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

FORM 10-K

(Mark One)

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

For the fiscal year ended October 31, 2018

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 0-19807

SYNOPSYS, INC.
(Exact name of registrant as specified in its charter)

Delaware	**56-1546236**
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification No.)

690 East Middlefield Road, Mountain View, California 94043
(Address of principal executive offices, including zip code)

(650) 584-5000
(Registrant's telephone number, including area code)

Securities Registered Pursuant to Section 12(b) of the Act:

Title of Each Class	Name of Each Exchange on Which Registered
Common Stock, $0.01 par value	**Nasdaq Global Select Market**

Securities Registered Pursuant to Section 12(g) of the Act: **None**

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ☒ No ☐
Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes ☐ No ☒

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

Indicate by check mark whether the registrant has submitted electronically and posted on its corporate Web site, if any, every Interactive Data File required to be submitted and posted 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 and post such files). Yes ☒ No ☐

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K (§ 229.405 of this chapter) is not contained herein, and will not be contained, to the best of registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. ☒

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

Large accelerated filer ☒ Accelerated filer ☐ Non-accelerated filer ☐ Smaller Reporting Company ☐
Emerging growth company ☐

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

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

The aggregate market value of the voting and non-voting common equity held by non-affiliates computed by reference to the price at which the common equity was last sold as of the last business day of the registrant's most recently completed second fiscal quarter was approximately $10.5 billion. Aggregate market value excludes an aggregate of approximately 29.2 million shares of common stock held by the registrant's executive officers and directors and by each person known by the registrant to own 5% or more of the outstanding common stock on such date. Exclusion of shares held by any of these persons should not be construed to indicate that such person possesses the power, direct or indirect, to direct or cause the direction of the management or policies of the registrant, or that such person is controlled by or under common control with the registrant.

On December 12, 2018, 149,515,012 shares of the registrant's Common Stock, $0.01 par value, were outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's Proxy Statement relating to the registrant's 2019 Annual Meeting of Stockholders, scheduled to be held on April 8, 2019, are incorporated by reference into Part III of this Annual Report on Form 10-K where indicated. Except as expressly incorporated by reference, the registrant's Proxy Statement shall not be deemed to be part of this report.

SYNOPSYS, INC.

ANNUAL REPORT ON FORM 10-K
Fiscal year ended October 31, 2018

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Cautionary Note Regarding Forward-Looking Statements

This Annual Report on Form 10-K (this Form 10-K or Annual Report) contains forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended (the Securities Act), Section 21E of the Securities Exchange Act of 1934, as amended (the Exchange Act), and the Private Securities Litigation Reform Act of 1995. Any statements herein that are not statements of historical fact are forward-looking statements. Words such as “may,” “will,” “could,” “would,” “can,” “should,” “anticipate,” “expect,” “intend,” “believe,” “estimate,” “project,” “continue,” “forecast,” “likely,” “potential,” “seek,” or the negatives of such terms, and similar expressions are intended to identify forward-looking statements. This Form 10-K includes, among others, forward-looking statements regarding:

- our business, product and platform strategies;
- our business outlook;
- the continuation of current industry trends towards customer and vendor consolidation, and the impact of such consolidation;
- prior and future acquisitions, including the expected benefits and risks of completed acquisitions;
- the impact of macroeconomic conditions on our business and our customers’ businesses;
- demand for our products and our customers’ products;
- the expected realization of our backlog;
- customer license renewals;
- the completion of development of our unfinished products, or further development or integration of our existing products;
- technological trends in integrated circuit design;
- our ability to successfully compete in the markets in which we serve;
- our license mix, our business model, and variability in our revenue;
- litigation;
- our ability to protect our intellectual property;
- our cash, cash equivalents and cash generated from operations;
- our available-for-sale securities; and
- our future liquidity requirements.

These statements are based on our current expectations about future events and involve certain known and unknown risks, uncertainties and other factors that could cause our actual results, time frames or achievements to differ materially from those expressed or implied in our forward-looking statements. Accordingly, we caution readers not to place undue reliance on these statements. Such risks and uncertainties include, among others, those listed in Part I, Item 1A, *Risk Factors* of this Form 10-K. The information included herein represents our estimates and assumptions as of the date of this filing. Unless required by law, we undertake no obligation to update publicly any forward-looking statements, or to update the reasons actual results could differ materially from those anticipated in these forward-looking statements, even if new information becomes available in the future. All subsequent written or oral forward-looking statements attributable to Synopsys, Inc. or persons acting on our behalf are expressly qualified in their entirety by these cautionary statements. Readers are urged to carefully review and consider the various disclosures made in this report and in other documents we file from time to time with the Securities and Exchange Commission (SEC) that attempt to advise interested parties of the risks and factors that may affect our business.

Fiscal Year End

Our fiscal year ends on the Saturday nearest to October 31 and consists of 52 weeks, with the exception that approximately every five years, we have a 53-week year. Fiscal 2018 was a 53-week year and ended on November 3, 2018. Fiscal 2017 and 2016 were 52-week years and ended on October 28, 2017 and October 29, 2016, respectively. Fiscal 2019 will be a 52-week year.

For presentation purposes, this Form 10-K refers to the closest calendar month end.

PART I

Item 1. *Business*

Company Overview

Synopsys, Inc. provides products and services used by designers across the entire silicon to software spectrum, from engineers creating advanced semiconductors to software developers seeking to ensure the security and quality of their code. We are a global leader in supplying the electronic design automation (EDA) software that engineers use to design and test integrated circuits (ICs), also known as chips. We also offer semiconductor intellectual property (IP) products, which are pre-designed circuits that engineers use as components of larger chip designs rather than designing those circuits themselves. We provide software and hardware used to validate the electronic systems that incorporate chips and the software that runs on them. To complement these offerings, we provide technical services and support to help our customers develop advanced chips and electronic systems. We are also a leading provider of software tools and services that improve the security and quality of software code in a wide variety of industries, including electronics, financial services, media, automotive, medicine, energy and industrials.

Corporate Information

We incorporated in 1986 in North Carolina and reincorporated in 1987 in Delaware. Our headquarters are located at 690 East Middlefield Road, Mountain View, California 94043, and our headquarters' telephone number is (650) 584-5000. We have approximately 120 offices worldwide.

Our annual and quarterly reports on Forms 10-K and 10-Q (including related filings in XBRL format), current reports on Form 8-K, and Proxy Statements relating to our annual meetings of stockholders (including any amendments to these reports, as well as filings made by our executive officers and directors) are available through the Investor Relations page of our website *(www.synopsys.com)* free of charge as soon as practicable after we file them with, or furnish them to, the SEC *(www.sec.gov)*. We use our Investor Relations page as a routine channel for distribution of important information, including news releases, investor presentations, and financial information. The contents of our website are not part of this Form 10-K.

Background

Recent years have seen a remarkable proliferation of consumer and wireless electronic products, particularly mobile devices. The growth of the Internet and cloud computing has provided people with new ways to create, store and share information. At the same time, the increasing use of electronics in cars, buildings, appliances and other consumer products is creating a connected landscape of "smart" devices. Numerous software applications (apps) have been developed to expand the potential of these connected devices. The increasing viability of artificial intelligence and machine learning is driving an increase in the activity of new and existing chip design companies around the world.

