certain holders of our 2014 Notes to exchange $150.0 million

in aggregate principal amount of the 2014 Notes for $150.0 million in aggregate principal amount of our new 2.75% Exchange Convertible Senior Notes due 2034. 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. Because of this conversion option, along with a redemption premium, the net effective interest rate for the 2018 Notes is higher than the 2014 Notes. The effective interest rate on the 2014 Notes and the 2018 Notes is approximately 3.0% and 12.3%, respectively.

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 the Trustee 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 bonds retired. In accordance with ASC 470, we recognized a loss of $9.0 million on the conversion of the debt, representing the difference between the fair value of the bonds converted and the carrying value of the bonds at the time of conversion.

Following the retirement of the 2018 Notes in the first quarter of 2019, only $51.25 million of principal of the 2014 Notes remained outstanding. Interest expense fell for the three and six months ended June 30, 2019, compared to the three and six months ended June 30, 2018 due to the retirement of the 2018 Notes in the first quarter of 2019.

Other income primarily consists of interest income and gains or losses on foreign exchange. Other income for the second quarter of 2019 includes $350 thousand of interest income, partially offset by $125 thousand of foreign exchange losses. By comparison, other income for the second quarter of 2018 includes $133 thousand of interest income and $122 thousand of foreign exchange gains. Other income for the six months ended June 30, 2019 includes $770 thousand of interest income partially offset by $80 thousand of foreign exchange losses. Other income for the six months ended June 30, 2018 includes $275 thousand of interest income and $59 thousand of foreign exchange gain. Higher interest income in the 2019 periods compared to the year ago periods is attributable to higher cash and investment balances; the increase in foreign exchange losses is due to the impact of a stronger U.S. dollar.

Income Tax Benefit

Our tax provision is generally driven by three components 1) tax provision from our foreign operations and 2) tax benefits from the deduction of amortization of acquisition-related intangible assets and 3) discrete items, such as changes to recording or releasing valuation allowances or return-to-provision true-ups. 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 for both the three and six months ended June 30, 2019, respectively. We recorded a tax benefit of $0.2 million and $1.4 million for the three and six months ended June 30, 2018, respectively. The benefit for all periods was primarily attributable to the tax benefit from the amortization of our acquisition-related deferred tax liability, partially offset by a provision from our foreign operations.

In the future we may release valuation allowances and recognize deferred tax assets in certain of our foreign subsidiaries depending on the achievement of future profitability in the relevant jurisdictions. Any release of valuation allowances could have the effect of decreasing the income tax provision in the period the valuation allowance is released. We continue to monitor the likelihood that we will be able to recover our deferred tax assets, including those for which a valuation allowance is recorded. There can be no assurance that we will generate profits in the future periods enabling us to fully realize our deferred tax assets. The timing of recording a valuation allowance or the reversal of such valuation allowance is subject to objective and subjective factors that cannot be readily predicted in advance.

Liquidity and Capital Resources

Sources of Liquidity

As of June 30, 2019, our principal sources of liquidity consisted of $24.0 million of cash and cash equivalents and $44.8 million of short-term investments as well as $12.5 million of availability under our Revolving Credit Facility.

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

	Six Months Ended June 30,	
	2019	2018
Net cash used in operating activities	$ (25,143)	$ (20,499)
Net cash provided by (used in) investing activities	(45,299)	3,936
Net cash provided by (used in) financing activities	1,187	(2,152)
Effect of foreign exchange fluctuations	(25)	83
Net decrease in cash, cash equivalents and restricted cash	$ (69,280)	$ (18,632)

Net Cash Used in Operating Activities

We derive cash flows from operations primarily from cash collected from the sale of our products and services. Our cash flows from operating activities are also significantly influenced by our use of cash for operating expenses to support the growth of our 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 for the six months ended June 30, 2019, was $25.1 million and consisted of a net loss of $39.2 million, adjusted for non-cash items of $24.2 million. Non-cash items included a loss on extinguishment of debt of $9.0 million, amortization of developed technology of $5.6 million, stock-based compensation expense of $5.3 million, amortization of debt discounts, premium and issuance cost of $2.0 million and depreciation and amortization of $2.4 million. The net change in assets and liabilities included a decrease in other liabilities of $9.2 million, an increase in accounts receivable of $2.4 million, an increase in inventories of $1.5 million, and an increase in prepaid expenses and other current assets of $1.3 million, partially offset by an increase in accounts payable of $3.4 million.

