

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

FORM 10-Q

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

For the Quarterly Period ended March 31, 2020

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 000-31311

PDF SOLUTIONS, INC.

(Exact name of Registrant as Specified in its Charter)

Delaware

(State or Other Jurisdiction of Incorporation or Organization)

25-1701361

(I.R.S. Employer Identification No.)

2858 De La Cruz Blvd.

Santa Clara, California

(Address of Principal Executive Offices)

95050

(Zip Code)

(408) 280-7900

(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, \$0.00015 par value	PDFS	The Nasdaq Stock Market LLC

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 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

Non-accelerated filer

Accelerated filer

Smaller reporting company

Emerging growth company

If an emerging growth company, indicated 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

There were 32,795,326 shares of the Registrant's Common Stock outstanding as of May 2, 2020.

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PART I — FINANCIAL INFORMATION**Item 1. Financial Statements**

PDF SOLUTIONS, INC.
CONDENSED CONSOLIDATED BALANCE SHEETS
(unaudited)
(in thousands, except par value)

	March 31, 2020	December 31, 2019
ASSETS		
Current assets:		
Cash and cash equivalents	\$ 100,385	\$ 97,605
Accounts receivable, net of allowance for doubtful accounts of \$154 in 2020 and \$213 in 2019	37,363	40,651
Prepaid expenses and other current assets	11,628	9,320
Total current assets	149,376	147,576
Property and equipment, net	41,009	40,798
Operating lease right-of-use assets, net	7,368	7,609
Goodwill	2,293	2,293
Intangible assets, net	5,904	6,221
Deferred tax assets	25,085	25,327
Other non-current assets	8,322	9,720
Total assets	<u>\$ 239,357</u>	<u>\$ 239,544</u>
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current liabilities:		
Accounts payable	\$ 4,828	\$ 7,636
Accrued compensation and related benefits	4,754	5,072
Accrued and other current liabilities	1,406	1,665
Operating lease liabilities – current portion	1,954	1,867
Deferred revenues – current portion	12,326	10,639
Billings in excess of recognized revenues	1,796	1,117
Total current liabilities	27,064	27,996
Long-term income taxes payable	4,884	5,368
Non-current operating lease liabilities	7,310	7,677
Deferred revenues – non-current portion	1,630	2,346
Total liabilities	40,888	43,387
Commitments and contingencies (Note 12)		
Stockholders' equity:		
Preferred stock, \$0.00015 par value, 5,000 shares authorized, no shares issued and outstanding	—	—
Common stock, \$0.00015 par value, 70,000 shares authorized; shares issued 42,182 and 41,797, respectively; shares outstanding 32,795 and 32,503, respectively	5	5
Additional paid-in-capital	329,681	325,197
Treasury stock at cost, 9,387 and 9,294 shares, respectively	(93,173)	(91,695)
Accumulated deficit	(36,398)	(35,870)
Accumulated other comprehensive loss	(1,646)	(1,480)
Total stockholders' equity	198,469	196,157
Total liabilities and stockholders' equity	<u>\$ 239,357</u>	<u>\$ 239,544</u>

See accompanying Notes to Condensed Consolidated Financial Statements (unaudited)

PDF SOLUTIONS, INC.
CONDENSED CONSOLIDATED STATEMENTS OF COMPREHENSIVE LOSS
(unaudited)
(in thousands, except per share amounts)

	Three Months Ended March 31,	
	2020	2019
Revenues:		
Analytics	\$ 13,248	\$ 11,434
Integrated Yield Ramp	7,910	9,107
Total revenues	<u>21,158</u>	<u>20,541</u>
Costs and Expenses:		
Costs of revenues	8,487	7,867
Research and development	8,590	8,246
Selling, general and administrative	7,895	7,011
Amortization of other acquired intangible assets	173	108
Restructuring charges	—	92
Interest and other expense (income), net	20	6
Loss before income taxes	<u>(4,007)</u>	<u>(2,789)</u>
Income tax benefit	(3,479)	(98)
Net loss	<u>\$ (528)</u>	<u>\$ (2,691)</u>
Other comprehensive loss:		
Foreign currency translation adjustments, net of tax	(166)	(52)
Comprehensive loss	<u>\$ (694)</u>	<u>\$ (2,743)</u>
Net loss per share:		
Basic	<u>\$ (0.02)</u>	<u>\$ (0.08)</u>
Diluted	<u>\$ (0.02)</u>	<u>\$ (0.08)</u>
Weighted average common shares:		
Basic	<u>32,703</u>	<u>32,485</u>
Diluted	<u>32,703</u>	<u>32,485</u>

See accompanying Notes to Condensed Consolidated Financial Statements (unaudited)

PDF SOLUTIONS, INC.
CONDENSED CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY
(unaudited)
(in thousands)

	Common Stock		Additional Paid-In Capital	Treasury Stock		Accumulated Deficit	Accumulated Other Comprehensive Loss	Total Stockholders' Equity
	Shares	Amount		Shares	Amount			
Balances, December 31, 2019	32,503	\$ 5	\$ 325,197	9,294	\$(91,695)	\$ (35,870)	\$ (1,480)	\$ 196,157
Issuance of common stock in connection with employee stock purchase plan	89	-	810	-	-	-	-	810
Issuance of common stock in connection with exercise of options	21	-	161	-	-	-	-	161
Vesting of restricted stock units	182	-	-	-	-	-	-	-
Purchases of treasury stock in connection with tax withholdings on restricted stock grants	-	-	-	93	(1,478)	-	-	(1,478)
Stock-based compensation expense	-	-	3,513	-	-	-	-	3,513
Comprehensive loss	-	-	-	-	-	(528)	(166)	(694)
Balances, March 31, 2020	<u>32,795</u>	<u>\$ 5</u>	<u>\$ 329,681</u>	<u>9,387</u>	<u>\$(93,173)</u>	<u>\$ (36,398)</u>	<u>\$ (1,646)</u>	<u>\$ 198,469</u>

	Common Stock		Additional Paid-In Capital	Treasury Stock		Accumulated Deficit	Accumulated Other Comprehensive Loss	Total Stockholders' Equity
	Shares	Amount		Shares	Amount			
Balances, December 31, 2018	32,382	\$ 5	\$ 310,660	8,295	\$(79,142)	\$ (30,452)	\$ (1,276)	\$ 199,795
Issuance of common stock in connection with employee stock purchase plan	87	-	782	-	-	-	-	782
Issuance of common stock in connection with exercise of options	87	-	518	-	-	-	-	518
Vesting of restricted stock units	104	-	-	-	-	-	-	-
Purchases of treasury stock in connection with tax withholdings on restricted stock grants	-	-	-	54	(557)	-	-	(557)
Repurchases of common stock	(314)	-	-	314	(3,917)	-	-	(3,917)
Stock-based compensation expense	-	-	3,469	-	-	-	-	3,469
Comprehensive loss	-	-	-	-	-	(2,691)	(52)	(2,743)
Balances, March 31, 2019	<u>32,346</u>	<u>\$ 5</u>	<u>\$ 315,429</u>	<u>8,663</u>	<u>\$(83,616)</u>	<u>\$ (33,143)</u>	<u>\$ (1,328)</u>	<u>\$ 197,347</u>

See accompanying Notes to Condensed Consolidated Financial Statements (unaudited)

PDF SOLUTIONS, INC.
CONDENSED CONSOLIDATED STATEMENTS OF CASH FLOWS
(unaudited)
(in thousands)

	Three Months Ended March 31,	
	2020	2019
Cash flows from operating activities:		
Net loss	\$ (528)	\$ (2,691)
Adjustments to reconcile net loss to net cash provided by (used in) operating activities:		
Depreciation and amortization	1,667	1,292
Stock-based compensation expense	3,368	3,476
Amortization of acquired intangible assets	317	252
Amortization of costs capitalized to obtain revenue contracts	124	105
Reversal of allowance for doubtful accounts	(60)	—
Deferred taxes	45	(2,054)
Unrealized gain on foreign currency forward contract	—	(2)
Changes in operating assets and liabilities:		
Accounts receivable	3,348	(1,641)
Prepaid expenses and other current assets	(1,910)	(402)
Operating lease right-of-use assets	241	331
Other non-current assets	(1,906)	(285)
Accounts payable	163	198
Accrued compensation and related benefits	(271)	(472)
Accrued and other liabilities	(589)	585
Deferred revenues	972	429
Billings in excess of recognized revenues	679	894
Operating lease liabilities	(280)	(166)
Net cash provided by (used in) operating activities	5,380	(151)
Cash flows from investing activities:		
Purchases of property and equipment	(2,068)	(2,357)
Cash used in investing activities	(2,068)	(2,357)
Cash flows from financing activities:		
Proceeds from exercise of stock options	161	518
Repurchases of common stock	—	(3,917)
Proceeds from employee stock purchase plan	810	782
Payments for taxes related to net share settlement of equity awards	(1,478)	(557)
Net cash used in financing activities	(507)	(3,174)
Effect of exchange rate changes on cash and cash equivalents	(25)	8
Net change in cash and cash equivalents	2,780	(5,674)
Cash and cash equivalents, beginning of period	97,605	96,089
Cash and cash equivalents, end of period	\$ 100,385	\$ 90,415
Supplemental disclosure of cash flow information:		
Cash paid during the period for taxes	\$ 968	\$ 462
Cash paid for amounts included in the measurement of operating lease liabilities	\$ 397	\$ 276
Supplemental disclosure of noncash information:		
Stock-based compensation capitalized as software development costs	\$ 128	\$ —
Property and equipment received and accrued in accounts payable and accrued and other liabilities	\$ 796	\$ 1,284

See accompanying Notes to Condensed Consolidated Financial Statements (unaudited)

PDF SOLUTIONS, INC.
NOTES TO CONDENSED CONSOLIDATED FINANCIAL STATEMENTS (UNAUDITED)

1. BASIS OF PRESENTATION AND SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Basis of Presentation

The interim unaudited condensed consolidated financial statements included herein have been prepared by PDF Solutions, Inc. (the “Company”) pursuant to the rules and regulations of the Securities and Exchange Commission (“SEC”), including the instructions to the Quarterly Report on Form 10-Q and Article 10 of Regulation S-X. Certain information and footnote disclosures normally included in annual financial statements prepared in accordance with accounting principles generally accepted in the United States of America have been condensed or omitted. The interim unaudited condensed consolidated financial statements reflect, in the opinion of management, all adjustments necessary (consisting only of normal recurring adjustments), to present a fair statement of results for the interim periods presented. The operating results for any interim period are not necessarily indicative of the results that may be expected for other interim periods or the full fiscal year. The accompanying interim unaudited condensed consolidated financial statements should be read in conjunction with the audited consolidated financial statements and notes thereto in the Company’s Annual Report on Form 10-K for the year ended December 31, 2019.

The condensed consolidated financial statements include the accounts of the Company and its wholly-owned subsidiaries after the elimination of all intercompany balances and transactions.

The condensed consolidated balance sheet at December 31, 2019, has been derived from the audited consolidated financial statements but does not include all disclosures required by accounting principles generally accepted in the United States of America.

Reclassification of Prior Period Amounts

Certain prior period amounts have been reclassified to conform to the current year presentation of reporting amortization of costs capitalized to obtain revenue contracts, operating lease right-of-use assets, and operating lease liabilities on the Condensed Consolidated Statements of Cash Flows. This reclassification had no effect on the Company’s reported net loss or net cash used in operating activities.

Change in Presentation

In the fourth quarter of fiscal 2019, in order to enhance the transparency of our revenue reporting, the Company updated its Condensed Consolidated Statements of Comprehensive Loss to change its historical presentation of revenue categories. Previously, the Company presented revenue on two lines: Solutions and Gainshare performance incentives. Included within Solutions, was revenue from software and related revenue, SaaS solutions, Design-for-Inspection (DFI™) licenses, and fixed-price project-based solution implementation services. The previous Gainshare performance incentive category included only revenue from performance incentive programs. The Company now presents revenue in the following categories: Analytics and Integrated Yield Ramp. Integrated Yield Ramp revenue is comprised of all revenue from the Company’s Integrated Yield Ramp services engagements that include performance incentives based on customers’ yield achievement, i.e. both fixed-fees and Gainshare royalty from such engagements. Analytics comprises all other revenue, including from the Company’s licenses and services for Exensio Software, Exensio SaaS, DFI™ and Characterization Vehicle (CV) systems that do not include performance incentives based on customers’ yield achievement.