These developments have been fueled by innovation in the semiconductor and software industries. It is common for a single chip to combine many components (processor, communications, memory, custom logic, input/output) and embedded software into a single system-on-chip (SoC), necessitating highly complex chip designs. The most complex chips today contain more than a billion transistors. Transistors are the basic building blocks for ICs, each of which may have features that are less than 1/1,000th the diameter of a human hair. At such small dimensions, the wavelength of light itself can become an obstacle to production, proving too big to create such dense features and requiring creative and complicated new approaches from designers. Designers have turned to new manufacturing techniques to solve these problems, such as multiple-patterning lithography and FinFET transistors, which in turn have introduced new challenges to design and production.

The popularity of mobile devices and other electronic products has increased demand for chips and systems with greater functionality and performance, reduced size, and lower power consumption. Our customers are the designers of those products and are facing intense pressure to deliver innovative products in shorter timeframes and at lower prices. In other words, innovation in chip and system design often hinges on providing products "better," "sooner," and "cheaper" than competitors. The designs of these chips and systems are extremely complex and necessitate state-of-the-art design solutions.

A similar dynamic is at work in the software arena, where the pace of innovation often requires developers—also our customers—to deliver more secure, high-quality software, which can include millions of lines of code, in increasingly frequent release cycles. Bugs, defects, and security vulnerabilities in code can be difficult to detect and expensive to fix. But, at a time when software is prevalent in many industries across a growing array of smart devices, it is crucial to have high-quality, secure code to ensure consumers' privacy and safety.

Our Role—The Silicon to Software™ Partner

Synopsys' products and services enable innovators across a variety of markets—from mobile electronics and finance to media, medical, energy, industrial, and automotive—to develop smart and secure products and applications. Across all industries, our customers face tremendous pressure to build differentiated chips and develop robust code more quickly and cost-effectively than ever before. With the increasing amount of embedded software in today's devices, security and quality are top concerns. Synopsys technologies and services are designed to help our customers—both hardware designers and software developers—to speed time to market, achieve the highest quality of results, mitigate risk, and maximize profitability. Our offerings span from silicon to software.

The task of the chip and system designer is to determine how best to design, locate, and connect the building blocks of chips, and to verify that the resulting design behaves as intended and can be manufactured efficiently and cost-effectively. This task is a complex, multi-step process that is both expensive and time-consuming. We offer a wide range of products that help designers at different steps in the overall design process, both for the design of individual ICs and for the design of larger systems. Our products can increase designer productivity and efficiency by automating tasks, keeping track of large amounts of design data, adding intelligence to the design process, facilitating reuse of past designs and reducing errors. Our IP products offer proven, high-quality pre-configured circuits that are ready-to-use in a chip design, saving customers time and enabling them to direct resources to features that differentiate their products. Our global service and support engineers also provide expert technical support and design assistance to our customers.

The task of the software developer is to write code that not only accomplishes the developer's goal as efficiently as possible, but also runs securely and is free of defects. We offer products that can help developers write higher quality, more secure code by analyzing their code for quality defects and known security vulnerabilities, adding intelligence and automation to the software testing process, and helping to eliminate defects in a systematic manner. To the extent that developers make use of open source software in their code, our products can help developers better manage the composition and security of the code. Our products enable software developers to catch flaws earlier in the development cycle, when they are less costly to fix.

Products and Services

Revenue from our products and services is categorized into four groups:

- Core EDA, which includes digital, custom and Field Programmable Gate Array (FPGA) IC design and verification products;
- IP, Systems and Software Integrity, which includes our DesignWare® IP portfolio, system-level products, and software security and quality testing solutions;
- Manufacturing Solutions; and
- Professional Services and Other.

Core EDA

The process of designing ICs contains many complex steps: architecture definition, register transfer level (RTL) design, functional/RTL verification, logic design or synthesis, gate-level verification, floorplanning, and place and route, to name just a few. Designers use our Core EDA products to automate the IC design process and to reduce errors. We offer a platform that features a large number of Core EDA products intended to address the process comprehensively. Our Core EDA products generally fall into the following categories:

- Digital, custom and FPGA IC design, which includes software tools to design an IC; and
- Verification, which includes technology to verify that an IC design behaves as intended.

Digital and Custom IC Design

Our Fusion Design Platform™ provides customers with a comprehensive digital design implementation solution that includes industry-leading products and incorporates common libraries and consistent timing, delay calculation, UPF power intent descriptions, and constraints throughout the design process. The Fusion Design Platform, which was launched in the fall of 2018, redefines conventional design tool boundaries to deliver a more integrated flow than ever before, with better quality of results and time to results. The platform gives designers the flexibility to integrate internally developed and third-party tools. With innovative technologies, a common foundation, and flexibility, our Fusion Design Platform helps reduce design times, decrease uncertainties in the design steps, and minimize the risks inherent in advanced, complex IC design. The platform supports multiple technology nodes, including most advanced technology nodes such as 16/14nm, 12nm, 10nm, and 7/8nm, with technology collaborations at 5nm and below.

Key design products, available as part of the Fusion Design Platform, include Design Compiler® logic synthesis, IC Compiler™ II physical design, Fusion Compiler™ RTL to GDSII design implementation, PrimeTime® static timing analysis, StarRC™ parasitic extraction, Ansys RedHawk fusion rail analysis, and IC Validator physical verification.

Our Custom Design Platform™ is a unified suite of design and verification tools that accelerates the development of robust custom and AMS designs. Anchored by the Custom Compiler custom design environment, the platform features industry-leading circuit simulation performance, a fast, easy-to-use custom layout editor complemented with best-in-class technologies for parasitic extraction, reliability analysis, and physical verification. Key features of the Custom Design Platform include reliability-aware verification, visually-assisted layout automation, extraction fusion, and DRC fusion technologies. The platform supports multiple technology nodes, including most advanced technology nodes such as 16/14nm, 12nm, 10nm, and 7/8nm.

Our Custom Design Platform is based on the OpenAccess database and includes open APIs for third-party tool integration. Platform tools include HSPICE® and FineSim® SPICE circuit simulators, CustomSim™ FastSPICE, Custom Compiler layout and schematic editor, StarRC parasitic extraction, and IC Validator physical verification.

FPGA Design

FPGAs are complex chips that can be customized or programmed to perform a specific function after they are manufactured. For FPGA design, we offer Synplify® (Pro® and Premier) implementation and Identify® debug software tools.

Verification

Our Verification Continuum™ platform is built from our industry-leading and fastest verification technologies, providing virtual prototyping, static and formal verification, simulation, emulation, FPGA-based prototyping, and debug in a unified environment with verification IP and planning and coverage technology. By providing a consistent model and debug environment across the flow of verification tasks and by enabling seamless transitions between simulation, emulation, and prototyping, the platform helps our customers accelerate hardware verification, bring up software earlier, and get to market sooner with advanced SoCs.

The individual products included in the Verification Continuum platform are reported in our Core EDA and IP, Systems & Software Integrity revenue categories. The solutions reported in our Core EDA revenue include the following:

- SpyGlass® family of static verification technologies including lint, CDC (clock domain crossing), RDC (reset domain crossing), DFT (design for test), and low-power analysis and verification;
- VCS® functional verification solution, our comprehensive RTL and gate-level simulation technology, including Fine-Grained Parallelism (FGP);
- Verdi® debug technology, the industry's most compressive SoC debug;
- VC Formal, our next-generation formal verification product;
- Verdi Coverage, our verification planning and coverage technology;

- ZeBu® emulation systems, which use high-performance hardware to emulate SoC designs so that designers can accelerate verification of large complex SoCs and perform earlier verification of the SoC together with software; and
- Other principal individual verification solutions, including CustomSim™ FastSPICE and FineSim® SPICE/FastSPICE circuit simulation and analysis products, HSPICE® circuit simulator, and CustomExplorer™ Ultra mixed-signal regression and analysis environment.