Net cash used in operating activities for the six months ended June 30, 2018, was $20.5 million, and consisted of a net loss of $29.5 million, adjusted for non-cash items of $15.3 million. Non-cash items included stock-based compensation expense of $3.8 million, amortization of developed technology of $5.6 million, depreciation and amortization of $2.9 million. The net change in assets and liabilities included an increase in accounts receivable of $1.8 million, an increase in prepaid expenses and other current assets of $1.0 million, and a decrease in other non-current liabilities of $6.7 million, offset by an increase in accounts payable of $2.4 million.

Net Cash Provided by (Used in) Investing Activities

Our primary investing activities consist of purchases, sales, and maturities of our short-term investments and to a much lesser extent, capital expenditures for manufacturing, laboratory, computer equipment and software to support our infrastructure and work force.

Net cash used in investing activities was $45.3 million during the six months ended June 30, 2019 and consisted of purchases of investments of $44.6 million and capital expenditures of $0.7 million. Net cash provided by investing activities for six months ended June 30, 2018 was $3.9 million and consisted of net redemptions of investments of $4.1 million and capital expenditures of $0.2 million.

Net Cash Provided by (Used in) Financing Activities

Net cash provided by financing activities was $1.2 million during the six months ended June 30, 2019. Net cash provided by financing activities primarily consisted of $1.0 million from the exercise of stock options and $0.6 of proceeds from our ESPP program, partially offset by $0.5 million for income taxes related to net share settlement of equity awards. Net cash used in financing activities was $2.2 million for the six months ended June 30, 2018 and consisted of $2.6 million of debt issuance costs, partially offset by $0.5 million of net proceeds from employee equity programs.

Liquidity and Capital Resources

As discussed above, 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 the Trustee 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 bonds retired.

We currently have outstanding $51.3 million in aggregate principal amount of our 2014 Notes as of June 30, 2019. The 2014 Notes will mature on February 1, 2034, unless earlier converted, redeemed, or repurchased in accordance with the terms of the 2014 Notes. Holders of the 2014 Notes may require us to repurchase all or a portion of their 2014 Notes on each of February 6, 2021, February 6, 2024, and February 6, 2029 at a repurchase price in cash equal to 100% of the principal amount of the Notes plus accrued and unpaid interest. If we undergo a fundamental change, as defined, holders of the 2014 Notes may require us to repurchase the 2014 Notes in whole or in part for cash at a repurchase price equal to 100% of the principal amount of the 2014 Notes plus accrued and unpaid interest.

We have a Revolving Credit Facility with Silicon Valley Bank, which matures on August 2, 2020. Amounts drawn under the Revolving Credit Facility will be used for working capital and general corporate purposes. As of June 30, 2019, total availability under the Revolving Credit Facility was $12.5 million. We currently have no outstanding debt under the Revolving Credit Facility, and we are in compliance with all the terms and conditions of the loan agreement governing the Revolving Credit Facility. See Note 6 to the condensed consolidated financial statements included in this Form 10-Q 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, through December 31, 2020. However, we may experience lower than expected cash generated from sales of our products and services 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.

Off-Balance Sheet Arrangements

As of June 30, 2019, we did not have any off-balance sheet arrangements as defined in Item 303(a)(4) of the Securities and Exchange Commission's Regulation S-K.

Contractual Obligations and Commitments

Our operating lease obligations include a lease for our current headquarters and leases for manufacturing, laboratory, warehousing and office space for our foreign subsidiaries. In the first quarter of 2019, we entered into a lease for a new headquarters in California which is expected to commence in late 2019 or the first quarter of 2020. Please see Note 7 to the financial statements for a discussion of our lease obligations.

Other than as disclosed above, there have been no material changes during the six months ended June 30, 2019 to our contractual obligations disclosed in our “Management’s Discussion and Analysis of Financial Condition and Results of Operations” included in our annual report on Form 10-K for the year ended December 31, 2018.