The change in presentation of revenue does not change the Company's net revenues or total cost of net revenues. The following table shows reclassified amounts to conform to the current period's presentation (in thousands):

	For the Three Months Ended March 31, 2019		
	Previously Reported	Change in Presentation Reclassification	Current Presentation
Revenues:			
Design-to-silicon-yield solutions	\$ 16,661	\$ (16,661)	N/A
Gainshare performance incentives	3,880	(3,880)	N/A
Analytics	N/A	11,434	\$ 11,434
Integrated Yield Ramp	N/A	9,107	9,107
Total revenues	<u>\$ 20,541</u>	<u>\$ —</u>	<u>\$ 20,541</u>

Since certain costs of revenues are attributed to both Analytics and Integrated Yield Ramp revenue categories, the Company believes it is more appropriate and meaningful to present the Condensed Consolidated Statements of Comprehensive Loss under a one-step presentation format that excludes any measure of gross margin. In the fourth quarter of fiscal 2019, the Company elected to change its Condensed Consolidated Statements of Comprehensive Loss presentation from a two-step presentation, where total costs of revenues was deducted from total revenues to report a gross profit line, to a one-step presentation, where total costs and expenses are deducted from total revenues. The change in presentation does not change previously presented amounts for costs of revenues, operating expenses and other expenses (income), or loss before income taxes.

Use of Estimates

The preparation of financial statements in conformity with generally accepted accounting principles in the United States ("U.S. GAAP") requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities, the disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting period. Significant estimates in these financial statements include revenue recognition, impairment of goodwill and long-lived assets, accounting for stock-based compensation expense, and income taxes. Actual results could differ from those estimates.

The global COVID-19 pandemic has impacted the operations and purchasing decisions of companies worldwide. It also has created and may continue to create significant uncertainty in the global economy. The Company has undertaken measures to protect its employees, partners, customers, and vendors. In addition, the Company's personnel worldwide are subject to various travel restrictions, which limit the ability of the Company to provide services to customers and affiliates. This impacts the Company's normal operations. To date, the Company has been able to provide uninterrupted access to its products and services due to its globally distributed workforce, many of whom are working remotely, and its pre-existing infrastructure that supports secure access to the Company's internal systems. If, however, the COVID-19 pandemic has a substantial impact on the productivity of the Company's employees or its partners' or customers' decision to use the Company's products and services, the results of the Company's operations and overall financial performance may be adversely impacted. The duration and extent of the impact from the COVID-19 pandemic depends on future developments that cannot be accurately predicted at this time. As of the date of issuance of the financial statements, the Company is not aware of any specific event or circumstance that would require updates to the Company's estimates and judgments or revisions to the carrying value of its assets or liabilities. These estimates may change, as new events occur and additional information is obtained, and are recognized in the condensed consolidated financial statements as soon as they become known. Actual results could differ from those estimates and any such differences may be material to the financial statements.

Recently Adopted Accounting Standards

Intangibles – Goodwill and Other

In January 2017, the Financial Accounting Standards Board (or FASB) issued Accounting Standards Update (ASU) No. 2017-04, Intangibles – Goodwill and Other (Topic 350). This standard eliminates step 2 from the annual goodwill impairment test. This update is effective for the Company beginning in the first quarter of 2020. The Company adopted this standard on January 1, 2020, and it did not have a material impact on its condensed consolidated financial statements and footnote disclosures.

Customer's Accounting for Implementation Costs Incurred in a Cloud Computing Arrangement That Is a Service Contract

In August 2018, the FASB issued ASU No. 2018-15, Intangibles – Goodwill and Other – Internal-Use Software (Subtopic 350-40): Customer's Accounting for Implementation Costs Incurred in a Cloud Computing Arrangement That Is a Service Contract. The new guidance clarifies the accounting for implementation costs incurred to develop or obtain internal-use software in cloud computing arrangements. Further, the standard also requires entities to expense the capitalized implementation costs of a hosting arrangement over the term of the hosting arrangement. This standard is effective for the Company beginning in the first quarter of 2020. Early adoption is permitted. ASU No. 2018-15 should be applied either retrospectively or prospectively to all implementation costs incurred after the date of adoption. The Company adopted ASU No. 2018-15 on January 1, 2020 on a prospective basis. There was no material impact on the Company's condensed consolidated financial statements as a result of adoption of ASU No. 2018-15 as of January 1, 2020. As of March 31, 2020, the implementation costs capitalized by the Company pertaining to a cloud computing arrangement related to sales order and customer relation management was not material. The capitalized implementation costs were included in "Other noncurrent assets" on the Condensed Consolidated Balance sheet and within the operating activities section of the Company's Condensed Consolidated Statement of Cash Flows for the months ended March 31, 2020. When the module or component of the hosting arrangement is ready for its intended use, the Company expects to amortize the capitalized implementation costs over the respective noncancellable period of the arrangement plus period covered by an option to extend the arrangement that is reasonably certain of being exercised. There has been no amortization expense related these assets for the months ended March 31, 2020.

Management has reviewed other recently issued accounting pronouncements and has determined there are not any that would have a material impact on the condensed consolidated financial statements.

Accounting Standards Not Yet Effective

In June 2016, the FASB issued ASU No. 2016-13, Financial Instruments – Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments (ASU 2016-13), which requires measurement and recognition of expected credit losses for financial assets held at the reporting date based on external information, or a combination of both relating to past events, current conditions, and reasonable and supportable forecasts. ASU No. 2016-13 replaces the existing incurred loss impairment model with a forward-looking expected credit loss model which will result in earlier recognition of credit losses. Subsequent to the issuance of ASU No. 2016-13, the FASB issued ASU No. 2018-19, Codification Improvements to Topic 326, Financial Instruments – Credit Losses, ASU No. 2019-04, Codification Improvements to Topic 326, Financial Instruments – Credit Losses, Topic 815, Derivatives and Hedging, and Topic 825, Financial Instrument, ASU No. 2019-05, Financial Instruments – Credit Losses (Topic 326) Targeted Transition Relief, ASU No. 2016-13, the FASB issued ASU No. 2019-10 Financial Instruments-Credit Losses (Topic 326), Derivatives and Hedging (Topic 815), and Leases (Topic 842), and ASU No. 2019-11 Codification Improvements to Topic 326, Financial Instruments-Credit Losses. The subsequent ASUs do not change the core principle of the guidance in ASU No. 2016-13. Instead, these amendments are intended to clarify and improve operability of certain topics included within ASU No. 2016-13.

Additionally, ASU No. 2019-10 defers the effective date for the adoption of the new standard on credit losses for public filers that are considered small reporting companies ("SRC") as defined by the SEC to fiscal years beginning after December 15, 2022, including interim periods within those fiscal years, which will be fiscal 2023 for the Company if it continue to be classified as a SRC. In February 2020, the FASB issued ASU 2020-02, which provides guidance regarding methodologies, documentation, and internal controls related to expected credit losses. The subsequent amendments will have the same effective date and transition requirements as ASU No. 2016-13. Early adoption is permitted. Topic 326 requires a modified retrospective approach by recording a cumulative-effect adjustment to retained earnings as of the beginning of the period of adoption. While the Company is currently evaluating the impact of Topic 326, the Company does not expect the adoption of this ASU to have a material impact on its condensed consolidated financial statements and the related disclosure.

In December 2019, the FASB issued ASU No. 2019-12, Income Taxes (Topic 740) related to simplifying the accounting for income taxes. The guidance is effective for the Company beginning in the first quarter of 2021 on a prospective basis. Early adoption is permitted. The Company is currently evaluating the impact of this ASU, and does not anticipate that the adoption of this ASU will have a significant impact on its consolidated financial statements or the related disclosures.

In January 2020, the FASB issued ASU No. 2020-01-Investments-Equity Securities (Topic 321), Investments-Equity Method and Joint Ventures (Topic 323), and Derivatives and Hedging (Topic 815)-Clarifying the Interactions between Topic 321, Topic 323, and Topic 815. This ASU clarifies the interaction between accounting standards related to equity securities (ASC 321), equity method investments (ASC 323), and certain derivatives (ASC 815). The amendments in this ASU are effective for fiscal years beginning after December 15, 2020. The Company does not anticipate that the adoption of this ASU will have a significant impact on its condensed consolidated financial statements or the related disclosures.

2. REVENUE FROM CONTRACTS WITH CUSTOMERS

The Company derives revenue from two sources: Analytics revenue and Integrated Yield Ramp revenue.

The Company recognizes revenue in accordance with Financial Accounting Standards Board (“FASB”) Accounting Standard Codification (“ASC”) Topic 606, *Revenue from Contracts with Customers*, and its related amendments (collectively known as “ASC 606”). ASC 606 outlines a single comprehensive model to use in accounting for revenue arising from contracts with customers. Revenue is recognized when control of products or services is transferred to customers, in an amount that reflects the consideration the Company expects to be entitled to in exchange for those promised products or services.

The Company determines revenue recognition through the following five steps:

- Identification of the contract, or contracts, with a customer
- Identification of the performance obligations in the contract
- Determination of the transaction price
- Allocation of the transaction price to the performance obligations in the contract
- Recognition of revenue when, or as, performance obligations are satisfied

The Company accounts for a contract when it has approval and commitment from both parties, the rights of the parties are identified, payment terms are identified, the contract has commercial substance, and collectability of consideration is probable.

Contracts with multiple performance obligations

The Company enters into contracts that can include various combinations of licenses, products and services, some of which are distinct and are accounted for as separate performance obligations. For contracts with multiple performance obligations, the Company allocates the transaction price of the contract to each performance obligation on a relative basis using standalone selling price.

Analytics Revenue

Analytics revenue is derived from the following primary offerings: licenses and services for Exensio Software, Exensio SaaS, DFI™ and CV systems that do not include performance incentives based on customers’ yield achievement.

Revenue from standalone Exensio Software is recognized depending on whether the license is perpetual or time-based. Perpetual (one-time charge) license software is recognized at the time of the inception of the arrangement when control transfers to the customers, if the software license is distinct from the services offered by us. Revenue from post-contract support is recognized over the contract term on a straight-line basis, because we are providing (i) support and (ii) unspecified software updates on a when-and-if available basis over the contract term. Revenue from time-based-licensed software is allocated to each performance obligation and is recognized either at a point in time or over time as follows. The license component is recognized at the time when control transfers to the customer, with the post-contract support component recognized ratably over the committed term of the contract. For contracts with any combination of licenses, support, and other services, distinct performance obligations are accounted for separately. For contracts with multiple performance obligations, we allocate the transaction price of the contract to each performance obligation on a relative basis using standalone selling price (or SSP) attributed to each performance obligation.

Revenue from Exensio SaaS arrangements, which allow for the use of a cloud-based software product or service over a contractually determined period of time without taking possession of software, is accounted for as subscriptions and is recognized as revenue ratably, on a straight-line basis, over the subscription period beginning on the date the service is first made available to customers.

Revenue from DFI™ and CV systems that do not include performance incentives based on customers' yield achievement is recognized primarily as services are performed. Where there are distinct performance obligations, the Company allocates revenue to all deliverables based on their standalone selling prices, or SSP. For these contracts with multiple performance obligations, the Company allocate the transaction price of the contract to each performance obligation on a relative basis using SSP attributed to each performance obligation. Where there are not discrete performance obligations, historically, revenue is primarily recognized as services are performed using a percentage of completion method based on costs or labor-hours inputs, whichever is the most appropriate measure of the progress towards completion of the contract.

Integrated Yield Ramp Revenue

The Integrated Yield Ramp revenue is derived from the Company's fixed-fee engagements that include performance incentives based on customers' yield achievement and Gainshare royalties, typically based on customer's wafer shipments, pertaining to these fixed-price contracts.

Revenue under these project-based contracts, which are delivered over a specific period of time typically for a fixed fee component paid on a set schedule, is recognized as services are performed using a percentage of completion. Similar to the services provided in connection with CV systems that are contributing to Analytics revenue, due to the nature of the work performed in these arrangements, the estimation of percentage of completion method is complex and subject to many variables that require significant judgement. Please refer to "Significant Judgments" section of this Note for further discussion.

The Gainshare royalty contained in IYR contracts is a variable fee related to continued usage of the Company's intellectual property ("IP") after the fixed-fee service period ends, based on the customers' yield achievement. Revenue derived from Gainshare is contingent upon the Company's customers reaching certain defined production yield levels. Gainshare royalty periods are generally subsequent to the delivery of all contractual services and performance obligations. The Company records Gainshare as a usage-based royalty derived from customers' usage of intellectual property and records it in the same period in which the usage occurs.

Disaggregation of Revenue

The Company disaggregates revenue from contracts with customers into the timing of the transfer of goods and services and the geographical regions. The Company determined that disaggregating revenue into these categories achieves the disclosure objective to depict how the nature, amount, timing, and uncertainty of revenue and cash flows are affected by economic factors.