The verification IP, virtual prototyping and FPGA-based prototyping solutions that are part of our Verification Continuum platform are included in our IP, Systems & Software Integrity category and further described below.

IP, Systems and Software Integrity

IP Products

As more functionality converges into a single device or even a single chip, and as chip designs grow more complex, the number of third-party IP blocks incorporated into designs is rapidly increasing. We are a leading provider of high-quality, silicon-proven IP solutions for SoCs. Our broad DesignWare IP portfolio includes:

- High-quality solutions for widely used wired and wireless interfaces such as USB, PCI Express, DDR, Ethernet, SATA, MIPI, HDMI, and Bluetooth Low Energy;
- Logic libraries and embedded memories, including memory compilers, non-volatile memory, standard cells, and integrated test and repair;
- Processor solutions, including configurable ARC® processor cores, software, Embedded Vision processor cores and application-specific instruction-set processor (ASIP) tools for embedded applications;
- IP subsystems for audio, sensor, and data fusion functionality that combine IP blocks, an efficient processor, and software into an integrated, pre-verified subsystem;
- Security IP solutions, including cryptographic cores and software, security subsystems, platform security and content protection IP;
- Analog IP including data converters and audio codecs; and
- SoC infrastructure IP, datapath and building block IP, mathematical and floating point components, ARM® AMBA® interconnect fabric and peripherals, and verification IP.

Our IP Accelerated initiative augments our established, broad portfolio of silicon-proven DesignWare IP with IP Prototyping Kits and customized IP subsystems to accelerate prototyping, software development, and integration of IP into SoCs.

We also offer a broad portfolio of IP that has been optimized to address specific application requirements for the mobile, automotive, digital home, internet of things, and cloud computing markets, enabling designers to quickly develop SoCs in these areas.

Our Verification IP portfolio, part of our Verification Continuum platform, is also part of the IP Products category.

System-Level Solutions

Our System-Level verification solutions include the following elements of our Verification Continuum platform:

- HAPS® FPGA-based prototyping systems, which provide design and verification teams with an integrated and scalable hardware-software solution for early software development and to improve their SoC schedules;
- Virtualizer™ virtual prototyping solutions, which address the increasing development challenges associated with software-rich semiconductor and electronic products by accelerating both the development and deployment of virtual prototypes; and

- Platform Architect solution, which provides architects and system designers with tools and efficient methods for early analysis and optimization of multi-core SoC architectures for performance and power.

We also provide a series of tools used in the design of optical systems and photonic devices. Our CODE V® solution enables engineers to model, analyze and optimize designs for optical imaging and communication systems. Our LightTools® design and analysis software allows designers to simulate and improve the performance of a broad range of illumination systems, from vehicle lighting to projector systems.

Software Integrity Solutions

Our Software Integrity platform is a comprehensive solution for building integrity—security and quality—into our customers' software development lifecycle and supply chain. These testing tools, services and programs enable our customers to manage open source license compliance and detect and remediate security vulnerabilities and defects across their entire software development lifecycle. Our offerings include security testing, managed services, programs and professional services, and training.

Key products in the security, quality and compliance testing space include:

- Coverity® static analysis tools (including regular critical updates), which analyze software code to find crash-causing bugs, incorrect program behavior, the latest security vulnerabilities, memory leaks and other performance-degrading flaws;

- Defensics® fuzz testing tools, which examine security vulnerabilities in software binaries and libraries, particularly network protocols and file formats, by systematically sending invalid or unexpected inputs to the system under test;

- Black Duck™ software composition analysis tools, which scan binary and source code for license issues and other known security vulnerabilities stemming from incorporated third-party and open source code; and

- Seeker® IAST tool, which identifies exploitable security vulnerabilities while web applications are running, thereby verifying results and eliminating false positives.

Managed Services allow developers to test code across many dimensions, and to rapidly respond to changing testing requirements and evolving threats. This includes Mobile AST services to find vulnerabilities in mobile applications as well as DAST services which identify security vulnerabilities while web applications are running, without the need for source code.

Programs and Professional Services address unique security and quality needs with specialized consulting by skilled experts, including the Building Security in Maturity Mode (BSIMM), which measures the effectiveness of software security initiatives by assessing the current state as compared to industry benchmarks.

Finally, training includes eLearning and instructor-led training that prepares developers and security professionals to build security and quality into their software development process and remediate found vulnerabilities and defects.

Manufacturing Solutions

Our Manufacturing Solutions software products and technologies enable semiconductor manufacturers to more quickly develop new fabrication processes that produce production-level yields. These products are used in the early research and development phase, as well as in the production phase, where designers use these products to help convert IC design layouts into the masks used to manufacture the devices.

Our Manufacturing Solutions include Sentaurus™ technology computer-aided design (TCAD) device and process simulation products, Proteus™ mask synthesis tools, CATS® mask data preparation software, Yield Explorer® Odyssey, and Yield-Manager® yield management solutions.

Professional Services and Other

We provide consulting and design services that address all phases of the SoC development process. These services assist our customers with new tool and methodology adoption, chip architecture and specification development, functional and low-power design and verification, and physical implementation and signoff. We also provide a broad range of expert training and workshops on our latest tools and methodologies. Professional services related to the security and quality of the software embedded on the chip or elsewhere are included in the Software Integrity Solutions category and further described above.

Customer Service and Technical Support

A high level of customer service and support is critical to the adoption and successful use of our products. We provide technical support for our products through both field-based and corporate-based application engineering teams. Customers that purchase Technology Subscription Licenses (TSLs) receive post-contract customer support bundled with their license fee. Customers that purchase perpetual licenses may purchase these services separately, as further described in *Product Sales and Licensing Agreements* below.

Post-contract customer support includes providing frequent updates and upgrades to maintain the utility of the software due to rapid changes in technology. Post-contract customer support for our EDA and IP products also includes access to the SolvNet® portal, where customers can explore our complete design knowledge database. Updated daily, the SolvNet portal includes technical documentation, design tips, and answers to user questions. Customers can also engage, for additional charges, with our worldwide network of applications consultants for additional support needs.

In addition, we offer training workshops designed to increase customer design proficiency and productivity with our products. Workshops cover our EDA products and methodologies used in our design and verification flows, as well as specialized modules addressing system design, logic design, physical design, simulation and testing. We offer regularly scheduled public and private courses in a variety of locations worldwide, as well as online training (live or on-demand) through our Virtual Classrooms.

Product Warranties

We generally warrant our products to be free from defects in media and to substantially conform to material specifications for a period of 90 days for our software products and for up to 6 months for our hardware products. In many cases, we also provide our customers with limited indemnification with respect to claims that their use of our software products infringes on United States patents, copyrights, trademarks or trade secrets. We have not experienced material warranty or indemnity claims to date.

Support for Industry Standards

We actively create and support standards that help our EDA and IP customers increase productivity, facilitate efficient design flows, improve interoperability of tools from different vendors, and ensure connectivity, functionality and interoperability of IP building blocks. Standards in the electronic design industry can be established by formal accredited organizations, industry consortia, company licensing made available to all, de facto usage, or through open source licensing.

Synopsys' EDA products support many standards, including the most commonly used hardware description languages: SystemVerilog, Verilog, VHDL, and SystemC®. Our products utilize numerous industry-standard data formats, APIs, and databases for the exchange of design data among our tools, other EDA vendors' products, and applications that customers develop internally. We also comply with a wide range of industry standards within our IP product family to ensure usability and interconnectivity.