Item 3. 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 six months ended June 30, 2019 and 2018, our gains and losses related to changes in foreign exchange rates was less than $0.1 million. 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, cash equivalents and short-term investments of $68.9 million at June 30, 2019. These amounts were held primarily in cash on deposit with banks, treasury bills and money market funds which are short-term. Cash and cash equivalents and investments are held for working capital purposes. Due to the short-term nature of these investments, we believe that we do not have any material exposure to changes in the fair value of our investment portfolio due to 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. However, we may adopt specific hedging strategies in the future.

Item 4. 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 June 30, 2019. The term “disclosure controls and procedures,” as defined in Rules 13a-15(e) and 15d-15(e) under the Exchange Act, means controls and other procedures of a company that are designed to ensure that information required to be disclosed by a company in the reports that it files or submits under the Exchange Act is recorded, processed, summarized and reported, within the time periods specified in the SEC’s rules and forms. Disclosure controls and procedures include, without limitation, controls and procedures designed to ensure that information required to be disclosed by a company in the reports that it files or submits under the Exchange Act is accumulated and communicated to the company’s management, including its principal executive and principal financial officers, as appropriate to allow timely decisions regarding required disclosure. Management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving their objectives and management necessarily applies its judgment in evaluating the cost-benefit relationship of possible controls and procedures. Based on the evaluation of our disclosure controls and procedures as of June 30, 2019, our Chief Executive Officer and Chief Financial Officer concluded that, as of such date, our disclosure controls and procedures were effective at the reasonable assurance level.

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 June 30, 2019 that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

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.

PART II. OTHER INFORMATION

Item 1. Legal Proceedings

In the normal course of business, we are from time to time involved in legal proceedings or potential legal proceedings, including matters involving employment, intellectual property, or others. Although the results of litigation and claims cannot be predicted with certainty, we currently believe that the final outcome of any currently pending matters would not have a material adverse effect on our business, operating results, financial condition, or cash flows. Regardless of the outcome, litigation can have an adverse impact on us because of defense and settlement costs, diversion of management resources, and other factors.

Item 1A. Risk Factors

Set forth below are the risks that we believe are material to our investors. Our risk factors disclosed in Part I, Item 1A, of our annual report on Form 10-K for the year ended December 31, 2018 provide additional disclosure and are incorporated herein by reference.

Risks Related to Fluidigm's Business and Strategy

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

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

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

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

We have incurred significant losses in each fiscal year since our inception, including net losses of $59.0 million, $60.5 million, and $76.0 million during the years 2018, 2017, and 2016, respectively. As of June 30, 2019, we had an accumulated deficit of $598.1 million. These losses have resulted principally from costs incurred in our research and development programs, and from our manufacturing costs and selling, general, and administrative expenses. To date, we have funded our operations primarily through equity offerings, the issuance of debt instruments, and from sales of our products.

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

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

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

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

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

The application of our technologies to high-throughput genomics, single-cell genomics and, particularly, mass cytometry applications are in many cases emerging market opportunities. We believe these opportunities will take several years to develop or

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

If our products fail to achieve and sustain sufficient market acceptance, our revenue will be adversely affected.

Our success depends on our ability to develop and market products that are recognized and accepted as reliable, enabling and cost-effective. Most of our potential customers already use expensive research systems in their laboratories and may be reluctant to replace those systems. Market acceptance of our systems will depend on many factors, including our ability to convince potential customers that our systems are an attractive alternative to existing technologies. Compared to some competing technologies, our technology is relatively new, and most potential customers have limited knowledge of, or experience with, our products. Prior to adopting our systems, some potential customers may need to devote time and effort to testing and validating our systems. Any failure of our systems to meet these customer benchmarks could result in customers choosing to retain their existing systems or to purchase systems other than ours, and revenue from the sale of legacy instruments that may have contributed significant revenue in prior periods may decrease.

In addition, it is important that our systems be perceived as accurate and reliable by the scientific and medical research community as a whole. Historically, a significant part of our sales and marketing efforts has been directed at convincing industry leaders of the advantages of our systems and encouraging such leaders to publish or present the results of their evaluation of our system. If we are unable to continue to induce leading researchers to use our systems, or if such researchers are unable to achieve and publish or present significant experimental results using our systems, acceptance and adoption of our systems will be slowed and our ability to increase our revenue would be adversely affected.