The Company's performance obligations are satisfied either over time or at a point-in-time. The following table represents a disaggregation of revenue by timing of revenue:

	Three Months Ended March 31,	
	2020	2019
Over time	58%	75%
Point-in-time	42%	25%
Total	100%	100%

International revenues accounted for approximately 59% of our total revenues for the three months ended March 31, 2020 as compared to 55% for the three months ended March 31, 2019. See Note 10. Customer and Geographic Information.

Significant Judgments

Judgments and estimates are required under ASC 606. Due to the complexity of certain contracts, the actual revenue recognition treatment required under ASC 606 for the Company's arrangements may be dependent on contract-specific terms and may vary in some instances.

For revenue under project-based contracts for fixed-price implementation services, revenue is recognized as services are performed using a percentage-of-completion method based on costs or labor-hours input method, whichever is the most appropriate measure of the progress towards completion of the contract. Due to the nature of the work performed in these arrangements, the estimation of percentage of completion method is complex, subject to many variables and requires significant judgment. Key factors reviewed by the Company to estimate costs to complete each contract are future labor and product costs and expected productivity efficiencies. If circumstances arise that change the original estimates of revenues, costs, or extent of progress toward completion, revisions to the estimates are made. These revisions may result in increases or decreases in estimated revenues or costs, and such revisions are reflected in revenue on a cumulative catch-up basis in the period in which the circumstances that gave rise to the revision become known.

The Company's contracts with customers often include promises to transfer products, licenses software and provide services, including professional services, technical support services, and rights to unspecified updates to a customer. Determining whether licenses and services are distinct performance obligations that should be accounted for separately, or not distinct and thus accounted for together, requires significant judgment. The Company rarely licenses software on a standalone basis, so the Company is required to estimate the range of SSPs for each performance obligation. In instances where SSP is not directly observable because the Company does not license the software or sell the service separately, the Company determines the SSP using information that may include market conditions and other observable inputs. The Company, in some cases, has more than one SSP for individual performance obligations. In these instances, the Company may use information such as the size of the customer and geographic region of the customer in determining the SSP.

The Company is required to record Gainshare royalty revenue in the same period in which the usage occurs. Because the Company generally does not receive the acknowledgment reports from its customers during a given quarter within the time frame necessary to adequately review the reports and include the actual amounts in quarterly results for such quarter, the Company accrues the related revenue based on estimates of customers underlying sales achievement. The Company's estimation process can be based on historical data, trends, seasonality, changes in the contract rate, knowledge of the changes in the industry and changes in the customer's manufacturing environment learned through discussions with customers and sales personnel. As a result of accruing revenue for the quarter based on such estimates, adjustments will be required in the following quarter to true-up revenue to the actual amounts reported.

Contract Balances

The Company performs its obligations under a contract with a customer by licensing software or providing services in exchange for consideration from the customer. The timing of the Company's performance often differs from the timing of the customer's payment, which results in the recognition of a receivable, a contract asset or a contract liability.

The Company classifies the right to consideration in exchange for software or services transferred to a customer as either a receivable or a contract asset. A receivable is a right to consideration that is unconditional, as compared to a contract asset, which is a right to consideration that is conditional upon factors other than the passage of time. The majority of the Company's contract assets represent unbilled amounts related to fixed-price service contracts when the revenue recognized exceeds the amount billed to the customer. The contract assets are generally classified as current and are recorded on a net basis with deferred revenue (i.e. contract liabilities) at the contract level. At March 31, 2020 and December 31, 2019, contract assets of \$1.4 million and \$3.6 million, respectively, are included in prepaid expenses and other current assets in the Condensed Consolidated Balance Sheets. The Company did not record any asset impairment charges related to contract assets during the months ended March 31, 2020 and 2019.

Deferred revenues consist substantially of amounts invoiced in advance of revenue recognition and are recognized as the revenue recognition criteria are met. Deferred revenues that will be recognized during the succeeding twelve-month period are recorded as current deferred revenues and the remaining portion is recorded as non-current deferred revenues in the Condensed Consolidated Balance Sheets. Revenue recognized for the three months ended March 31, 2020 and 2019, that was included in the deferred revenues and billings in excess of recognized revenues balances at the beginning of each reporting period was \$4.6 million and \$3.3 million, respectively.

At March 31, 2020, the aggregate amount of the transaction price allocated to the remaining performance obligations related to customer contracts that were unsatisfied or partially unsatisfied was approximately \$68.5 million. Given the applicable contract terms, the majority of this amount is expected to be recognized as revenue over the next two years, with the remainder in the following five years. This amount does not include contracts to which the customer is not committed, nor contracts for which we recognize revenue equal to the amount we have the right to invoice for services performed, or future sales-based or usage-based royalty payments in exchange for a license of intellectual property. This amount is subject to change due to future revaluations of variable consideration, terminations, other contract modifications, or currency adjustments. The estimated timing of the recognition of remaining unsatisfied performance obligations is subject to change and is affected by changes to the scope, change in timing of delivery of products and services, or contract modifications.

The adjustment to revenue recognized in the three months ended March 31, 2020 and 2019 from performance obligations satisfied (or partially satisfied) in previous periods was an increase of \$0.7 million and decrease of \$0.5 million, respectively. These amounts primarily represent changes in estimated percentage-of-completion based contracts and changes in estimated Gainshare royalty for those customers that reported actual Gainshare revenue with some time lag.

Costs to obtain or fulfill a contract

The Company capitalizes the incremental costs to obtain or fulfill a contract with a customer, including direct sales commissions and related fees, when it expects to recover those costs. Amortization expense related to these capitalized costs is recognized over the period associated with the revenue from which the cost was incurred. Total capitalized direct sales commission costs included in prepaid expenses and other current assets in the accompanying Condensed Consolidated Balance Sheets as of March 31, 2020 and December 31, 2019 were \$0.4 million. Total capitalized direct sales commission costs included in other non-current assets in the accompanying Condensed Consolidated Balance Sheets as of March 31, 2020 and December 31, 2019 were \$0.8 million and \$0.4 million, respectively. Amortization of these assets during each of the three months ended March 31, 2020 and 2019 was \$0.1 million. There was no impairment loss in relation to the costs capitalized for the periods presented.

Certain eligible initial project costs are capitalized when the costs relate directly to the contract, the costs generate or enhance resources of the Company that will be used in satisfying the performance obligation in the future, and the costs are expected to be recovered. These costs primarily consist of transition and set-up costs related to the installation of systems and processes and other deferred fulfillment costs eligible for capitalization. Capitalized costs are amortized consistent with the transfer to the customer of the services to which the asset relates and recorded as a component of cost of revenues. The Company also incurs certain direct costs to provide services in relation to the specific anticipated contracts. The Company recognizes such costs as a component of costs of revenues, the timing of which is dependent upon identification of a contract arrangement. The Company also defers costs from arrangements that required it to defer the revenues, typically due to the pattern of transfer of the performance obligations in the contract. These costs are recognized in proportion to the related revenue. At the end of the reporting period, the Company evaluates its deferred costs for their probable recoverability. The Company recognizes impairment of deferred costs when it is determined that the costs no longer have future benefits and are no longer recoverable. There was no impairment loss in relation to the costs capitalized for the periods presented. Deferred costs balance included in prepaid expenses and other current assets in the accompanying Condensed Consolidated Balance Sheets as of March 31, 2020 and December 31, 2019 was \$0.3 million. Deferred costs balance included in other non-current assets in the accompanying Condensed Consolidated Balance Sheets as of March 31, 2020 was immaterial and was \$0.2 million as of December 31, 2019.

Practical Expedients

The Company does not adjust transaction price for the effects of a significant financing component when the period between the transfers of the promised good or service to the customer and payment for that good or service by the customer is expected to be one year or less. The Company assessed each of its revenue generating arrangements in order to determine whether a significant financing component exists, and determined its contracts did not include a significant financing component for the three months ended March 31, 2020 and 2019.

3. BALANCE SHEET COMPONENTS

Accounts receivable

Accounts receivable include amounts that are unbilled at the end of the period that are expected to be billed and collected within 12-month period. Unbilled accounts receivable, included in accounts receivable, totaled \$9.4 million and \$7.4 million as of March 31, 2020, and December 31, 2019, respectively. Unbilled accounts receivable that are not expected to be billed and collected during the succeeding 12-month period are recorded in other non-current assets and totaled \$2.8 million and \$4.1 million as of March 31, 2020, and December 31, 2019, respectively.

Property and equipment

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

	March 31, 2020	December 31, 2019
Computer equipment	\$ 10,893	\$ 10,880
Software	4,685	4,690
Furniture, fixtures and equipment	2,419	2,395
Leasehold improvements	6,087	6,095
Laboratory and other equipment	4,974	4,933
Test equipment	23,604	22,980
Construction-in-progress	19,377	18,245
	<u>72,039</u>	<u>70,218</u>
Less: accumulated depreciation and amortization	(31,030)	(29,420)
Total	<u>\$ 41,009</u>	<u>\$ 40,798</u>

Test equipment includes DFI™ assets at customer sites that are contributing to DFI™ revenues. The construction-in-progress balance related to construction of DFI™ assets totaled \$17.7 million and \$16.6 million as of March 31, 2020 and December 31, 2019, respectively. Depreciation and amortization expense for the three months ended March 31, 2020 and 2019 was \$1.7 million and \$1.3 million, respectively.

Goodwill and Intangible Assets

As of March 31, 2020, and December 31, 2019, the carrying amount of goodwill was \$2.3 million.

Intangible assets balance was \$5.9 million and \$6.2 million as of March 31, 2020 and December 31, 2019, respectively. Intangible assets as of March 31, 2020 and December 31, 2019 consist of the following (in thousands):

	Amortization Period (Years)	March 31, 2020			December 31, 2019		
		Gross Carrying Amount	Accumulated Amortization	Net Carrying Amount	Gross Carrying Amount	Accumulated Amortization	Net Carrying Amount
Acquired identifiable intangibles:							
Customer relationships	1 – 9	\$ 7,440	\$ (5,047)	\$ 2,393	\$ 7,440	\$ (4,935)	\$ 2,505
Developed technology	4 – 9	17,460	(14,290)	3,170	17,460	(14,101)	3,359
Tradename	2 – 7	790	(679)	111	790	(673)	117
Patent	7 – 10	1,800	(1,570)	230	1,800	(1,560)	240
Total		<u>\$ 27,490</u>	<u>\$ (21,586)</u>	<u>\$ 5,904</u>	<u>\$ 27,490</u>	<u>\$ (21,269)</u>	<u>\$ 6,221</u>

The weighted average amortization period for acquired identifiable intangible assets was 6.0 years as of March 31, 2020. Intangible asset amortization expense was \$0.3 million during each of the three months ended March 31, 2020 and 2019, which was recorded in other expense (income), net in the Company's Condensed Consolidated Statements Comprehensive Loss. The Company expects annual amortization of acquired identifiable intangible assets to be as follows (in thousands):

Year Ending December 31,	Amount
2020 (remaining nine months)	\$ 952
2021	1,093
2022	886
2023	886
2024	747
2025 and thereafter	1,340
Total future amortization expense	<u>\$ 5,904</u>

Intangible assets are amortized over their useful lives unless these lives are determined to be indefinite. Intangible assets are reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount of an asset or asset group may not be recoverable. During the three months ended March 31, 2020, there were no indicators of impairment related to the Company's intangible assets.

4. LEASES

The Company leases administrative and sales offices and certain equipment under noncancellable operating leases, which contain various renewal options and, in some cases, require payment of common area costs, taxes and utilities. These operating leases expire at various times through 2028. The Company had no leases that were classified as a financing lease as of March 31, 2020 and December 31, 2020.

Leases with an initial term of 12 months or less are not recorded on the balance sheets, and the Company recognizes lease expense for these leases on a straight-line basis over the lease term. Long-term operating leases are included in operating lease right-of-used (ROU) assets and operating lease liabilities in the Company's Condensed Consolidated Balance Sheets.

ROU assets represent the Company's right to use an underlying asset for the lease term and operating lease liabilities represent the Company's obligation to make lease payments arising from the lease. Operating lease ROU assets and liabilities are recognized based on the present value of remaining lease payments over the lease term. In determining the present value of lease payments, implicit rate must be used when readily determinable. As the Company's leases do not provide implicit rates, at the date of the Company's adoption of the new lease standard, the discount rate is calculated using the Company's incremental borrowing rate determined based on the information available. The operating lease ROU asset also includes any lease payments made and excludes lease incentives or tenant improvement allowance. The Company's lease terms may include options to extend or terminate the lease when it is reasonably certain that the Company will exercise that option. Operating lease expense for lease payments is recognized on a straight-line basis over the lease term. Variable lease payment amounts that cannot be determined at the commencement of the lease such as increases in lease payments based on changes in index rates or usage, and common area maintenance costs are not included in the ROU assets or operating lease liabilities. These are expensed as incurred and recorded as variable lease expense.