Our Software Integrity solutions support several existing and emerging industry standards for software coding and security, such as the Motor Industry Software Reliability Association (MISRA) coding standards for the automotive industry. In addition, our products support multiple major programming languages, including C/C++, Objective C, C#, JavaScript (including many commonly used frameworks), and others. In addition, we support many common compilers, development environments, frameworks, and data and file formats.

Sales, Distribution and Backlog

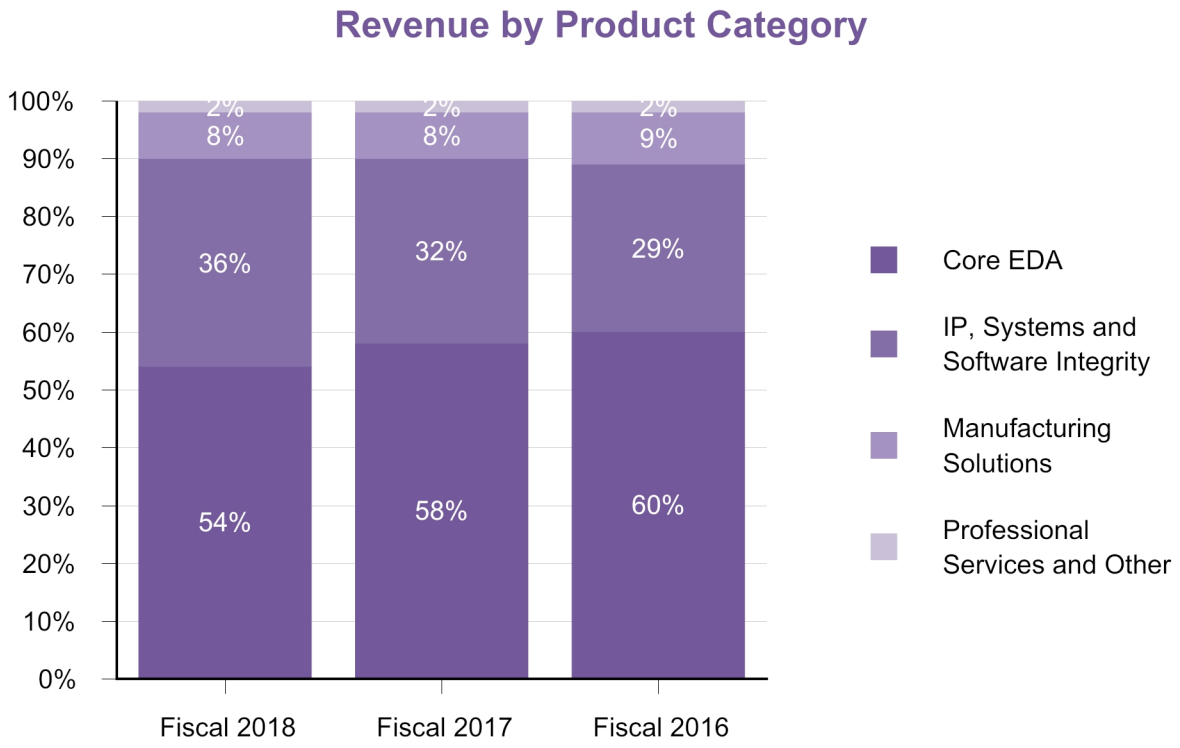
Our EDA and IP customers are primarily semiconductor and electronics systems companies. The customers for our Software Integrity solutions include many of these companies as well as companies from a wider array of industries, including electronics, financial services, media, automotive, medicine, energy and industrials. We market our products and services principally through direct sales in the United States and our principal foreign markets. We typically distribute our software products and documentation to customers electronically, but provide physical media (e.g., DVD-ROMs) when requested by the customer.

We maintain sales and support centers throughout the United States. Outside the United States, we maintain sales, support or service offices in Canada, multiple countries in Europe, Israel and multiple countries in Asia, including Japan, China, Korea, and Taiwan. Our international headquarters are located in Dublin, Ireland. Our offices are further described under Part I, Item 2, *Properties.*

Information relating to domestic and foreign operations, including revenue and long-lived assets by geographic area, is contained in Note 13 of *Notes to Consolidated Financial Statements* in Part II, Item 8, *Financial Statements and Supplementary Data*. Risks related to our foreign operations are described in Part I, Item 1A, *Risk Factors*.

Our backlog was approximately $4.0 billion on October 31, 2018, an increase from backlog of $3.7 billion on October 31, 2017, resulting primarily from the timing of large multi-year contract renewals. Backlog represents committed orders that are expected to be recognized as revenue over the following three years. We currently expect that $1.7 billion of our backlog will be recognized after fiscal 2019. Backlog may not be a reliable predictor of our future sales as business conditions may change and technologies may evolve, and customers may seek to renegotiate their arrangements or may default on their payment obligations. For this and other reasons, we may not be able to recognize expected revenue from backlog when anticipated.

Revenue attributable to each of our four product categories is shown below as a percentage of total revenue for the last three fiscal years.



Aggregate revenue derived from Intel Corporation and its subsidiaries through multiple agreements accounted for 15.4%, 17.9% and 15.9% of our total revenue in fiscal 2018, 2017 and 2016, respectively. No other customer accounted for more than 10% of our revenue during such periods.

Product Sales and Licensing Agreements

We typically license our software to customers under non-exclusive license agreements that restrict use of our software to specified purposes within specified geographical areas. The majority of our licenses are network licenses that allow a number of individual users to access the software on a defined network, including, in some cases, regional or global networks. License fees depend on the type of license, product mix and number of copies of each product licensed.

In a number of cases, we provide our customers the right to “re-mix” a portion of the software they initially licensed for other specified Synopsys products. For example, a customer may use our front-end design products for a portion of the license term and then exchange such products for back-end place-and-route software for the remainder of the term in order to complete the customer’s IC design. This practice helps ensure the customer’s access to the complete design flow needed to design their product. Offering remix rights to customers gives us an advantage over competitors who offer a narrower range of products because customers can obtain more of their design flow from a single vendor. At the same time—because in such cases the customer does not need to obtain a new license and pay an additional license fee for the use of the additional products—the use of these arrangements could result in reduced revenue compared to licensing the individual products separately without re-mix rights.

We currently offer our software products under, primarily, two license types: TSLs and perpetual licenses. For a full discussion of these types of licenses, see Part II, Item 7, *Management’s Discussion and Analysis of Financial Condition and Results of Operations—Critical Accounting Policies and Estimates* and *Results of Operations—Revenue Background*.

We typically license our DesignWare IP products under nonexclusive license agreements that provide usage rights for specific applications. Fees under these licenses are typically charged on a per design basis plus, in some cases, royalties. Royalty arrangements are not material to our total revenue.

Our hardware products, which principally consist of our prototyping and emulation systems, are either sold or leased to our customers. Our professional services team typically provides design consulting services to our customers under consulting agreements with statements of work specific to each project.

Competition

The EDA industry is highly competitive. We compete against other EDA vendors and against our customers' own design tools and internal design capabilities. In general, we compete principally on technology leadership, product quality and features (including ease-of-use), license terms, price and payment terms, post-contract customer support, flexibility of tool use, and interoperability with our own and other vendors' products. We also deliver a significant amount of engineering and design consulting for our products. No single factor drives an EDA customer's buying decision, and we compete on all fronts to capture a higher portion of our customers' budgets. Our competitors include EDA vendors that offer varying ranges of products and services, such as Cadence Design Systems, Inc. and Mentor Graphics Corporation (now part of Siemens AG). We also compete with other EDA vendors, including new entrants to the marketplace, that offer products focused on one or more discrete phases of the IC design process, as well as with customers' internally developed design tools and capabilities.