We may experience development or manufacturing problems or delays that could limit the potential growth of our revenue or increase our losses.

We may encounter unforeseen situations in the manufacturing and assembly of our products that would result in delays or shortfalls in our production. For example, our production processes and assembly methods may have to change to accommodate any significant future expansion of our manufacturing capacity, which may increase our manufacturing costs, delay production of our products, reduce our product margin, and adversely impact our business. Conversely, if demand for our products shifts such that a manufacturing facility is operated below its capacity for an extended period, we may adjust our manufacturing operations to reduce fixed costs, which could lead to uncertainty and delays in manufacturing times and quality during any transition period.

Additionally, all of our integrated fluidic circuits (IFCs) for commercial sale are manufactured at our facility in Singapore. Production of the elastomeric block that is at the core of our IFCs is a complex process requiring advanced clean rooms, sophisticated equipment, and strict adherence to procedures. Any contamination of the clean room, equipment malfunction, or failure to strictly follow procedures can significantly reduce our yield in one or more batches. We have in the past experienced variations in yields due to such factors. A drop in yield can increase our cost to manufacture our IFCs or, in more severe cases, require us to halt the manufacture of our IFCs until the problem is resolved. Identifying and resolving the cause of a drop in yield can require substantial time and resources.

Furthermore, developing an IFC for a new application may require developing a specific production process for that type of IFC. While all of our IFCs are produced using the same basic processes, significant variations may be required to ensure adequate yield of any particular type of IFC. Developing such a process can be very time consuming, and any unexpected difficulty in doing so can delay the introduction of a product.

If our manufacturing activities are adversely impacted, or if we are otherwise unable to keep up with demand for our products by successfully manufacturing, assembling, testing, and shipping our products in a timely manner, our revenue could be impaired, market acceptance for our products could be adversely affected and our customers might instead purchase our competitors' products.

If our research and product development efforts do not result in commercially viable products within anticipated timelines, if at all, our business and results of operations will be adversely affected.

Our business is dependent on the improvement of our existing products, our development of new products to serve existing markets, and our development of new products to create new markets and applications that were previously not practical with existing systems. We intend to devote significant personnel and financial resources to research and development activities designed to advance the capabilities of our technology. We have developed design rules for the implementation of our technology that are frequently revised to reflect new insights we have gained about the technology. In addition, we have discovered that biological or chemical reactions sometimes behave differently when implemented on our systems rather than in a standard laboratory environment. Furthermore, many such reactions take place within the confines of single cells, which have also demonstrated unexpected behavior when grown and manipulated within microfluidic environments. As a result, research and development efforts may be required to transfer certain reactions and cell handling techniques to our systems. In the past, product development projects have been significantly delayed when we encountered unanticipated difficulties in implementing a process on our systems. We may have similar delays in the future, and we may not obtain any benefits from our research and development activities. Any delay or failure by us to develop and release new products or product enhancements would have a substantial adverse effect on our business and results of operations.

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

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

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

If our products contain defects, we may experience:

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

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

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

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

We expect that our revenue in the foreseeable future will continue to be derived primarily from sales of our systems, IFCs, assays, and reagents to academic research institutions, translational research and medicine centers, cancer centers, clinical research laboratories biopharmaceutical, biotechnology, and agricultural biotechnology (Ag-Bio) companies, and contract research organizations worldwide. Our success will depend upon their demand for and use of our products. Accordingly, the spending policies of these customers could have a significant effect on the demand for our technology. These policies may be based on a wide variety of factors, including concerns regarding any future federal government budget sequestrations, the availability of resources to make purchases, the spending priorities among various types of equipment, policies regarding spending during recessionary periods, and changes in the political climate. In addition, academic, governmental, and other research institutions that fund research and development activities may be subject to stringent budgetary constraints that could result in spending reductions, reduced allocations, or budget cutbacks, which could jeopardize the ability of these customers to purchase our products. Our operating results may fluctuate substantially due to reductions and delays in research and development expenditures by these customers. For example, reductions in capital and operating expenditures by these customers may result in lower than expected sales of our systems, IFCs, assays, and reagents. These reductions and delays may result from factors that are not within our control, such as:

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

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

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

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

be available to us on acceptable terms, or at all. If our manufacturing capabilities are impaired, we may not be able to manufacture and ship our products in a timely manner, which would adversely impact our business.