Lease expense for the three months ended March 31, 2020 and 2019 was comprised of the following (in thousands):

	Three Months Ended March 31,	
	2020	2019
Operating lease expense	\$ 455	\$ 470
Short-term lease and variable lease expense	147	111
Total lease expense	<u>\$ 602</u>	<u>\$ 581</u>

Supplemental balance sheets information related to leases was as follows:

	March 31,	December 31,
	2020	2019
Weighted average remaining lease term under operating ROU leases (in years)	7.04	7.2
Weighted average discount rate for operating lease liabilities	5.25%	5.25%
Operating lease ROU assets obtained (in thousands)	\$ —	\$ 333

Maturity of operating lease liabilities as of March 31, 2020, are as follows (in thousands):

Year Ending December 31,	Amount(a)
2020 (remaining nine months)	\$ 1,529
2021	1,776
2022	1,567
2023	1,350
2024	1,070
2025 and thereafter	3,789
Total future minimum lease payments	\$ 11,081
Less: Interest(b)	(1,817)
Present value of future minimum lease payments operating lease liabilities(c)	<u>\$ 9,264</u>

(a) As of March 31, 2020, the total operating lease liability includes approximately \$1.0 million related to an option to extend a lease term that is reasonably certain to be exercised.

(b) Calculated using incremental borrowing interest rate for each lease.

(c) Includes the current portion of operating lease liabilities of \$2.0 million as of March 31, 2020.

5. STOCKHOLDERS' EQUITY

Stock Repurchase Program

On May 29, 2018, the Board of Directors terminated the 2016 stock repurchase program, and adopted a new program (the "2018 Program") to repurchase up to \$25.0 million of the Company's common stock both on the open market and in privately negotiated transactions over the next two years. During the three months ended March 31, 2020, no shares were repurchased under the 2018 program. During the three months ended March 31, 2019, the Company repurchased approximately 314,000 shares at an average price of \$12.46 per share, for \$3.9 million under the 2018 program. Under the 2018 program, as of March 31, 2020, \$15.2 million of the Company's common stock remained available for future repurchases.

6. EMPLOYEE BENEFIT PLANS

On March 31, 2020, the Company had the following stock-based compensation plans:

Employee Stock Purchase Plan

In July 2001, the Company adopted a ten-year Employee Stock Purchase Plan (as amended, the "Purchase Plan") under which eligible employees can contribute up to 10% of their compensation, as defined in the Purchase Plan, towards the purchase of shares of PDF common stock at a price of 85% of the lower of the fair market value at the beginning of the offering period or the end of the purchase period. The Purchase Plan consists of twenty-four-month offering periods with four six-month purchase periods in each offering period. Under the Purchase Plan, on January 1 of each year, starting with 2002, the number of shares reserved for issuance will automatically increase by the lesser of (1) 675,000 shares, (2) 2% of the Company's outstanding common stock on the last day of the immediately preceding year, or (3) the number of shares determined by the board of directors. At the annual meeting of stockholders on May 18, 2010, the Company's stockholders approved an amendment to the Purchase Plan to extend it through May 17, 2020.

On April 26, 2020, the Company's Board of Directors approved an amendment to the Purchase Plan to extend it through June 22, 2030, subject to the approval of the Company's stockholders.

The Company estimated the fair value of purchase rights granted under the Purchase Plan during the period using the Black-Scholes-Merton option-pricing model with the following weighted average assumptions, resulting in the following weighted average fair values:

	Three Months Ended March 31,	
	2020	2019
Expected life (in years)	1.25	1.25
Volatility	34.25%	45.19%
Risk-free interest rate	1.43%	2.52%
Expected dividend	—	—
Weighted average fair value of purchase rights granted during the period	\$ 4.83	\$ 3.67

During the three months ended March 31, 2020 and 2019, a total of approximately 89,000 and 88,000 shares, respectively, were issued at a weighted-average purchase price of \$9.02 and \$8.93 per share, respectively. As of March 31, 2020, there was \$0.7 million of unrecognized compensation cost related to the Purchase Plan. That cost is expected to be recognized over a weighted average period of 1.01 years. As of March 31, 2020, 5.8 million shares were available for future issuance under the Purchase Plan.

Stock Incentive Plans

On November 16, 2011, the Company's stockholders initially approved the 2011 Stock Incentive Plan, which has been amended and restated and approved by the Company's stockholders a number of times since then (as amended, the "2011 Plan"). Under the 2011 Plan, the Company may award stock options, stock appreciation rights, stock grants or stock units covering shares of the Company's common stock to employees, directors, non-employee directors and contractors. The aggregate number of shares reserved for awards under this plan is 10,300,000 shares, plus up to 3,500,000 shares previously issued under the 2001 Stock Plan adopted by the Company in 2001, which expired in 2011 (the "2001 Plan") that are (i) forfeited or (ii) repurchased by the Company or shares subject to awards previously issued under the 2001 Plan that expire or that terminate without having been exercised or settled in full on or after November 16, 2011. In case of awards other than options or stock appreciation rights ("SARs"), the aggregate number of shares reserved under the 2011 Plan will be decreased at a rate of 1.33 shares issued pursuant to such awards. The exercise price for stock options must generally be at prices no less than the fair market value at the date of grant. Stock options generally expire ten years from the date of grant and become vested and exercisable over a four-year period.

On April 26, 2020 the Company's Board of Directors amended the 2011 Plan, subject to the approval of the Company's stockholder, to increase the number of shares reserved for awards under it to a total of 11,550,000 shares, which is an increase of an additional 1,250,000 shares and extend the term of the 2011 Plan through June 22, 2030.

In 2003, in connection with its acquisition of IDS Systems Inc., the Company assumed IDS' 2001 Stock Option / Stock Issuance Plan (the "IDS Plan"). The IDS Plan expired in 2011. Stock options granted under the 2001 Plan and IDS Plan generally expire ten years from the date of grant and become vested and exercisable over a four-year period. Although no new awards may be granted under the 2001 Plan or IDS Plan, awards made under the 2001 Plan and IDS Plan that are currently outstanding remain subject to the terms of each such plan.

As of March 31, 2020, 10.8 million shares of common stock were reserved to cover stock-based awards under the 2011 Plan, of which 3.4 million shares were available for future grant. The number of shares reserved and available under the 2011 Plan includes 0.5 million shares that were subject to awards previously made under the 2001 Plan and were forfeited, expired or repurchased by the Company after the adoption of the 2011 Plan through March 31, 2020. As of March 31, 2020, there were no outstanding awards that had been granted outside of the 2011, 2001 or the IDS Plans (collectively, the "Stock Plans").

The Company estimated the fair value of share-based awards granted under the 2011 Stock Plan during the period using the Black-Scholes-Merton option-pricing model with the following weighted average assumptions, resulting in the following weighted average fair values:

	Three Months Ended March 31,	
	2020	2019
Expected life (in years)	4.45	4.46
Volatility	38.77%	45.26%
Risk-free interest rate	0.88%	2.55%
Expected dividend	—	—
Weighted average fair value per share of options granted during the period	\$ 5.21	\$ 4.51

Stock-based compensation is estimated at the grant date based on the award's fair value and is recognized on a straight-line basis over the vesting periods, generally four years. Stock-based compensation expense before taxes related to the Company's stock plans and employee stock purchase plan was allocated as follows (in thousands):

	Three Months Ended March 31,	
	2020	2019
Costs of revenues	\$ 909	\$ 860
Research and development	1,455	1,718
Selling, general and administrative	1,004	898
Stock-based compensation expenses	<u>\$ 3,368</u>	<u>\$ 3,476</u>

The stock-based compensation expense in the table above includes immaterial expense or credit adjustments related to cash-settled SARs granted to certain employees. The Company accounted for these awards as liability awards and the amount was included in accrued compensation and related benefits. Stock-based compensation capitalized in the capitalized software development costs, which were included in the Property and Equipment, net, was approximately \$0.1 million at March 31, 2020.

Additional information with respect to options under the Stock Plans during the three months ended March 31, 2020, was as follows:

	Number of Options (in thousands)	Weighted Average Exercise Price per Share	Weighted Average Remaining Contractual Term (years)	Aggregate Intrinsic Value (in thousands)
Outstanding, January 1, 2020	745	\$ 10.64		
Granted (weighted average fair value of \$5.21 per share)	13	\$ 15.76		
Exercised	(21)	\$ 7.68		
Canceled	(2)	\$ 10.66		
Expired	(9)	\$ 8.86		
Outstanding, March 31, 2020	<u>726</u>	\$ 10.84	<u>4.44</u>	<u>\$ 1,566</u>
Vested and expected to vest, March 31, 2020	<u>713</u>	\$ 10.79	<u>4.35</u>	<u>\$ 1,560</u>
Exercisable, March 31, 2020	<u>562</u>	\$ 10.10	<u>3.18</u>	<u>\$ 1,484</u>

The aggregate intrinsic value in the table above represents the total intrinsic value based on the Company's closing stock price of \$11.72 per share as of March 31, 2020. The total intrinsic value of options exercised during the three months ended March 31, 2020, was \$0.1 million.

As of March 31, 2020, there was \$0.7 million of total unrecognized compensation cost related to unvested stock options. That cost is expected to be recognized over a weighted average period of 2.7 years. The total fair value of shares vested during the three months ended March 31, 2020, was \$0.1 million.

Nonvested restricted stock units activity during the three months ended March 31, 2020, was as follows:

	Shares (in thousands)	Weighted Average Grant Date Fair Value Per Share
Nonvested, January 1, 2020	1,887	\$ 12.30
Granted	248	\$ 15.35
Vested	(275)	\$ 13.52
Forfeited	(26)	\$ 11.78
Nonvested, March 31, 2020	1,834	\$ 12.54

As of March 31, 2020, there was \$18.2 million of total unrecognized compensation cost related to nonvested restricted stock units. That cost is expected to be recognized over a weighted average period of 2.6 years. Restricted stock units do not have rights to dividends prior to vesting.

7. RESTRUCTURING CHARGES

On September 27, 2018, the Board of Directors of the Company approved a reduction in its workforce to reduce expenses and align its operations with evolving business needs. Notifications to the affected employees began on October 24, 2018.

From inception of the restructuring plan to March 31, 2020, the Company has recorded restructuring charges of \$0.7 million, primarily consisting of employee separation charges. As of March 31, 2020, the Company has substantially completed the implementation of the restructuring plan, and the remaining charges expected to be incurred are not expected to be significant.

The following table summarizes the activities of restructuring liabilities under this plan (in thousands):

	Three Months Ended March 31,	
	2020	2019
Beginning balance	\$ —	\$ 244
Restructuring charges	—	92
Cash payments	—	(245)
Ending balance	\$ —	\$ 91

Cash payments for the remaining restructuring liabilities as of March 31, 2019 were paid in the second quarter of fiscal 2019.

8. INCOME TAXES

Income tax benefit increased \$3.4 million for the three months ended March 31, 2020, to a \$3.5 million income tax benefit as compared to an income tax benefit of \$0.1 million for the three months ended March 31, 2019. The Company's effective tax rate benefit was 87% and 4% for the three months ended March 31, 2020 and 2019, respectively. The Company's effective tax rate benefit increased in the three months ended March 31, 2020, as compared to the same period in 2019, primarily due to a favorable increase in excess tax benefits related to employee stock compensation and an income tax benefit recorded to carryback net operating losses (NOLs), pursuant to the provisions of Coronavirus Aid, Relief, and Economic Security Act ("CARES Act") passed on March 27, 2020, which allows any federal net operating losses generated in years beginning after December 31, 2017 and before January 1, 2021 to be carried back up to five taxable years to offset taxable income in the prior periods.

The Company's total amount of unrecognized tax benefits, excluding interest and penalties, as of March 31, 2020, was \$13.0 million, of which \$7.4 million, if recognized, would affect the Company's effective tax rate. The Company's total amount of unrecognized tax benefits, excluding interest and penalties, as of December 31, 2019, was \$13.6 million, of which \$7.9 million, if recognized, would affect the Company's effective tax rate. As of March 31, 2020, the Company has recorded unrecognized tax benefits of \$2.6 million, including interest and penalties of \$0.8 million, as long-term taxes payable in its Condensed Consolidated Balance Sheet. The remaining \$11.2 million has been recorded net of our deferred tax assets, of which \$5.6 million is subject to a full valuation allowance.

The valuation allowance was approximately \$10.0 million and \$10.5 million as of March 31, 2020, and December 31, 2019, respectively, which was related to California R&D tax credits and California net operating losses related to our acquisition of Synticity that we currently do not believe are more likely than not to be ultimately realized.