In the area of IP products, we compete against numerous other IP providers, including Cadence Design Systems, Inc., and our customers' internally developed IP. We generally compete on the basis of product quality, reliability and features, ease of integration with customer designs, compatibility with design tools, license terms, price and payment terms, and customer support.

In the area of Software Integrity solutions, we compete with numerous other solution providers, many of which focus on specific aspects of software security or quality analysis. We also compete with frequent new entrants, which include start-up companies and more established software companies. For example, competitors named in the Gartner Magic Quadrant for Application Security Testing include Checkmarx Ltd., International Business Machines Corporation, Micro Focus International plc, and Veracode (acquired by Thoma Bravo, LLC).

Proprietary Rights

We primarily rely upon a combination of copyright, patent, trademark, and trade secret laws and license and non-disclosure agreements to establish and protect our proprietary rights. We have a diversified portfolio of more than 3,100 United States and foreign patents issued, and we will continue to pursue additional patents in the future. Our issued patents have expiration dates through 2037. Our patents primarily relate to our products and the technology used in connection with our products. Our source code is protected both as a trade secret and as an unpublished copyrighted work. However, third parties may independently develop similar technology. In addition, effective copyright and trade secret protection may be unavailable or limited in some foreign countries. While protecting our proprietary technology is important to our success, our business as a whole is not significantly dependent upon any single patent, copyright, trademark, or license.

In many cases, under our customer agreements and other license agreements, we offer to indemnify our customers if the licensed products infringe on a third party's intellectual property rights. As a result, we may from time to time need to defend claims that our customers' use of our products infringes on these third-party rights. We license software and other intellectual property from third parties, including, in several instances, for inclusion in our products. Risks related to our use of third-party technology are described in Part I, Item 1A, *Risk Factors*.

Employees

As of October 31, 2018, Synopsys had 13,245 employees, of which 4,679 were based in the United States.

Executive Officers of the Registrant

The executive officers of Synopsys and their ages as of December 14, 2018 were as follows:

Name	Age	Position
Aart J. de Geus	64	Co-Chief Executive Officer and Chairman of the Board of Directors
Chi-Foon Chan	69	Co-Chief Executive Officer and President
Trac Pham	49	Chief Financial Officer
Joseph W. Logan	59	Sales and Corporate Marketing Officer
John F. Runkel, Jr.	63	General Counsel and Corporate Secretary

Aart J. de Geus co-founded Synopsys and has served as Chairman of our Board of Directors since February 1998 and Chief Executive Officer since January 1994. He has served as Co-Chief Executive Officer with Dr. Chi-Foon Chan since May 2012. Since the inception of Synopsys in December 1986, Dr. de Geus has held a variety of positions, including President, Senior Vice President of Engineering and Senior Vice President of Marketing. He has served as a member of Synopsys' Board of Directors since 1986, and served as Chairman of our Board from 1986 to 1992 and again from 1998 until present. Dr. de Geus has also served on the board of directors of Applied Materials, Inc. since July 2007. Dr. de Geus holds an M.S.E.E. from the Swiss Federal Institute of Technology in Lausanne, Switzerland and a Ph.D. in Electrical Engineering from Southern Methodist University.

Chi-Foon Chan has served as our Co-Chief Executive Officer since May 2012 and as our President and a member of our Board of Directors since February 1998. Prior to his appointment as our Co-Chief Executive Officer in May 2012, he had served as our Chief Operating Officer since April 1997. Dr. Chan joined Synopsys in May 1990 and has held various senior management positions, including Executive Vice President, Office of the President from September 1996 to February 1998 and Senior Vice President, Design Tools Group from February 1994 to April 1997. Dr. Chan has also held senior management and engineering positions at NEC Electronics and Intel Corporation. Dr. Chan holds a B.S. in Electrical Engineering from Rutgers University, and an M.S. and a Ph.D. in Computer Engineering from Case Western Reserve University.

Trac Pham is our Chief Financial Officer. Mr. Pham joined Synopsys in November 2006 as Vice President, Financial Planning and Strategy. He became our Vice President, Corporate Finance, in August 2012, assuming additional responsibility for our tax and treasury functions, before being appointed Chief Financial Officer in December 2014. Mr. Pham holds a Bachelor of Arts in Economics from the University of California, Berkeley and an MPIA (Master of Pacific International Affairs) from the University of California, San Diego. He is an active status California CPA.

Joseph W. Logan serves as our Sales and Corporate Marketing Officer. He became Senior Vice President of Worldwide Sales in September 2006, and assumed responsibility for our Corporate Marketing organization in August 2013. Previously, Mr. Logan was head of sales for Synopsys' North America East region from September 2001 to September 2006. Prior to Synopsys, Mr. Logan was head of North American Sales and Support at Avant! Corporation. Mr. Logan holds a B.S.E.E. from the University of Massachusetts, Amherst.

John F. Runkel, Jr. has served as our General Counsel and Corporate Secretary since May 2014. From October 2008 to March 2013, he was Executive Vice President, General Counsel, and Corporate Secretary of Affymetrix, Inc. He served as Senior Vice President, General Counsel and Corporate Secretary of Intuitive Surgical, Inc. from 2006 to 2007. Mr. Runkel served in several roles at VISX, Inc. from 2001 to 2005, most recently as Senior Vice President of Business Development and General Counsel. Mr. Runkel was also a partner at the law firm of Sheppard, Mullin, Richter & Hampton LLP for 11 years. He holds a Bachelor of Arts and a Juris Doctorate from the University of California, Los Angeles.

There are no family relationships among any Synopsys executive officers or directors.

Item 1A. *Risk Factors*

A description of the risk factors associated with our business is set forth below. Investors should carefully consider these risks and uncertainties before investing in our common stock.

The growth of our business depends primarily on the semiconductor and electronics industries.

The growth of the electronic design automation (EDA) industry as a whole, our EDA and intellectual property (IP) product sales, and to some extent our Software Integrity Solutions sales, is dependent on the semiconductor and electronics industries. A substantial portion of our business and revenue depends upon the commencement of new design projects by semiconductor manufacturers and their customers. The increasing complexity of designs of systems-on-chips and integrated circuits, and customers' concerns about managing costs, have previously led and in the future could lead to a decrease in design starts and design activity in general, with some customers focusing more on one discrete phase of the design process or opting for less advanced, but less risky, manufacturing processes that may not require the most advanced EDA products. Demand for our products and services could decrease and our financial condition and results of operations could be adversely affected if growth in the semiconductor and electronics industries slows or stalls. Additionally, as the EDA industry matures, consolidation may result in stronger competition from companies better able to compete as sole source vendors. This increased competition may cause our revenue growth rate to decline and exert downward pressure on our operating margins, which may have an adverse effect on our business and financial condition.

Furthermore, the semiconductor and electronics industries have become increasingly complex ecosystems. Many of our customers outsource the manufacture of their semiconductor designs to foundries. Our customers also frequently incorporate third-party IP, whether provided by us or other vendors, into their designs to improve the efficiency of their design process. We work closely with major foundries to ensure that our EDA, IP, and manufacturing solutions are compatible with their manufacturing processes. Similarly, we work closely with other major providers of semiconductor IP, particularly microprocessor IP, to optimize our EDA tools for use with their IP designs and to assure that their IP and our own IP products, which may each provide for the design of separate components on the same chip, work effectively together. If we fail to optimize our EDA and IP solutions for use with major foundries' manufacturing processes or major IP providers' products, or if our access to such foundry processes or third-party IP products is hampered, then our solutions may become less desirable to our customers, resulting in an adverse effect on our business and financial condition.