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

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

- required compliance with existing and changing foreign regulatory requirements and laws that are or may be applicable to our business in the future, such as the European Union's General Data Protection Regulation and other data privacy requirements, labor and employment regulations, anticompetition regulations, the U.K. Bribery Act of 2010 and other anticorruption laws, and the RoHS and WEEE directives, which regulate the use of certain hazardous substances in, and require the collection, reuse, and recycling of waste from, products we manufacture;
- required compliance with U.S. laws such as the Foreign Corrupt Practices Act, and other U.S. federal laws and regulations established by the office of Foreign Asset Control;
- export requirements and import or trade restrictions;
- laws and business practices favoring local companies;
- longer payment cycles and difficulties in enforcing agreements and collecting receivables through certain foreign legal systems;
- changes in social, economic, and political conditions or in laws, regulations and policies governing foreign trade, manufacturing, development, and investment both domestically as well as in the other countries and jurisdictions in which we operate and into which we sell our products, including as a result of the 2016 advisory referendum approving the separation of the United Kingdom from the European Union (Brexit);
- potentially adverse tax consequences, tariffs, customs charges, bureaucratic requirements, and other trade barriers;
- difficulties and costs of staffing and managing foreign operations; and
- difficulties protecting or procuring intellectual property rights.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Our success depends on our ability to develop new products and applications for our technology in existing and new markets, while improving the performance and cost-effectiveness of our systems. New technologies, techniques, or products

could emerge that might offer better combinations of price and performance than our current or future product lines and systems. Existing markets for our products, including high-throughput genomics, single-cell genomics and mass cytometry, as well as potential markets for our products such as high-throughput DNA sequencing and molecular applications, are characterized by rapid technological change and innovation. It is critical to our success for us to anticipate changes in technology and customer requirements and to successfully introduce new, enhanced, and competitive technology to meet our customers' and prospective customers' needs on a timely and cost-effective basis. Developing and implementing new technologies will require us to incur substantial development costs and we may not have adequate resources available to be able to successfully introduce new applications of, or enhancements to, our systems. We cannot guarantee that we will be able to maintain technological advantages over emerging technologies in the future. While we typically plan improvements to our systems, we may not be able to successfully implement these improvements. If we fail to keep pace with emerging technologies, demand for our systems will not grow and may decline, and our business, revenue, financial condition, and operating results could suffer materially. In addition, if we introduce enhanced systems but fail to manage product transitions effectively, customers may delay or forgo purchases of our systems and our operating results may be adversely affected by product obsolescence and excess inventory. Even if we successfully implement some or all of these planned improvements, we cannot guarantee that our current and potential customers will find our enhanced systems to be an attractive alternative to existing technologies, including our current products.

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

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

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

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

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

- difficulties in integrating and managing the operations, technologies, and products of the companies we acquire;
- diversion of our management's attention from normal daily operation of our business;
- our inability to maintain the key business relationships and the reputations of the businesses we acquire;
- our inability to retain key personnel of the acquired company;
- uncertainty of entry into markets in which we have limited or no prior experience and in which competitors have stronger market positions;
- our dependence on unfamiliar affiliates and customers of the companies we acquire;

- insufficient revenue to offset our increased expenses associated with acquisitions;
- our responsibility for the liabilities of the businesses we acquire, including those which we may not anticipate; and
- our inability to maintain internal standards, controls, procedures, and policies.

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

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

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

We have implemented security controls to protect our information technology infrastructure but, despite our efforts, we are not fully insulated from technology disruptions that could adversely impact us. For example, in early March 2019, we experienced a ransomware attack that infiltrated and encrypted certain of our information technology systems, including systems containing critical business data. Immediately following the attack, actions were taken to recover the compromised systems and we believe we were able to restore their operation without significant loss of business data. Based on the nature of the attack and its impact on our systems, we do not believe confidential data was lost or disclosed, but we are continuing to monitor the situation. If confidential data is later determined to have been released in the course of this event, it is possible that we could be the subject of actions by governmental authorities or claims from persons alleging they suffered damages from such a release. As of the date of this filing, we estimate the costs associated with the intrusion and remediation to be approximately $0.6 million, net of insurance proceeds received. Although we believe we have now contained the disruption, we anticipate additional work and expense in the future as we continue to respond to the attack and further enhance our security processes and initiatives.