The Company conducts business globally and, as a result, files numerous consolidated and separate income tax returns in the U.S. federal, various state and foreign jurisdictions. Because the Company used some of the tax attributes carried forward from previous years to tax years that are still open for audit, the federal and California statute of limitations remains open for all tax years since 1999 and 2002, respectively. The Company is not currently subject to an income tax examination or under audit in any jurisdiction.

9. NET LOSS PER SHARE

Basic net loss per share is computed by dividing net loss by weighted average number of common shares outstanding for the period (excluding outstanding stock options and shares subject to repurchase). Diluted net loss per share is computed using the weighted-average number of common shares outstanding for the period plus the potential effect of dilutive securities which are convertible into common shares (using the treasury stock method), except in cases in which the effect would be anti-dilutive. The following is a reconciliation of the numerators and denominators used in computing basic and diluted net loss per share (in thousands except per share amount):

	Three Months Ended March 31,	
	2020	2019
Numerator:		
Net loss	\$ (528)	\$ (2,691)
Denominator:		
Basic weighted-average shares outstanding	32,703	32,485
Effect of dilutive options and restricted stock units	—	—
Diluted weighted average shares outstanding	32,703	32,485
Net loss per share - Basic	\$ (0.02)	\$ (0.08)
Net loss per share - Diluted	\$ (0.02)	\$ (0.08)

For the periods ended March 31, 2020 and 2019, because the Company was in a loss position, basic net loss per share is the same as diluted net loss per share as the inclusion of the potential common shares would have been anti-dilutive.

The following table sets forth potential shares of common stock that are not included in the diluted net loss per share calculation above because to do so would be anti-dilutive for the periods indicated (in thousands):

	Three Months Ended March 31,	
	2020	2019
Outstanding options	400	622
Nonvested restricted stock units	716	748
Employee Stock Purchase Plan	100	379
Total	1,216	1,749

10. CUSTOMER AND GEOGRAPHIC INFORMATION

Operating segments are defined as components of an enterprise about which separate financial information is available that is evaluated regularly by the chief operating decision maker, or group, in deciding how to allocate resources and in assessing performance.

The Company's chief operating decision maker, the chief executive officer, reviews discrete financial information presented on a consolidated basis for purposes of regularly making operating decisions, allocation of resources, and assessing financial performance. Accordingly the Company considers itself to be in one operating and reporting segment, specifically the provision of services for differentiated data and analytics solutions to the semiconductor and electronics industries.

The Company had revenues from an individual customer in excess of 10% of total revenues as follows:

Customer	Three Months Ended March 31,	
	2020	2019
A	26%	36%

The Company had gross accounts receivable from individual customers in excess of 10% of gross accounts receivable as follows:

Customer	March 31,	December 31,
	2020	2019
A	17%	27%
B	15%	14%
C	14%	12%

Revenues from customers by geographic area based on the location of the customers' work sites are as follows (in thousands):

	Three Months Ended March 31,			
	2020		2019	
	Revenues	Percentage of Revenues	Revenues	Percentage of Revenues
United States	\$ 8,617	41%	\$ 9,315	45%
China	2,959	14	2,983	15
Taiwan	2,668	12	1,755	9
Rest of the world	6,914	33	6,488	31
Total revenue	\$ 21,158	100%	\$ 20,541	100%

Long-lived assets, net by geographic area are as follows (in thousands):

	March 31,	December 31,
	2020	2019
United States	\$ 46,065	\$ 46,000
Rest of the world	2,312	2,407
Total long-lived assets, net	\$ 48,377	\$ 48,407

11. FAIR VALUE MEASUREMENTS

Fair value is the exit price, or the amount that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants as of the measurement date. The multiple assumptions used to value financial instruments are referred to as inputs, and a hierarchy for inputs used in measuring fair value is established, that maximizes the use of observable inputs and minimizes the use of unobservable inputs by requiring that the most observable inputs be used when available. Observable inputs reflect assumptions market participants would use in pricing an asset or liability based on market data obtained from independent sources while unobservable inputs reflect a reporting entity's pricing based upon its own market assumptions. These inputs are ranked according to a fair value hierarchy that prioritizes the inputs to valuation techniques used to measure fair value into three broad levels.

Level 1 - Inputs are quoted prices in active markets for identical assets or liabilities.

Level 2 - Inputs are quoted prices for similar assets or liabilities in an active market, quoted prices for identical or similar assets or liabilities in markets that are not active, inputs other than quoted prices that are observable and market-corroborated inputs which are derived principally from or corroborated by observable market data.

Level 3 - Inputs are derived from valuation techniques in which one or more significant inputs or value drivers are unobservable.

The following table represents the Company's assets measured at fair value on a recurring basis as of March 31, 2020, and the basis for that measurement (in thousands):

Assets	Total	Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Money market mutual funds	\$ 27,745	\$ 27,745	\$ —	\$ —

The following table represents the Company's assets measured at fair value on a recurring basis as of December 31, 2019, and the basis for that measurement (in thousands):

Assets	Total	Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Money market mutual funds	\$ 27,644	\$ 27,644	\$ —	\$ —

The Company enters into foreign currency forward contracts to reduce the exposure to foreign currency exchange rate fluctuations on certain foreign currency denominated monetary assets and liabilities, primarily on third-party accounts payables and intercompany balances. The primary objective of the Company's hedging program is to reduce volatility of earnings related to foreign currency exchange rate fluctuations. The counterparty to these foreign currency forward contracts is a financial institution that the Company believes is creditworthy, and therefore, the Company believes the credit risk of counterparty nonperformance is not significant. These foreign currency forward contracts are not designated for hedge accounting treatment.

Therefore, the change in fair value of these contracts is recorded into earnings as a component of other expense (income), net, and offsets the change in fair value of the foreign currency denominated assets and liabilities, which is also recorded in other expense (income), net. The Company recognized a realized loss of \$0.3 million during each of the three months ended March 31, 2020 and 2019, which was recorded in other expense (income), net in the Company's Condensed Consolidated Statements Comprehensive Loss.

The Company carries these derivatives financial instruments on its Condensed Consolidated Balance Sheets at their fair values. The Company's foreign currency forward contracts are classified as Level 2 because it is not actively traded and the valuation inputs are based on quoted prices and market observable data of similar instruments. As of March 31, 2020 and December 31, 2019, the Company had no outstanding forward contracts.

12. COMMITMENTS AND CONTINGENCIES

Indemnifications — The Company generally provides a warranty to its customers that its software will perform substantially in accordance with documented specifications typically for a period of 90 days following initial delivery of its products. The Company also indemnifies certain customers from third-party claims of intellectual property infringement relating to the use of its products. Historically, costs related to these guarantees have not been significant. The Company is unable to estimate the maximum potential impact of these guarantees on its future results of operations.

Purchase obligations — The Company has purchase obligations with certain suppliers for the purchase of goods and services entered in the ordinary course of business. As of March 31, 2020, total outstanding purchase obligations were \$12.8 million, the majority of which due within the next 24 months.

Indemnification of Officers and Directors — As permitted by the Delaware general corporation law, the Company has included a provision in its certificate of incorporation to eliminate the personal liability of its officers and directors for monetary damages for breach or alleged breach of their fiduciary duties as officers or directors, other than in cases of fraud or other willful misconduct.

In addition, the Bylaws of the Company provide that the Company is required to indemnify its officers and directors even when indemnification would otherwise be discretionary, and the Company is required to advance expenses to its officers and directors as incurred in connection with proceedings against them for which they may be indemnified. The Company has entered into indemnification agreements with its officers and directors containing provisions that are in some respects broader than the specific indemnification provisions contained in the Delaware general corporation law. The indemnification agreements require the Company to indemnify its officers and directors against liabilities that may arise by reason of their status or service as officers and directors other than for liabilities arising from willful misconduct of a culpable nature, to advance their expenses incurred as a result of any proceeding against them as to which they could be indemnified, and to obtain directors' and officers' insurance if available on reasonable terms. The Company has obtained directors' and officers' liability insurance in amounts comparable to other companies of the Company's size and in the Company's industry. Since a maximum obligation of the Company is not explicitly stated in the Company's Bylaws or in its indemnification agreements and will depend on the facts and circumstances that arise out of any future claims, the overall maximum amount of the obligations cannot be reasonably estimated.

Legal Proceedings — From time to time, the Company is subject to various claims and legal proceedings that arise in the ordinary course of business. The Company accrues for losses related to litigation when a potential loss is probable and the loss can be reasonably estimated in accordance with FASB requirements. As of March 31, 2020, the Company was not party to any material legal proceedings, thus no loss was probable and no amount was accrued.

On May 6, 2020, the Company initiated an arbitration proceeding with the Hong Kong International Arbitration Center against SMIC New Technology Research & Development (Shanghai) Corporation ("SMIC") due to SMIC's failure to pay fees due to PDF under a series of contracts. The Company seeks to recover the unpaid fees, a declaration requiring SMIC to pay fees under the contracts in the future, and costs associated with bringing the arbitration proceeding.

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

Forward-Looking Statements

The following discussion of our financial condition and results of operations contains forward-looking statements within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934. All statements other than statements of historical fact may be forward-looking statements. In some cases, you can identify forward-looking statements by terminology such as “may,” “could,” “should,” “expect,” “plan,” “anticipate,” “believe,” “estimate,” “predict,” “potential,” “target” or “continue,” the negative effect of terms like these or other similar expressions. Any statement concerning future financial performance (including future revenues, earnings or growth rates), ongoing business strategies or prospects, possible actions taken by us or our subsidiaries, and the potential impact of the COVID-19 pandemic on our business, which may be provided by us are also forward-looking statements. These forward-looking statements are only predictions. Forward-looking statements are based on current expectations and projections about future events and are inherently subject to a variety of risks and uncertainties, many of which are beyond our control, which could cause actual results to differ materially from those anticipated or projected. All forward-looking statements included in this document are based on information available to us on the date of filing and we further caution investors that our business and financial performance are subject to substantial risks and uncertainties. We assume no obligation to update any such forward-looking statements. In evaluating these statements, you should specifically consider various factors, including the risk factors set forth in Item 1. “Business” and Item 7. “Management’s Discussion and Analysis of Financial Condition and Results of Operations” in our Annual Report on Form 10-K for the year ended December 31, 2019, filed with the Securities and Exchange Commission on March 10, 2020. All references to “we”, “us”, “our”, “PDF”, “PDF Solutions” or “the Company” refer to PDF Solutions, Inc.

Overview

We offer products and services designed to empower engineers and data scientists across the semiconductor ecosystem to improve the yield, quality, and profitability of their products. We derive revenues from two sources: Analytics and Integrated Yield Ramp. Our offerings combine proprietary software, physical IP for Integrated Circuits (or IC) designs, electrical measurement hardware tools, proven methodologies, and professional services. We primarily monetize our offerings through time-based license fees, contract revenue for professional services, and increasingly recently, software as a service (or SaaS). In some cases, especially on our historical integrated yield ramp (or IYR) engagements, we also receive a value-based royalty that we call Gainshare. Our products, services, and solutions have been sold to integrated device manufacturers (or IDMs), fabless semiconductor companies, foundries, out-sourced semiconductor assembly and test (or OSATs), and system houses.

Industry Trend

The global COVID-19 pandemic has impacted the operations and purchasing decisions of companies worldwide. The full potential economic impact is not yet known and is difficult to predict. The global financial markets have been significantly disrupted, which may impact access to financing or result in a recession or long-term market correction. In January 2020, the Chinese government imposed certain restrictions on the movement of people and goods to limit the spread of the coronavirus in and around Wuhan. While our China operations are not located in Wuhan, our Shanghai office was temporarily shut down and the restrictions continue to limit the ability of our local employees to travel to customer sites or visit our other offices. Our offices in Italy and Germany were closed in February 2020 and by March 2020 our corporate headquarters in the United States and several other impacted locations were temporarily closed as well. In addition, our personnel worldwide are subject to various travel restrictions, which limit our ability to provide services to customers at their facilities. To date, we have been able to provide uninterrupted access to our products and services due to our globally distributed workforce, many of whom are already working remotely, and our pre-existing infrastructure, which supports secure access to our internal systems. If, however, the COVID-19 pandemic has a substantial impact on our employees’ productivity or our partners or customers decision to use our products and services, our ability to deliver on current commitments, to secure future bookings, or achieve expected financial performance may be harmed. The duration and extent of the impact from the COVID-19 pandemic depends on future developments that cannot be accurately predicted at this time, such as the severity and transmission rate of the virus, the extent and effectiveness of containment actions and the impact of these and other factors on our employees, customers, partners and vendors.