Consolidation among our customers and within the industries in which we operate, as well as our dependence on a relatively small number of large customers, may negatively impact our operating results.

A number of business combinations, including mergers, asset acquisitions and strategic partnerships, among our customers in the semiconductor and electronics industries have occurred over the last several years, and more could occur in the future. Consolidation among our customers could lead to fewer customers or the loss of customers, increased customer bargaining power, or reduced customer spending on software and services. Furthermore, we depend on a relatively small number of large customers, and on such customers continuing to renew licenses and purchase additional products from us, for a large portion of our revenue. Reduced customer spending or the loss of a small number of customers, particularly our large customers, could adversely affect our business and financial condition. In addition, we and our competitors from time to time acquire businesses and technologies to complement and expand our respective product offerings. If any of our competitors consolidate or acquire businesses and technologies which we do not offer, they may be able to offer a larger technology portfolio, additional support and service capability, or lower prices, which could negatively impact our business and operating results.

Uncertainty in the global economy, and its potential impact on the semiconductor and electronics industries in particular, may negatively affect our business, operating results and financial condition.

While the global economy has shown improvement in recent years, there are still uncertainties surrounding the strength of the recovery in many regions. Uncertainty caused by challenging global economic conditions could lead some of our customers to postpone their decision-making, decrease their spending and/or delay their payments to us. Such caution by customers could, among other things, limit our ability to maintain or increase our sales or recognize revenue from committed contracts.

We cannot predict the stability of the economy as a whole or the industries in which we operate. Further economic instability could adversely affect the banking and financial services industry and result in credit downgrades of the

banks we rely on for foreign currency forward contracts, credit and banking transactions, and deposit services, or cause them to default on their obligations. There is uncertainty regarding how proposed, contemplated or future changes to the complex laws and regulations governing our industry, the banking and financial services industry, and the economy could affect our business. In addition, economic conditions could deteriorate in the future, and, in particular, the semiconductor and electronics industries could fail to grow, including as the result of any disruption of international trade relationships. In the event of future improvements in economic conditions for our customers, the positive impact on our revenues and financial results may be deferred due to our business model. Any of the foregoing could cause adverse effects on our business, operating results and financial condition, and could cause our stock price to decline.

Our operating results may fluctuate in the future, which may adversely affect our stock price.

Our operating results are subject to quarterly and annual fluctuations, which may adversely affect our stock price. Our historical results should not be viewed as indicative of our future performance due to these periodic fluctuations.

Many factors may cause our revenue or earnings to fluctuate, including:

- Changes in demand for our products—especially products, such as hardware, generating upfront revenue—due to fluctuations in demand for our customers' products and due to constraints in our customers' budgets for research and development and EDA products and services;
- Product competition in the EDA industry, which can change rapidly due to industry or customer consolidation and technological innovation;
- Our ability to innovate and introduce new products and services or effectively integrate products and technologies that we acquire;
- Failures or delays in completing sales due to our lengthy sales cycle, which often includes a substantial customer evaluation and approval process because of the complexity of our products and services;
- Our ability to implement effective cost control measures;
- Our dependence on a relatively small number of large customers, and on such customers continuing to renew licenses and purchase additional products from us, for a large portion of our revenue;
- Changes to the amount, composition and valuation of, and any impairments to or write-offs of, our inventory;
- Changes in the mix of our products sold, as increased sales of our products with lower gross margins, such as our hardware products, may reduce our overall margins;
- Expenses related to our acquisition and integration of businesses and technology;
- Changes in tax rules, as well as changes to our effective tax rate, including the tax effects of infrequent or unusual transactions and tax audit settlements;
- Delays, increased costs or quality issues resulting from our reliance on third parties to manufacture our hardware products, which includes a sole supplier for certain hardware components;
- General economic and political conditions that affect the semiconductor and electronics industries, such as disruptions to international trade relationships, including tariffs, export licenses, or other trade barriers affecting our or our suppliers' products; and
- Changes in accounting standards, such as Topic 606, as discussed in Note 14 of *Notes to Consolidated Financial Statements*, which, for example, could impact the expected realization of our backlog.

The timing of revenue recognition may also cause our revenue and earnings to fluctuate. The timing of revenue recognition is affected by factors that include:

- Cancellations or changes in levels of orders or the mix between upfront products revenue and time-based products revenue;
- Delay of one or more orders for a particular period, particularly orders generating upfront products revenue, such as hardware;
- Delay in the completion of professional services projects that require significant modification or customization and are accounted for using the percentage of completion method;
- Delay in the completion and delivery of IP products in development as to which customers have paid for early access;

- Customer contract amendments or renewals that provide discounts or defer revenue to later periods;
- The levels of our hardware revenues, which are recognized upfront and are primarily dependent upon our ability to provide the latest technology and meet customer requirements, and which may also impact our levels of excess and obsolete inventory expenses;
- Changes in accounting standards, such as Topic 606, as discussed in Note 14 of *Notes to Consolidated Financial Statements*; and
- Changes in our revenue recognition model.

These factors, or any other factors or risks discussed herein, could negatively impact our revenue or earnings and cause our stock price to decline. Additionally, our results may fail to meet or exceed the expectations of securities analysts and investors, or such analysts may change their recommendation regarding our stock, which could cause our stock price to decline. Our stock price has been, and may continue to be, volatile, which may make it more difficult for our stockholders to sell their shares at a time or a price that is favorable to them.

We operate in highly competitive industries, and if we do not continue to meet our customers' demand for innovative technology at lower costs, our products may become uncompetitive and obsolete, and our business and financial condition may be harmed.

We compete against EDA vendors that offer a variety of products and services, such as Cadence Design Systems, Inc. and Mentor Graphics Corporation (now part of Siemens AG). We also compete with other EDA vendors, including new entrants to the marketplace, that offer products focused on one or more discrete phases of the IC design process. Moreover, our customers internally develop design tools and capabilities that compete with our products, including internal designs that compete with our IP products.

In the area of IP products, we compete against numerous other IP providers as well as our customers' internally developed IP. In the area of software integrity solutions, we compete with numerous other solution providers, many of which focus on specific aspects of software security or quality analysis. We also compete with frequent new entrants, which include start-up companies and more established software companies.

The industries in which we operate are highly competitive and the demand for our products and services is dynamic and depends on a number of factors, including demand for our customers' products, design starts and our customers' budgetary constraints. Technology in these industries evolves rapidly and is characterized by frequent product introductions and improvements as well as changes in industry standards and customer requirements. Semiconductor device functionality requirements continually increase while feature widths decrease, substantially increasing the complexity, cost and risk of chip design and manufacturing. At the same time, our customers and potential customers continue to demand an overall lower total cost of design, which can lead to the consolidation of their purchases with one vendor. In order to succeed in this environment, we must successfully meet our customers' technology requirements and increase the value of our products, while also striving to reduce their overall costs and our own operating costs.

We compete principally on the basis of technology, product quality and features (including ease-of-use), license or usage terms, post-contract customer support, interoperability among products, and price and payment terms. Specifically, we believe the following competitive factors affect our success:

- Our ability to anticipate and lead critical development cycles and technological shifts, innovate rapidly and efficiently, improve our existing products, and successfully develop or acquire new products;
- Our ability to offer products that provide both a high level of integration into a comprehensive platform and a high level of individual product performance;
- Our ability to enhance the value of our offerings through more favorable terms such as expanded license usage, future purchase rights, price discounts and other differentiating rights, such as multiple tool copies, post-contract customer support, "re-mix" rights that allow customers to exchange the software they initially licensed for other Synopsys products, and the ability to purchase pools of technology;
- Our ability to compete on the basis of payment terms; and
- Our ability to provide engineering and design consulting for our products.