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

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

Since 2017, we have been implementing efficiency and cost-savings initiatives intended to stabilize our business operations and return to growth. These efficiency initiatives have included targeted workforce reductions, optimizing our facilities, and reducing excess space. Further actions such as these may be required on an ongoing basis to optimize our organization. For example, we may need to decrease or defer capital expenditures and development activities or implement further operating

expense reduction measures. The implementation of these efficiency and cost-savings initiatives could impair our ability to invest in developing, marketing and selling new and existing products, be disruptive to our operations, make it difficult to attract or retain employees, result in higher than anticipated charges, divert the attention of management, result in a loss of accumulated knowledge, impact our customer and supplier relationships, and otherwise adversely affect our results of operations and financial condition. In addition, our ability to complete our efficiency and cost-savings initiatives and achieve the anticipated benefits within the expected time frame is subject to estimates and assumptions and may vary materially from our expectations, including as a result of factors that are beyond our control. Furthermore, our efforts to grow our business and become profitable may not be successful.

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

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

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

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

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

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

reporting, promotional restrictions, reporting adverse events or malfunctions for our products, and general prohibitions against misbranding and adulteration.

In addition, we may in the future submit 510(k) premarket notifications to the FDA to obtain FDA clearance of certain of our products on a selected basis. It is possible, in the event we elect to submit 510(k) applications for certain of our products, that the FDA would take the position that a more burdensome premarket application, such as a premarket approval application or a de novo application is required for some of our products. If such applications were required, greater time and investment would be required to obtain FDA approval. Even if the FDA agreed that a 510(k) was appropriate, FDA clearance can be expensive and time consuming. It generally takes a significant amount of time to prepare a 510(k), including conducting appropriate testing on our products, and several months to years for the FDA to review a submission. Notwithstanding the effort and expense, FDA clearance or approval could be denied for some or all of our products. Even if we were to seek and obtain regulatory approval or clearance, it may not be for the intended uses we believe are important or commercially attractive.

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

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

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

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

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

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

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

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

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

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

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

Our compliance with Section 404 requires that we incur substantial accounting expense and expend significant management time on compliance-related issues. We currently do not have an internal audit group, and we continue to evaluate our need for additional accounting and financial staff with appropriate public company experience and technical accounting knowledge. Moreover, if we do not comply with the requirements of Section 404, or if we or our independent registered public accounting firm identify deficiencies in our internal control over financial reporting that are deemed to be material weaknesses, the market

price of our stock could decline and we could be subject to sanctions or investigations by the Nasdaq Global Select Market (Nasdaq), the SEC, or other regulatory authorities, which would require additional financial and management resources.

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

As of December 31, 2018, we had approximately $165.9 million of goodwill and net intangible assets, including approximately $104.1 million of goodwill and $61.8 million of net intangible assets. These assets represent a significant portion of the assets recorded on our consolidated balance sheet and relate primarily to our acquisition of DVS Sciences, Inc., or DVS, in February 2014. In addition, if in the future we acquire additional businesses, technologies, or other intangible assets, a substantial portion of the value of such assets may be recorded as goodwill or intangible assets.

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

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

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

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

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

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

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

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

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

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

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

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

Section 382 of the Internal Revenue Code of 1986, as amended, referred to as the "Code," imposes an annual limitation on the amount of taxable income that may be offset if a corporation experiences an "ownership change" as defined in Section 382 of the Code. An ownership change occurs when a company's "five-percent shareholders" (as defined in Section 382 of the Code)

collectively increase their ownership in the company by more than 50 percentage points (by value) over a rolling three-year period. Additionally, various states have similar limitations on the use of state net operating losses, referred to as our NOLs, following an ownership change.