Certain general business trends may affect our Analytics revenue. In particular, the confluence of Industry 4.0 (i.e. the fourth industrial revolution, or the automation and data exchange in manufacturing technologies and processes) and cloud computing (i.e. the on-demand availability of computing resources and data storage without direct active management by the user) is driving increased innovation in semiconductor and electronics manufacturing and analytics, as well as in the organization of IT networks and computing at those same companies. First, the ubiquity of connectivity and sensor technology enables any manufacturing company to augment its factories and visualize its entire production line. In parallel, the cost per terabyte of data storage has continually decreased year to year. The combination of these two trends means that more data is collected and stored than ever before. Semiconductor companies are striving to analyze these very large data sets in real-time to make rapid decisions that measurably improve manufacturing efficiency and quality. In parallel, the traditional practice of on-site data storage, even for highly sensitive data, is changing. The ability to cost-effectively and securely store, analyze, and retrieve massive quantities of data from the cloud versus on-premise enables data to be utilized across a much broader population of users, frequently resulting in greater demands on analytics programs. The combination of these two trends means that cloud-based, analytic programs that effectively manage identity management, physical security and data protection are increasingly in demand for insights and efficiencies across the organizations of these companies. We believe that all these trends will continue for the next few years, and the challenges involved in adopting Industry 4.0 and secure cloud computing will create opportunities for companies that have a combination of advanced analytics capabilities, proven and established data infrastructures, and professional services to optimize their environment to customers' specialized needs.

Other business trends may continue to affect our Integrated Yield Ramp revenue. The logic foundry market at the leading edge nodes, such as 10nm and 7nm has undergone significant change over the past few years. The leading foundry continues to increase market share as other foundries have either suspended 7nm development, forecasted a later start of mass production, or started later than originally forecast in some cases. This trend will likely continue to negatively impact our Integrated Yield Ramp business on these nodes. We expect most logic foundries to invest in derivatives of older process nodes, such as 28nm and 20nm, to extract additional value as many of their customers will not move to advanced nodes due to either technological barriers or restrictive economics. Foundries that participate at leading edge nodes are expected to continue to invest in new technologies such as memory, packaging, and multi-patterned and EUV lithography, as well as new innovations in process control and variability management. We expect China's investment in semiconductors to continue. In order for these trends to provide opportunities for us to increase our business in process control and electrical characterization, Chinese semiconductor manufacturers will need to increase their production volumes on advanced technology nodes and continue to engage foreign suppliers. As a result of these market developments, we have chosen to focus our resources and investments in products, services, and solutions for analytics.

There are other general business trends that may affect our business opportunities. For instance, the demand for consumer electronics, communications devices, and high performance computing continues to drive technological innovation in the semiconductor industry as the need for products with greater performance, lower power consumption, reduced costs and smaller size continues to grow with each new product generation. In addition, advances in computing systems and mobile devices have fueled demand for higher capacity memory chips. To meet these demands, IC manufacturers and designers are constantly challenged to improve the overall performance of their ICs by designing and manufacturing ICs with more embedded applications to create greater functionality while lowering power and cost per transistor. As this trend continues, companies will continually be challenged to improve process capabilities to optimally produce ICs with minimal random and systematic yield loss, which is driven by the lack of compatibility between the design and its respective manufacturing process. We believe that these difficulties will continue to create a need for all types of products and services that address yield loss across the IC product life cycle.

Financial Highlights

Financial highlights for the three months ended March 31, 2020, were as follows:

- Total revenues were \$21.2 million, which was an increase of \$0.6 million, or 3%, compared to the three months ended March 31, 2019. Analytics revenue was \$13.2 million, which was an increase of \$1.8 million, or 16%, compared to the three months ended March 31, 2019. The increase in Analytics revenue was primarily driven by \$1.5 million higher business activity in licenses and services for our Exensio products, and \$1.5 million increase in Characterization Vehicle (CV) services due to higher hours worked across multiple contracts and customers. The increase was offset by \$1.2 million lower revenue from Design-for-Inspection™ (DFI™) systems and services. Integrated Yield Ramp revenue decreased \$1.2 million for the three months ended March 31, 2020, compared to the three months ended March 31, 2019, due primarily to a \$3.3 million decrease in revenue from our yield ramp services from lower hours worked across multiple contracts and customers, partially offset by a \$2.1 million increase in Gainshare royalty from the 14nm technology nodes.
- Costs of revenues increased \$0.6 million for the three months ended March 31, 2020, compared to the three months ended March 31, 2019, primarily due to (i) a \$0.6 million increase in direct costs related to third-party software royalty and licenses expense, equipment and hardware expense related to a new customer engagement, and amortization of deferred costs, and (ii) a \$0.7 million increase in information technology-related costs and facilities expense mainly due to higher cloud-delivery related costs and depreciation expense of test equipment, partially offset by (i) a \$0.5 million decrease in personnel-related costs, and (ii) a \$0.2 million decrease in travel expenses resulting from lesser business travel in the first quarter of 2020 due to the global COVID-9 pandemic.
- Gross margin of 60%, compared to 62% for the three months ended March 31, 2019.
- Net loss was \$0.5 million, compared to \$2.7 million for the three months ended March 31, 2019. The decrease in net loss was primarily attributable to a \$0.6 million increase in revenues and a \$3.4 million increase in tax benefits, partially offset by a \$0.6 million increase in costs of revenues, and a \$1.2 million increase in operating expenses as we continued to make investments in research and development sales and marketing activities.
- Cash, cash equivalents and investments increased \$2.8 million to \$100.4 million at March 31, 2020, from \$97.6 million at December 31, 2019, primarily due to the collection of accounts receivables, partially offset by cash used in investing activities related to the property and equipment purchased for the development of our DFI™ solution.

Critical Accounting Policies and Estimates

See Note 1 of “Notes to Condensed Consolidated Financial Statements (Unaudited)” of this Quarterly Report on Form 10-Q for a description of recent accounting pronouncements and accounting changes, including the expected dates of adoption and estimated effects, if any, on our condensed consolidated financial statements, and to Management’s Discussion and Analysis of Financial Condition and Results of Operations contained in Part II, Item 7 of our Annual Report on Form 10-K for the year ended December 31, 2019.

There have been no material changes during the three months ended March 31, 2020 to the items that we disclosed as our critical accounting policies and estimates in Management’s Discussion and Analysis of Financial Condition and Results of Operations in our Annual Report on Form 10-K for the fiscal year ended December 31, 2019.

The following is a brief discussion of the more significant accounting policies and methods that we use.

General

Our discussion and analysis of our financial conditions, results of operations and cash flows are based on our condensed consolidated financial statements, which have been prepared in conformity with accounting principles generally accepted in the United States of America. Our preparation of these consolidated financial statements requires us to make estimates and assumptions that affect the reported amounts of assets and liabilities, the disclosure of contingent assets and liabilities at the dates of the financial statements and the reported amounts of revenues and expenses during the reporting periods. We base our estimates on historical experience and on various other assumptions that we believe to be reasonable under the circumstances. The most significant estimates and assumptions relate to revenue recognition, valuation of long-lived assets including goodwill and intangible assets, and the realization of deferred tax assets. Actual amounts may differ from such estimates under different assumptions or conditions.

Revenue Recognition

We derive revenue from two sources: Analytics and Integrated Yield Ramp.

Analytics Revenue

Analytics revenue is derived from the following primary offerings: licenses and services for Exensio Software, Exensio SaaS, DFI and CV systems that do not include performance incentives based on customers' yield achievement.

Revenue from standalone Exensio Software is recognized depending on whether the license is perpetual or time-based. Perpetual (one-time charge) license software is recognized at the time of the inception of the arrangement when control transfers to the customers, if the software license is distinct from the services offered by us. Revenue from post-contract support is recognized over the contract term on a straight-line basis, because we are providing (i) support and (ii) unspecified software updates on a when-and-if available basis over the contract term. Revenue from time-based-licensed software is allocated to each performance obligation and is recognized either at a point in time or over time as follows. The license component is recognized at the time when control transfers to customers, with the post-contract support component recognized ratably over the committed term of the contract. For contracts with any combination of licenses, support, and other services, distinct performance obligations are accounted for separately. For contracts with multiple performance obligations, we allocate the transaction price of the contract to each performance obligation on a relative basis using standalone selling price (or SSP) attributed to each performance obligation.

Revenue from Exensio SaaS arrangements, which allow for the use of a cloud-based software product or service over a contractually determined period of time without taking possession of software, is accounted for as subscriptions and is recognized as revenue ratably, on a straight-line basis, over the subscription period beginning on the date the service is first made available to customers.

Revenue from DFI™ and CV systems that do not include performance incentives based on customers' yield achievement is recognized primarily as services are performed. Where there are distinct performance obligations, we allocate revenue to all deliverables based on their standalone selling prices, or SSP. For these contracts with multiple performance obligations, we allocate the transaction price of the contract to each performance obligation on a relative basis using SSP attributed to each performance obligation. Where there are not discrete performance obligations, historically, revenue is primarily recognized as services are performed using a percentage of completion method based on costs or labor-hours inputs, whichever is the most appropriate measure of the progress towards completion of the contract.

Integrated Yield Ramp Revenue

Integrated Yield Ramp revenue is derived from our yield ramp engagements, which include Gainshare or other performance incentives based on customers' yield achievement.

Revenue under these project-based contracts, which are delivered over a specific period of time typically for a fixed fee component paid on a set schedule, is recognized as services are performed using a percentage of completion. Similar to the services provided in connection with CV systems that are contributing to Analytics revenue, due to the nature of the work performed in these arrangements, the estimation of percentage of completion method is complex and subject to many variables that require significant judgement.

The Gainshare royalty contained in yield ramp contracts is a variable fee related to continued usage of our IP after the fixed-fee service period ends, based on the customers' yield achievement. Revenue derived from Gainshare is contingent upon our customers reaching certain defined production yield levels. Gainshare royalty periods are generally subsequent to the delivery of all contractual services and performance obligations. We record Gainshare as a usage-based royalty derived from customers' usage of intellectual property and record it in the same period in which the usage occurs.

Income Taxes

We are required to assess whether it is "more-likely-than-not" that we will realize our deferred tax assets. If we believe that they are not likely to be fully realizable before the expiration dates applicable to such assets, then to the extent we believe that recovery is not likely, we must establish a valuation allowance. The valuation allowance was approximately \$10.0 million and \$10.5 million as of March 31, 2020 and December 31, 2019 respectively, which was related to California R&D tax credits and California net operating losses related to an acquisition that we currently do not believe to be "more-likely-than-not" to be ultimately realized. If we conclude at a future financial reporting period that there has been a change in our ability to realize our California R&D credit and net operating loss carry forward deferred tax assets, and it is at such time "more-likely-than-not" that we will realize the tax credits before applicable expiration dates, our tax provision will decrease in the period in which we make such determination.

We evaluate our deferred tax assets for realizability considering both positive and negative evidence, including our historical financial performance, projections of future taxable income, future reversals of existing taxable temporary differences, tax planning strategies and any carryback availability. In evaluating the need for a valuation allowance, we estimate future taxable income based on management approved business plans. This process involves significant management judgment about assumptions that are subject to change from period to period based on changes in tax laws or variances between future projected operating performance and actual results. Changes in the net deferred tax assets, less offsetting valuation allowance, in a period are recorded through the income tax provision and could have a material impact on the Condensed Consolidated Statements of Comprehensive Loss.

Our income tax calculations are based on application of applicable U.S. federal, state, or foreign tax law. Our tax filings, however, are subject to audit by the respective tax authorities. Accordingly, we recognize tax liabilities based upon our estimate of whether, and the extent to which, additional taxes will be due when such estimates are more-likely-than-not to be sustained. An uncertain income tax position will not be recognized if it has less than a 50% likelihood of being sustained. To the extent the final tax liabilities are different than the amounts originally accrued, the increases or decreases are recorded as income tax expense or benefit in the Condensed Consolidated Statements of Comprehensive Loss. At March 31, 2020, no deferred taxes have been provided on undistributed earnings from the Company's international subsidiaries. The Company intends to reinvest the earnings of its non-U.S. subsidiaries in those operations indefinitely. As such, the Company has not provided for any foreign withholding taxes on the earnings of foreign subsidiaries as of March 31, 2020. The earnings of the Company's foreign subsidiaries are taxable in the U.S. in the year earned under the Global Intangible Low-Taxed Income rules implemented under 2017 Tax Cuts and Jobs Act.

On March 27, 2020, the Coronavirus Aid, Relief, and Economic Security Act ("CARES Act") was enacted. The CARES Act includes, among other things, refundable payroll tax credits, deferment of some employer FICA taxes, allowance of net operating loss carrybacks for up to five years, alternative minimum tax credit refunds, and technical amendments regarding the income tax depreciation of qualified improvement property placed in service after December 31, 2017. The removal of certain limitations on the utilization of NOLs resulted in the Company to recognize an income tax benefit of \$2.3 million from the carryback of federal NOLs during the three months ended March 31, 2020.