If we fail to successfully manage these competitive factors, fail to successfully balance the conflicting demands for innovative technology and lower overall costs, or fail to address new competitive forces, our business and financial condition will be adversely affected.

The global nature of our operations exposes us to increased risks and compliance obligations that may adversely affect our business.

We derive roughly half of our revenue from sales outside the United States, and we expect our orders and revenue to continue to depend on sales to customers outside the U.S. In addition, we have continually expanded our non-U.S. operations in the past several years. This strategy requires us to recruit and retain qualified technical and managerial employees, manage multiple remote locations performing complex software development projects and ensure intellectual property protection outside of the U.S. Our international operations and sales subject us to a number of increased risks, including:

- Ineffective or weaker legal protection of intellectual property rights;
- Uncertain economic and political conditions in countries where we do business;
- Difficulties in adapting to cultural differences in the conduct of business, which may include business practices in which we are prohibited from engaging by the Foreign Corrupt Practices Act or other anti-corruption laws;
- Financial risks such as longer payment cycles and difficulty in collecting accounts receivable;
- Inadequate local infrastructure that could result in business disruptions;
- Government trade restrictions, including tariffs, export licenses, or other trade barriers, and changes to existing trade arrangements between various countries;
- Additional taxes, interest, and potential penalties, and uncertainty around changes in tax laws of various countries; and
- Other factors beyond our control such as natural disasters, terrorism, civil unrest, war and infectious diseases.

As our business volume increases in the Asia Pacific region, there is inherent risk, based on the complex relationships between certain Asian countries and the United States, that political, diplomatic, or military events could result in trade disruptions, including tariffs, trade embargoes, and other trade barriers. A significant trade disruption or the establishment or increase of any trade barrier in any area where we do business could increase the cost of our products, which could adversely impact the margin that we earn on sales; make our products more expensive for customers, which could make our products less competitive and reduce consumer demand; adversely restrict or delay our suppliers of hardware components and products, which could adversely impact our future revenues and financial results; or otherwise have a materially adverse impact on our future revenue and profits, our and our customers' and suppliers' businesses, and our results of operations. Furthermore, if any of the foreign economies in which we do business deteriorate or if we fail to effectively manage our global operations, our business and results of operations will be harmed.

In response to U.S. tariffs, other countries may adopt tariffs and other trade barriers that could limit our ability to offer our products and services. Additionally, political uncertainty surrounding international trade disputes could have a negative impact on consumer confidence and spending, which could adversely impact our business operations.

In addition to tariffs and other trade barriers, our global operations are subject to numerous U.S. and foreign laws and regulations, including those related to anti-corruption, tax, corporate governance, imports and exports, financial and other disclosures, privacy and labor relations. These laws and regulations are complex and may have differing or conflicting legal standards, making compliance difficult and costly. In addition, there is uncertainty regarding how proposed, contemplated or future changes to these complex laws and regulations could affect our business. We may incur substantial expense in complying with the new obligations to be imposed by these laws and regulations, and we may be required to make significant changes in our business operations, all of which may adversely affect our revenues and our business overall. If we violate these laws and regulations we could be subject to fines, penalties or criminal sanctions, and may be prohibited from conducting business in one or more countries. Although we have implemented policies and procedures to help ensure compliance with these laws and regulations, there can be no assurance that our employees, contractors, agents or partners will not violate such laws and regulations. Any violation individually or in the aggregate could have a material adverse effect on our operations and financial condition.

Our financial results are also affected by fluctuations in foreign currency exchange rates. A weakening U.S. dollar relative to other currencies increases expenses of our foreign subsidiaries when they are translated into U.S. dollars in our consolidated statement of operations. Likewise, a strengthening U.S. dollar relative to other currencies, especially the Japanese Yen, reduces revenue of our foreign subsidiaries upon translation and consolidation.

Exchange rates are subject to significant and rapid fluctuations, and therefore we cannot predict the prospective impact of exchange rate fluctuations. Although we engage in foreign currency hedging activity, we may be unable to hedge all of our foreign currency risk, which could have a negative impact on our results of operations.

Cybersecurity threats or other security breaches could compromise sensitive information belonging to us or our customers and could harm our business and our reputation, particularly that of our security testing solutions.

We store sensitive data, including intellectual property, our proprietary business information and that of our customers, and confidential employee information, in our data centers and on our networks. Despite our security measures, our information technology and infrastructure may be vulnerable to attacks by hackers or breached due to employee error, malfeasance or other disruptions that could result in unauthorized disclosure or loss of sensitive information.

For example, in October 2015, we discovered unauthorized third-party access, which had begun in July 2015, to our products and product license files hosted on our SolvNet customer license and product delivery system. We determined that no customer project or design data had been accessed. No personally identifiable information or payment card information is stored on the system. While we identified and closed the method used to gain access, it is possible that our security measures may be circumvented again in the future, and such a breach could harm our business and reputation. The techniques used to obtain unauthorized access to networks, or to sabotage systems, change frequently and generally are not recognized until launched against a target. We may be unable to anticipate these techniques or to implement adequate preventative measures. Furthermore, in the operation of our business we also use third-party vendors that store certain sensitive data, including confidential information about our employees, and these third parties are subject to their own cybersecurity threats. While our standard vendor terms and conditions include provisions requiring the use of appropriate security measures to prevent unauthorized use or disclosure of our data, as well as other safeguards, a breach may still occur. Any security breach of our own or a third-party vendor's systems could cause us to be non-compliant with applicable laws or regulations, subject us to legal claims or proceedings, disrupt our operations, damage our reputation, and cause a loss of confidence in our products and services, any of which could adversely affect our business.

Our software products, including our hosted solutions as well as our software security and quality testing solutions, may also be vulnerable to cyber attack. An attack could disrupt the proper functioning of our software, cause errors in the output of our customers' work, allow unauthorized access to our or our customers' proprietary information, and other destructive outcomes. As a result, our reputation could suffer, customers could stop buying our products, we could face lawsuits and potential liability, and our financial performance could be negatively impacted.

We offer software security and quality testing solutions. If we fail to identify new and increasingly sophisticated methods of cyber attack, or fail to invest sufficient resources in research and development regarding new threat vectors, our security testing products and services may fail to detect vulnerabilities in our customers' software code. An actual or perceived failure to identify security flaws may harm the perceived reliability of our security testing products and services, and could result in a loss of customers or sales, or an increased cost to remedy a problem. Furthermore, our growth and recent acquisitions in the software security and quality testing space may increase our visibility as a security-focused company and may make us a more attractive target for attacks on our own information technology infrastructure. Successful attacks could damage our reputation as a security-focused company.

If we fail to protect our proprietary technology, our business will be harmed.

Our success depends in part upon protecting our proprietary technology. Our efforts to protect our technology may be costly and unsuccessful. We rely on agreements with customers, employees and other third-parties as well as intellectual property laws worldwide to protect our proprietary technology. These agreements may be breached, and we may not have adequate remedies for any breach. Additionally, despite our measures to prevent piracy, other parties may attempt to illegally copy or use our products, which could result in lost revenue. Some foreign countries do not currently provide effective legal protection for intellectual property and our ability to prevent the unauthorized use of our products in those countries is therefore limited. Our trade secrets may also be stolen, otherwise become known, or be independently developed by competitors.