If we experience an ownership change, our ability to use our NOLs, any loss or deduction attributable to a "net unrealized built-in loss" and other tax attributes, which we refer to as tax benefits, could be substantially limited, and the timing of the usage of the tax benefits could be substantially delayed, which could significantly impair the value of the tax benefits. There is no assurance that we will be able to fully utilize the tax benefits and we could be required to record an additional valuation allowance related to the amount of the tax benefits that may not be realized, which could adversely impact our results of operations.

We believe that these tax benefits are a valuable asset for us. However, legislation commonly known as the 2017 Tax Cuts and Jobs Act includes a decrease in the U.S. federal corporate income tax rate from 35% to 21%, and our tax benefits were revalued at the newly enacted rate. We do not expect this to have a material impact on our financial statements because we currently maintain a full valuation allowance on our U.S. deferred tax assets; however, this reduction in the U.S. federal corporate income tax rate results in a corresponding reduction in the value of our tax benefits. On November 21, 2016, our board of directors approved a tax benefit preservation plan, or Tax Benefit Preservation Plan, in an effort to protect our tax benefits during the effective period of the tax benefit preservation plan. Our board of directors elected to let the Tax Benefit Preservation Plan expire in August 2017 based on its determination, in consultation with our management and tax advisors, that our NOLs were not at material risk of limitation based on an ownership change pursuant to Section 382. Our board of directors will continue to monitor our NOLs, however, and could elect to adopt a similar plan if it believes a potential risk exists that our NOLs could be limited. Any future tax benefit preservation plan could make it more difficult for a third party to acquire, or could discourage a third party from acquiring, us or a large block of our common stock.

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

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

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

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

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

successful, our technologies and products may not gain market acceptance, which would materially and adversely impact our business operations.

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

We have considered implementing a company-wide ERP system to handle the business and financial processes within our operations and corporate functions. ERP implementations are complex and time-consuming projects that involve substantial expenditures on system software and implementation activities that can continue for several years. ERP implementations also require transformation of business and financial processes in order to reap the benefits of the ERP system. If we decide to implement a company-wide ERP system, our business and results of operations could be adversely affected if we experience operating problems and/or cost overruns during the ERP implementation process, or if the ERP system and the associated process changes do not give rise to the benefits that we expect. If we do not effectively implement the ERP system as planned or if the system does not operate as intended, our business, results of operations, and internal controls over financial reporting could be adversely affected.

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

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

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

The FASB also issued Accounting Standards Update (ASU) 2016-02, *Leases (Topic 842)*. The core principle is that lessees should recognize the assets and liabilities arising from leases on the balance sheet. Under the new standard, lessees will be required to recognize lease assets and liabilities for all leases, with certain exceptions, on their balance sheets. We adopted ASU 2016-02 as of January 1, 2019. The adoption of this standard had a material impact on our consolidated financial statements. We continue to identify the appropriate changes to our business processes, systems, and controls to support the new lease standard and the required disclosures under the new standard.

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

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

We have significant outstanding convertible debt, and may be required to repay, refinance or restructure a portion of such debt before 2021. As of June 30, 2019, we had outstanding $51.3 million aggregate principal amount of our 2014 Notes. The 2014

Notes will mature on February 1, 2034, unless earlier converted, redeemed, or repurchased in accordance with the terms of the 2014 Notes. Holders of the 2014 Notes may require us to repurchase all or a portion of their 2014 Notes on each of February 6, 2021, February 6, 2024, and February 6, 2029 at a repurchase price in cash equal to 100% of the principal amount of the Notes plus accrued and unpaid interest. If we undergo a fundamental change, as defined in the terms of each of the applicable series of Notes, holders of the 2014 Notes may require us to repurchase the 2014 Notes in whole or in part for cash at a repurchase price equal to 100% of the principal amount of the 2014 Notes plus accrued and unpaid interest. If we refinance the debt owed under the 2014 Notes, we may issue additional convertible notes or other debt, which could include additional company obligations and represent more dilution to existing stockholders and noteholders.