Valuation of Long-lived Assets including Goodwill and Intangible Assets

We record goodwill when the purchase consideration of an acquisition exceeds the fair value of the net tangible and identified intangible assets as of the date of acquisition. We have one operating segment and one operating unit. We perform an annual impairment assessment of goodwill during the fourth quarter of each calendar year or more frequently, if required to determine if any events or circumstances exist, such as an adverse change in business climate or a decline in the overall industry demand, that would indicate that it would more likely than not reduce the fair value of a reporting unit below its carrying amount, including goodwill. If events or circumstances do not indicate that the fair value of a reporting unit is below its carrying amount, then goodwill is not considered to be impaired and no further testing is required. If the carrying amount exceeds its fair value, an impairment loss would be recognized equal to the amount of excess, limited to the amount of total goodwill. There was no goodwill impairment for the three months ended March 31, 2020.

Our long-lived assets, excluding goodwill, consist of property and equipment and intangible assets. We periodically review our long-lived assets for impairment. For assets to be held and used, we initiate our review whenever events or changes in circumstances indicate that the carrying amount of a long-lived asset group may not be recoverable. Recoverability of an asset group is measured by comparison of its carrying amount to the expected future undiscounted cash flows that the asset group is expected to generate. If it is determined that an asset group is not recoverable, an impairment loss is recorded in the amount by which the carrying amount of the asset group exceeds its fair value. There was no impairment of long-lived assets for the three months ended March 31, 2020.

Recent Accounting Pronouncements and Accounting Changes

See Note 1 of “Notes to Condensed Consolidated Financial Statements (Unaudited)” of this Quarterly Report on Form 10-Q for a description of recent accounting pronouncements and accounting changes, including the expected dates of adoption and estimated effects, if any, on our Condensed Consolidated Financial Statements.

Results of Operations

Income Statement Presentation

In the fourth quarter of fiscal 2019, in order to enhance the transparency of our revenue reporting, the Company updated its Condensed Consolidated Statements of Comprehensive Loss to change its historical presentation of revenue categories. Previously, the Company presented revenue on two lines: Solutions and Gainshare performance incentives. Included within Solutions, was revenue from software and related revenue, SaaS solutions, Design-for-Inspection (DFI™) licenses, and fixed-price project-based solution implementation services. The previous Gainshare performance incentive category included only revenue from performance incentive programs. The Company now presents revenue in the following categories: Analytics and Integrated Yield Ramp. Integrated Yield Ramp revenue is comprised of all revenue from the Company’s Integrated Yield Ramp services engagements that include performance incentives based on customers’ yield achievement, i.e. both fixed-fees and Gainshare royalty from such engagements. Analytics comprises all other revenue, including from the Company’s licenses and services for Exensio Software, Exensio SaaS, DFI™ and CV systems that do not include performance incentives based on customers’ yield achievement.

The change in presentation of revenue does not change the Company’s net revenues or total cost of net revenues. The following table shows reclassified amounts to conform to the current period’s presentation (in thousands):

	For the Three Months Ended March 31, 2019		
	Previously Reported	Change in Presentation Reclassification	Current Presentation
Revenues:			
Design-to-silicon-yield solutions	\$ 16,661	\$ (16,661)	N/A
Gainshare performance incentives	3,880	(3,880)	N/A
Analytics	N/A	11,434	\$ 11,434
Integrated Yield Ramp	N/A	9,107	9,107
Total revenues	<u>\$ 20,541</u>	<u>\$ —</u>	<u>\$ 20,541</u>

Since certain costs of revenues are attributed to both Analytics and Integrated Yield Ramp revenue categories, the Company believes it is more appropriate and meaningful to present the Condensed Consolidated Statements of Comprehensive Loss under a one-step presentation format that excludes any measure of gross margin. In the fourth quarter of fiscal 2019, the Company elected to change its Condensed Consolidated Statements of Comprehensive Loss presentation from a two-step presentation, where total costs of revenues was deducted from total revenues to report a gross profit line, to a one-step presentation, where total costs and expenses are deducted from total revenues. The change in presentation does not change previously presented amounts for costs of revenues, operating expenses and other expenses (income), or loss before income taxes.

Discussion of Financial Data for the Three Months Ended March 31, 2020 and 2019**Revenues, Costs of Revenues, and Gross Margin**

	Three Months Ended March 31,		Change	
	2020	2019	\$	%
(Dollars in thousands)				
Revenues:				
Analytics	\$ 13,248	\$ 11,434	\$ 1,814	16%
Integrated Yield Ramp	7,910	9,107	(1,197)	(13)%
Total revenues	\$ 21,158	\$ 20,541	\$ 617	3%
Costs of revenues	8,487	7,867	620	8%
Gross profit	\$ 12,671	\$ 12,674	\$ (3)	—%
Gross margin	60%	62%		
<i>Analytics revenue as a percentage of total revenues</i>	63%	56%		
<i>Integrated Yield Ramp revenue as a percentage of total revenues</i>	37%	44%		

Analytics Revenue

Analytics revenue increased \$1.8 million for the three months ended March 31, 2020, compared to the three months ended March 31, 2019. The increase in Analytics revenue was primarily driven by \$1.5 million higher business activity in licenses and services for our Exensio products, \$1.5 million increase in CV services due to higher hours worked across multiple contracts and customers. The increase was offset by \$1.2 million lower revenue from DFI™ systems and services.

Integrated Yield Ramp Revenue

Integrated Yield Ramp revenue decreased \$1.2 million for the three months ended March 31, 2020, compared to the three months ended March 31, 2019, due primarily to a \$3.3 million decrease in revenue from our yield ramp services from lower hours worked across multiple contracts and customers, partially offset by a \$2.1 million increase in Gainshare royalty from the 14nm technology nodes. Our Integrated Yield Ramp revenue may continue to fluctuate from period to period primarily due to the contribution of Gainshare royalty, which is dependent on many factors that are outside our control, including among others, continued production of ICs by our customers at facilities at which we generate Gainshare, sustained yield improvements by our customers, and our ability to enter into new contracts containing Gainshare.

Our revenues may fluctuate in the future and are dependent on a number of factors, including the semiconductor industry's continued acceptance of our products, services and solutions, the timing of purchases by existing and new customers, cancellations by existing customers, and our ability to attract new customers and penetrate new markets, and further penetration of our current customer base. Fluctuations in future results may also occur if any of our significant customers renegotiate pre-existing contractual commitments, including due to adverse changes in their own business.

Costs of Revenues

Costs of revenues consist of costs incurred to provide and support our services, costs recognized in connection with licensing our software, and amortization of acquired technology. Costs of revenues consist of services costs and software licenses costs. Services costs consist of material, employee compensation and related benefits, overhead costs, travel and allocated facilities-related costs. Software license costs consist of costs associated with licensing third-party software used by the Company in providing services to our customers in solution engagements, or sold in conjunction with our software products. The increase in costs of revenues of \$0.6 million was primarily due to (i) a \$0.6 million increase in direct costs related to third-party software royalty and licenses expense, equipment and hardware expense related to a new customer engagement, and amortization of deferred costs, and (ii) a \$0.7 million increase in information technology (IT) related costs and facilities expense mainly due to higher cloud-delivery related costs and depreciation expense of test equipment, partially offset by (i) a \$0.5 million decrease in personnel-related costs, and (ii) a \$0.2 million decrease in travel expenses resulting from lesser business travel in the first quarter of 2020 due to the global COVID-9 pandemic.

Gross Margin

Gross margin in the first quarter of 2020 was 60% compared to 62% for the year-ago period, or a decrease of 2%. The higher gross margin during the first quarter of 2019 was primarily due to a \$3.3 million nonrecurring revenue from a customer contract amendment, partially offset by an overall increase in Analytics revenue during the first quarter of 2020, which revenue is comprised of software and term-based licenses that include lower direct costs of revenues to deliver than IYR offerings.

Operating Expenses:

Research and Development

(Dollars in thousands)	Three Months Ended March 31,		Change	
	2020	2019	\$	%
Research and development	\$ 8,590	\$ 8,246	\$ 344	4%
As a percentage of total revenues	41%	40%		

Research and development expenses consist primarily of personnel-related costs to support product development activities, including compensation and benefits, outside development services, travel, facilities cost allocations, and stock-based compensation charges. Research and development expenses increased for the three months ended March 31, 2020, compared to the year-ago period, primarily due to (i) a \$0.2 million increase in depreciation expense, (ii) a \$0.2 million increase in subcontractor expenses that is primarily related to our DFI™ and Exensio solutions, and (iii) a \$0.1 million increase in software licenses and maintenance expense, partially offset by a \$0.2 million decrease in personnel-related costs. We anticipate our expenses in research and development will fluctuate in absolute dollars from period to period due to the timing of product development projects and supporting revenue generating activity requirements.

Selling, General and Administrative

(Dollars in thousands)	Three Months Ended March 31,		Change	
	2020	2019	\$	%
Selling, general and administrative	\$ 7,895	\$ 7,011	\$ 884	13%
As a percentage of total revenues	37%	34%		

Selling, general and administrative expenses consist primarily of compensation and benefits for sales, marketing and general and administrative personnel, legal and accounting services, marketing communications, travel and facilities cost allocations, and stock-based compensation charges. Selling, general and administrative expenses increased for the three months ended March 31, 2020, compared to the year-ago period, primarily due to (i) a \$0.4 million increase in personnel-related costs, (ii) a \$0.3 million increase in legal fees, and (iii) a \$0.3 million increase in subcontractor expenses, partially offset by a \$0.1 million decrease in travel expenses. We anticipate our selling, general and administrative expenses will fluctuate in absolute dollars from period to period as a result of cost control initiatives and to support increased selling efforts in the future.

Amortization of Other Acquired Intangible Assets

(Dollars in thousands)	Three Months Ended March 31,		Change	
	2020	2019	\$	%
Amortization of other acquired intangible assets	\$ 173	\$ 108	\$ 65	60%

Amortization of other acquired intangible assets consists of amortization of intangibles acquired as a result of certain business combination.

Interest and Other Expense (Income), Net

(Dollars in thousands)	Three Months Ended March 31,		Change	
	2020	2019	\$	%
Interest and other expense (income), net	\$ 20	\$ 6	\$ 14	233%

Interest and other expense (income), net, primarily consists of interest income and foreign currency transaction exchange gains and losses. Interest and other expense (income), net increased for the three months ended March 31, 2020, compared to year-ago period, primarily due to a decrease in interest income due to lower interest rates, partially offset by lower net unfavorable fluctuations in foreign exchange rates.

Income Tax Benefit

(Dollars in thousands)	Three Months Ended March 31,		Change	
	2020	2019	\$	%
Income tax benefit	\$ (3,479)	\$ (98)	\$ (3,381)	3,450%

Income tax benefit increased \$3.4 million for the three months ended March 31, 2020, compared to the year-ago period, primarily due to excess tax benefit from employee stock compensation expense and as a result of the provisions of the CARES Act. During the three months ended March 31, 2020, the Company recorded income tax benefit of \$2.3 million from the carryback of federal NOLs pursuant to the provisions of the CARES Act.

Liquidity and Capital Resources

As of March 31, 2020, our working capital, defined as total current assets less total current liabilities, was \$122.3 million, compared to \$119.6 million as of December 31, 2019. Cash and cash equivalents were \$100.4 million as of March 31, 2020, compared to \$97.6 million as of December 31, 2019. As of March 31, 2020, and December 31, 2019, cash and cash equivalents held by our foreign subsidiaries were \$2.3 million and \$3.8 million, respectively. We believe that our existing cash resources and anticipated funds from operations will satisfy our cash requirements to fund our operating activities, capital expenditures, and other obligations for at least the next twelve months.

(In thousands)	Three Months Ended March 31,		\$ Change
	2020	2019	
Net cash flows provided by (used in):			
Operating activities	\$ 5,380	\$ (151)	\$ 5,531
Investing activities	(2,068)	(2,357)	289
Financing activities	(507)	(3,174)	2,667
Effect of exchange rate changes on cash and cash equivalents	(25)	8	(33)
Net increase (decrease) in cash and cash equivalents	\$ 2,780	\$ (5,674)	\$ 8,454

Net Cash Flows Provided by (Used in) Operating Activities

Cash flow from operating activities during the three months ended March 31, 2020 mostly consisted of net loss, adjusted for certain non-cash items which primarily consisted of depreciation and amortization, share-based compensation expense and deferred tax assets. The \$5.5 million increase in cash flows from operating activities for the three months ended March 31, 2020, compared to the year-ago period, was driven primarily by a \$2.2 million decrease in net loss, an increase in non-cash adjustments to net loss by \$2.4 million, which was primarily due to an increase in deferred tax assets of \$2.1 million, and an increase in depreciation and amortization of \$0.4 million, and a \$0.9 million increase in net change from operating assets and liabilities.