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

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

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

Risks Related to Intellectual Property

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

We are subject to certain U.S. government regulations because we have licensed technologies that were developed with U.S. government grants. In accordance with these regulations, these licenses provide that products embodying the technologies are subject to domestic manufacturing requirements. If this domestic manufacturing requirement is not met, the government agency that funded the relevant grant is entitled to exercise specified rights, referred to as “march-in rights,” which if exercised would allow the government agency to require the licensors or us to grant a non-exclusive, partially exclusive, or exclusive license in any field of use to a third party designated by such agency. All of our microfluidic systems revenue is dependent upon the availability of our IFCs, which incorporate technology developed with U.S. government grants. Our genomics instruments, including microfluidic systems, and IFCs are manufactured at our facility in Singapore. The federal regulations allow the funding government agency to grant, at the request of the licensors of such technology, a waiver of the domestic manufacturing requirement. Waivers may be requested prior to any government notification. We have assisted the licensors of these technologies with the analysis of the domestic manufacturing requirement, and, in December 2008, the sole licensor subject to the requirement applied for a waiver of the domestic manufacturing requirement with respect to the relevant patents licensed to us by this licensor. In July 2009, the funding government agency granted the requested waiver of the domestic manufacturing requirement for a three-year period commencing in July 2009. In June 2012, the licensor requested a continued waiver of the domestic manufacturing requirement with respect to the relevant patents, but the government agency has not yet taken any action in response to this request. If the government agency does not grant the requested waiver or the government fails to grant additional

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

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

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

Item 5. Other Information

None.

Item 6. Exhibits

The documents listed in the Exhibit List, which follows below, are incorporated by reference or are filed with this quarterly report on Form 10-Q, in each case as indicated therein (numbered in accordance with Item 601 of Regulation S-K).

EXHIBIT LIST

Exhibit Number	Description	Incorporated by Reference From Form	Incorporated by Reference From Exhibit Number	Date Filed
10.1	First Amendment to Lease between AP3-SF3 CT North, LLC and Fluidigm Corporation, dated April 26, 2019.	10-Q	10.2	5/7/2019
10.2	Amended and Restated 2011 Equity Incentive Plan.	8-K	10.1	6/5/2019
31.1	Certification Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 302 of the Sarbanes-Oxley Act of 2002 of Chief Executive Officer.	Filed herewith		
31.2	Certification Pursuant to 18 U.S.C. Section 1350, as Adopted Pursuant to Section 302 of the Sarbanes-Oxley Act of 2002 of Chief Financial Officer.	Filed herewith		
32.1(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.	Furnished herewith		
32.2(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 Financial Officer.	Furnished 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.LAB	XBRL Taxonomy Extension Label Linkbase Document	Filed herewith		
101.PRE	XBRL Taxonomy Extension Presentation Linkbase Document	Filed herewith		
101.DEF	XBRL Taxonomy Extension Definition Linkbase Document	Filed herewith		

(1) 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-Q 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 the registrant specifically incorporates it by reference.

SIGNATURES

Pursuant to the requirements 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: August 7, 2019

By: /s/ Stephen Christopher Linthwaite

Stephen Christopher Linthwaite

President and Chief Executive Officer

Dated: August 7, 2019

By: /s/ Vikram Jog

Vikram Jog

Chief Financial Officer

Exhibit 31.1

**CERTIFICATION OF 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 quarterly report on Form 10-Q 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.

Dated: August 7, 2019

By: /s/ Stephen Christopher Linthwaite
Stephen Christopher Linthwaite
President and Chief Executive Officer
(Principal 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 quarterly report on Form 10-Q 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.

Dated: August 7, 2019

By: /s/ Vikram Jog
Vikram Jog
Chief Financial Officer
(Principal Financial Officer)

Exhibit 32.1

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

I, Stephen Christopher Linthwaite, the president and 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,

(i) the Quarterly Report of the Company on Form 10-Q for the quarter ended June 30, 2019 (the "Report"), fully complies with the requirements of section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended; and

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

Date: August 7, 2019

By: /s/ Stephen Christopher Linthwaite

Stephen Christopher Linthwaite
President and Chief Executive Officer
(Principal Executive Officer)

Exhibit 32.2

CERTIFICATION OF CHIEF FINANCIAL OFFICER
PURSUANT TO 18 U.S.C. § 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,

(i) the Quarterly Report of the Company on Form 10-Q for the quarter ended June 30, 2019 (the "Report"), fully complies with the requirements of section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended; and

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

Date: August 7, 2019

By: /s/ Vikram Jog
Vikram Jog
Chief Financial Officer
(Principal Financial Officer)