The major contributors to the net change in operating assets and liabilities for the three months ended March 31, 2020 were as follows:

- Accounts receivable decreased by \$3.3 million, primarily due to increased collection and lower invoicing activity due to the decline in revenue during the quarter, partially offset by increase in unbilled accounts receivables due to timing of billing and revenue recognition.
- Prepaid and other current assets increased by \$1.9 million, primarily due to increase in income tax receivable, partially offset by decrease in contract assets due to timing of billing and revenue recognition related to our fixed-price service contracts.
- Other noncurrent assets decreased by \$1.9 million, primarily due to decrease in noncurrent portion of unbilled receivables due to timing of billing and revenue recognition.
- Deferred revenues increased by \$1.0 million, primarily due to timing of billing and revenue recognition.

Cash Flows Used in Investing Activities

Cash used in investing activities decreased by \$0.3 million for the three months ended March 31, 2020 compared to the year-ago period. For the three months ended March 31 2020, cash used in investing activities related to property and equipment purchased for the development our DFI™ solution. For the three months ended March 31 2019, cash used in investing activities related to property and equipment purchased for the development our DFI™ solution, new office headquarters and expansion of our research and development laboratory and clean room.

Net Cash Flows Used in Financing Activities

Net cash used in financing activities decreased by \$2.7 million for the three months ended March 31, 2020 compared to the year-ago period. For the three months ended March 31, 2020, net cash used in financing activities primarily consisted of \$1.5 million cash payments for taxes related to net share settlement of equity awards, partially offset by \$1.0 million of proceeds from our Employee Stock Purchase Plan and exercise of stock options. For the three months ended March 31, 2019, net cash used in financing activities primarily consisted of \$3.9 million cash used to repurchase shares of our common stock and \$0.6 million cash payments for taxes related to net share settlement of equity awards, partially offset by \$1.3 million of proceeds from our Employee Stock Purchase Plan and exercise of stock options.

Off-Balance Sheet Agreements

We do not have any off-balance sheet arrangements, investments in special purpose entities or undisclosed borrowings or debt.

Contractual Obligations

The following table summarizes our known contractual obligations (in thousands) as of March 31, 2020:

Contractual Obligations	Payments Due by Period						
	2020 (remaining nine months)	2021	2022	2023	2024	2025 and thereafter	Total
Operating lease obligations(1)	\$ 1,529	\$ 1,776	\$ 1,567	\$ 1,108	\$ 806	\$ 2,976	\$ 9,762
Purchase obligations(2)	8,422	2,905	447	364	320	321	12,779
Total(3)	\$ 9,951	\$ 4,681	\$ 2,014	\$ 1,472	\$ 1,126	\$ 3,297	\$ 22,541

- (1) Refer to Note 4, Leases of the Notes to Condensed Consolidated Financial Statements (Item 1 of Part I of this Report)
- (2) Purchase obligations consist of agreements to purchase goods and services entered in the ordinary course of business.
- (3) The contractual obligation table above excludes liabilities for uncertain tax positions of \$2.6 million, which are not practicable to assign to any particular years, due to the inherent uncertainty of the tax positions. See Note 8 of "Notes to Condensed Consolidated Financial Statements" for further discussion.

Item 3. Quantitative and Qualitative Disclosures about Market Risk

We are exposed to three primary types of market risks: credit risk and counterparty risk, foreign currency exchange rate risk and interest rate risk. The following discusses our exposure to market risk related to changes in interest rates and foreign currency exchange rates. We do not currently own any equity investments, nor do we expect to own any in the foreseeable future. This discussion contains forward-looking statements that are subject to risks and uncertainties. Actual results could vary materially as a result of a number of factors.

Interest Rate Risk. As of March 31, 2020, we had cash and cash equivalents of \$100.4 million. Cash and cash equivalents consisted of cash and highly liquid money market instruments. We would not expect our operating results or cash flows to be affected to any significant degree by the effect of a sudden change in market interest on our portfolio. A hypothetical increase in market interest rates of 100 basis points from the market rates in effect at March 31, 2020, would cause the fair value of these investments to decrease by an immaterial amount, which would not have significantly impacted our financial position or results of operations.

Foreign Currency and Exchange Risk. Certain of our payables for our international offices are denominated in the local currency, including the Euro, Yen and RMB. Therefore, a portion of our operating expenditures is subject to foreign currency risks. We enter into foreign currency forward contracts to reduce the exposure to foreign currency exchange rate fluctuations on certain foreign currency denominated monetary assets and liabilities. We do not use foreign currency forward contracts for speculative or trading purposes. We record these forward contracts at fair value. The counterparty to these foreign currency forward contracts is a financial institution that we believe is creditworthy, and therefore, we believe the credit risk of counterparty non-performance is not significant. The change in fair value of these contracts is recorded into earnings as a component of other income (expense), net and offsets the change in fair value of foreign currency denominated monetary assets and liabilities, which is also recorded in other income (expense), net. As of March 31, 2020, we had no outstanding forward contract. Subsequent to the end of first quarter of 2020, we entered into one outstanding forward contract with a notional amount of \$8.2 million. The foreign currency exchange rate movement of plus-or-minus 10% will result in the change in fair value of this contract of plus-or-minus \$0.8 million.

Item 4. Controls and Procedures

Evaluation of Disclosure Controls and Procedures

Our management, with the participation of our principal executive officer and principal financial and accounting officer, evaluated the effectiveness of our "disclosure controls and procedures" as defined in Exchange Act Rules 13a-15(e) and 15d-15(e) as of March 31, 2020, in connection with the filing of this Quarterly Report on Form 10-Q. Based on that evaluation as of March 31, 2020, our principal executive officer and principal financial and accounting officer concluded that our disclosure controls and procedures were effective to ensure that information we are required to disclose in reports that we file or submit under the Exchange Act is recorded, processed, summarized and reported within the time periods specified in rules and forms of the SEC and accumulated and communicated to our management as appropriate to allow timely decisions regarding required disclosure.

Changes in Internal Control over Financial Reporting

There were no changes in the Company's internal control over financial reporting during the three months ended March 31, 2020, that have materially affected, or are reasonably likely to materially affect, the Company's internal control over financial reporting.

PART II — OTHER INFORMATION

Item 1. Legal Proceedings

From time to time, we are subject to various claims and legal proceedings that arise in the ordinary course of business. We accrue for losses related to litigation when a potential loss is probable and the loss can be reasonably estimated in accordance with FASB requirements. During the reported period, we were not a party to any material legal proceedings, thus no loss was probable and no amount was accrued at March 31, 2020.

On May 6, 2020, we initiated an arbitration proceeding with the Hong Kong International Arbitration Center against SMIC New Technology Research & Development (Shanghai) Corporation (“SMIC”) due to SMIC’s failure to pay fees due to PDF under a series of contracts. We seek to recover the unpaid fees, a declaration requiring SMIC to pay fees under the contracts in the future, and costs associated with bringing the arbitration proceeding.

Item 1A. Risk Factors

Item 1A, “Risk Factors,” on pages 12 through 20 of the Company’s Annual Report on Form 10-K for the year ended December 31, 2019 provides information on the significant risks associated with our business. Except as set forth below, there have been no subsequent material changes to these risks.

The COVID-19 pandemic has significantly affected how we and our customers are operating our business and the duration and extent to which this will impact our future results of operations and overall financial performance remains uncertain.

As a result of the global COVID-19 pandemic, in January 2020, the Chinese government imposed certain restrictions on the movement of people and goods to limit the spread of the coronavirus in and around Wuhan. While our China operations are not located in Wuhan, our Shanghai office was temporarily shut down and the restrictions continue to limit the ability of our local employees to travel to customer sites or visit our other offices. Our offices in Italy and Germany were closed in February 2020 and by March 2020, our corporate headquarters in the United States and several other impacted locations were temporarily closed as well. In addition, our personnel worldwide are subject to various travel restrictions, which limit our ability to provide services to customers at their facilities. These impacts have disrupted our normal operations. If the COVID-19 pandemic has a substantial impact on our employees’ productivity or our partners’ or customers’ decision to use our products and services, our results of operations and overall financial performance may be harmed. The duration and extent of the impact from the COVID-19 pandemic depends on future developments that cannot be accurately predicted at this time, such as the severity and transmission rate of the virus, the extent and effectiveness of containment actions and the impact of these and other factors on our employees, customers, partners and vendors. If we are not able to respond to and manage the impact of such events effectively, our business may be harmed.

Moreover, the conditions caused by the COVID-19 pandemic could adversely affect our customers’ ability or willingness to purchase our products or services, delay prospective customers’ purchasing decisions, adversely impact our ability to provide or deliver products and on-site services to our customers, delay the provisioning of our offerings, lengthen payment terms, reduce the value or duration of their subscriptions, or affect attrition rates, all of which could adversely affect our future sales, operating results and overall financial performance.

Item 2. Unregistered Sales of Equity Securities and Use of Proceeds

None.

Item 3. Defaults Upon Senior Securities

None.

Item 4. Mine Safety Disclosures

None.

Item 5. Other Information

None.

Item 6. Exhibits

Exhibit Number	Description
10.1	Employment offer to Adnan Raza, dated January 23, 2020 (incorporated herein by reference to registrant's filing on Form 10-K filed on March 10, 2020).*
10.2	Amended and Restated Offer Letter Agreement between Christine Russell and PDF Solutions, Inc. dated March 9, 2020 (incorporated herein by reference to registrant's filing on Form 8-K/A filed on March 12, 2020).*
31.01	Certification of the principal executive officer pursuant to Exchange Act Rules 13a-14(a) and 15d-14(a), as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.†
31.02	Certification of the principal financial and accounting officer pursuant to Exchange Act Rules 13a-14(a) and 15d-14(a), as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002.†
32.01	Certification pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.**
32.02	Certification pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002.**
101.INS	XBRL Instance Document.†
101.SCH	XBRL Taxonomy Extension Schema Document.†
101.CAL	XBRL Taxonomy Extension Calculation Linkbase Document.†
101.DEF	XBRL Taxonomy Extension Definition Linkbase Document.†
101.LAB	XBRL Taxonomy Extension Label Linkbase Document.†
101.PRE	XBRL Taxonomy Extension Presentation Linkbase Document.†

* Indicates management contract or compensatory plan or arrangement.

† Filed herewith.

** Furnished, and not filed.

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.

PDF SOLUTIONS, INC.

Date: May 7, 2020

By: /s/ JOHN K. KIBARIAN
John K. Kibarian
President and Chief Executive Officer
(principal executive officer)

Date: May 7, 2020

By: /s/ ADNAN RAZA
Adnan Raza
Executive Vice President, Finance and Chief Financial
Officer
(principal financial and accounting officer)

CERTIFICATIONS

I, John K. Kibarian, certify that:

1. I have reviewed this quarterly report on Form 10-Q of PDF Solutions, Inc.;
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(s) 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(s) 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 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.

By: /s/ John K. Kibarian
John K. Kibarian
President and Chief Executive Officer
(principal executive officer)

Date: May 7, 2020

CERTIFICATIONS

I, Adnan Raza, certify that:

1. I have reviewed this quarterly report on Form 10-Q of PDF Solutions, Inc.;
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(s) 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(s) 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 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.

By: /s/ Adnan Raza
Adnan Raza
*Executive Vice President, Finance and
Chief Financial Officer
(principal financial and accounting
officer)*

Date: May 7, 2020

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

In connection with the Quarterly Report of PDF Solutions, Inc. (the "Company") on Form 10-Q for the quarter ended March 31, 2020, as filed with the Securities and Exchange Commission on May 7, 2020 (the "Report"), I, John K. Kibarian, President and Chief Executive Officer of the Company, certify, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, to my knowledge:

- (1) The Report fully complies with the requirements of section 13(a) or 15(d) of the Securities Exchange Act of 1934; and
- (2) The information contained in the Report fairly presents, in all material respects, the financial condition and result of operations of the Company.

By: /s/ John K. Kibarian
John K. Kibarian
*President and Chief Executive
Officer
(principal executive officer)*

Date: May 7, 2020

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

In connection with the Quarterly Report of PDF Solutions, Inc. (the "Company") on Form 10-Q for the quarter ended March 31, 2020 as filed with the Securities and Exchange Commission on May 7, 2020 (the "Report"), I, Adnan Raza, Executive Vice President, Finance and Chief Financial Officer of the Company, certify, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that, to my knowledge:

- (1) The Report fully complies with the requirements of section 13(a) or 15(d) of the Securities Exchange Act of 1934; and
- (2) The information contained in the Report fairly presents, in all material respects, the financial condition and result of operations of the Company.

By: /s/ Adnan Raza
Adnan Raza
Executive Vice President, Finance and Chief
Financial Officer
(principal financial and accounting officer)

Date: May 7, 2020