We may need to commence litigation or other legal proceedings in order to:

- Assert claims of infringement of our intellectual property;
- Defend our products from piracy;

- Protect our trade secrets or know-how; or
- Determine the enforceability, scope and validity of the propriety rights of others.

If we do not obtain or maintain appropriate patent, copyright or trade secret protection, for any reason, or cannot fully defend our intellectual property rights in certain jurisdictions, our business and operating results would be harmed. In addition, intellectual property litigation is lengthy, expensive and uncertain. Legal fees related to such litigation will increase our operating expenses and may reduce our net income.

We may not be able to realize the potential financial or strategic benefits of the acquisitions we complete, or find suitable target businesses and technology to acquire, which could hurt our ability to grow our business, develop new products or sell our products.

Acquisitions are an important part of our growth strategy. We have completed a significant number of acquisitions in recent years. We expect to make additional acquisitions in the future, but we may not find suitable acquisition targets or we may not be able to consummate desired acquisitions due to unfavorable credit markets, commercially unacceptable terms, or other risks, which could harm our operating results. Acquisitions are difficult, time-consuming, and pose a number of risks, including:

- Potential negative impact on our earnings per share;
- Failure of acquired products to achieve projected sales;
- Problems in integrating the acquired products with our products;
- Difficulties entering into new markets in which we are not experienced or where competitors may have stronger positions;
- Potential downward pressure on operating margins due to lower operating margins of acquired businesses, increased headcount costs and other expenses associated with adding and supporting new products;
- Difficulties in retaining and integrating key employees;
- Substantial reductions of our cash resources and/or the incurrence of debt;
- Failure to realize expected synergies or cost savings;
- Difficulties in integrating or expanding sales, marketing and distribution functions and administrative systems, including information technology and human resources systems;
- Dilution of our current stockholders through the issuance of common stock as part of the merger consideration;
- Assumption of unknown liabilities, including tax and litigation, and the related expenses and diversion of resources;
- Disruption of ongoing business operations, including diversion of management's attention and uncertainty for employees and customers, particularly during the post-acquisition integration process;
- Potential negative impacts on our relationships with customers, distributors and business partners;
- Exposure to new operational risks, regulations, and business customs to the extent acquired businesses are located in regions where we are not currently conducting business;
- The need to implement controls, processes and policies appropriate for a public company at acquired companies that may have lacked such controls, processes and policies;
- Negative impact on our net income resulting from acquisition-related costs; and
- Requirements imposed by government regulators in connection with their review of an acquisition, including required divestitures or restrictions on the conduct of our business or the acquired business.

If we do not manage the foregoing risks, the acquisitions that we complete may have an adverse effect on our business and financial condition.

We pursue new product and technology initiatives from time to time, and if we fail to successfully carry out these initiatives, our business, financial condition, or results of operations could be adversely impacted.

As part of the evolution of our business, we have made substantial investments to develop new products and enhancements to existing products through our acquisitions and research and development efforts. If we are unable to anticipate technological changes in our industry by introducing new or enhanced products in a timely and cost-effective manner, or if we fail to introduce products that meet market demand, we may lose our competitive position, our products may become obsolete, and our business, financial condition or results of operations could be adversely affected.

Additionally, from time to time, we invest in expansion into adjacent markets, including software security and quality solutions. Although we believe these solutions are complementary to our EDA tools, we have less experience and a more limited operating history in offering software quality, testing, and security products and services, and our efforts in this area may not be successful. Our success in these new markets depends on a variety of factors, including the following:

- Our ability to attract a new customer base, including in industries in which we have less experience;
- Our successful development of new sales and marketing strategies to meet customer requirements;
- Our ability to accurately predict, prepare for, and promptly respond to technological developments in new fields, including, in the case of our software quality, testing, and security tools and services, identifying new security vulnerabilities in software code and ensuring support for a growing number of programming languages;
- Our ability to compete with new and existing competitors in these new industries, many of which may have more financial resources, industry experience, brand recognition, relevant intellectual property rights, or established customer relationships than we currently do, and could include free and open source solutions that provide similar software quality, testing, and security tools without fees;
- Our ability to skillfully balance our investment in adjacent markets with investment in our existing products and services;
- Our ability to attract and retain employees with expertise in new fields;
- Our ability to sell and support consulting services at profitable margins; and
- Our ability to manage our revenue model in connection with hybrid sales of licensed products and consulting services.

Difficulties in any of our new product development efforts or our efforts to enter adjacent markets could adversely affect our operating results and financial condition.

We may have to invest more resources in research and development than anticipated, which could increase our operating expenses and negatively affect our operating results.

We devote substantial resources to research and development. New competitors, technological advances in the semiconductor industry or by competitors, our acquisitions, our entry into new markets, or other competitive factors may require us to invest significantly greater resources than we anticipate. If we are required to invest significantly greater resources than anticipated without a corresponding increase in revenue, our operating results could decline. Additionally, our periodic research and development expenses may be independent of our level of revenue, which could negatively impact our financial results. Finally, there can be no guarantee that our research and development investments will result in products that create additional revenue.

Our hardware products, which primarily consist of prototyping and emulation systems, subject us to distinct risks.

The growth in sales of our hardware products subjects us to several risks, including:

- Increased dependence on a sole supplier for certain hardware components, which may reduce our control over product quality and pricing and may lead to delays in production and delivery of our hardware products, should our supplier fail to deliver sufficient quantities of acceptable components in a timely fashion;
- Increasingly variable revenue and decreasingly accurate revenue forecasts, due to fluctuations in hardware revenue, which is recognized upfront upon shipment, as opposed to most sales of software products for which revenue is recognized over time;
- Overall reductions in margins, as the gross margin for our hardware products is typically lower than those of our software products;
- Longer sales cycles, which create risks of insufficient, excess or obsolete inventory and variations in inventory valuation, which can adversely affect our operating results;
- Decreases or delays in customer purchases in favor of next-generation releases, which may lead to excess or obsolete inventory or require us to discount our older hardware products; and
- Longer warranty periods than those of our software products, which may require us to replace hardware components under warranty, thus increasing our costs.

Changes in United States Generally Accepted Accounting Principles (U.S. GAAP) could adversely affect our financial results and may require significant changes to our internal accounting systems and processes.

We prepare our consolidated financial statements in conformity with U.S. GAAP. These principles are subject to interpretation by the Financial Accounting Standards Board (FASB), the Securities and Exchange Commission (SEC) and various bodies formed to interpret and create appropriate accounting principles and guidance.

The FASB periodically issues new accounting standards on a variety of topics, including, for example, revenue recognition and accounting for leases. For information regarding new accounting standards, please refer to Note 14 of *Notes to Consolidated Financial Statements* under the heading "Effect of New Accounting Pronouncements." These and other such standards generally result in different accounting principles, which may significantly impact our reported results or could result in variability of our financial results. For example, the recent new revenue recognition standard will be applicable to us beginning in fiscal 2019 and could lead to increased volatility in our total revenue, as some of our revenue may be recognized in different periods and with less predictability than is the case under current accounting standards.

Our results could be adversely affected by a change in our effective tax rate as a result of tax law changes and related new or revised guidance and regulations, changes in our geographical earnings mix, unfavorable government reviews of our tax returns, material differences between our forecasted and actual annual effective tax rates, future changes to our tax structure, or by evolving enforcement practices.

Our operations are subject to income and transaction taxes in the United States and in multiple foreign jurisdictions, with a significant amount of our foreign earnings generated by our subsidiaries organized in Ireland and Hungary. Because we have a wide range of statutory tax rates in the multiple jurisdictions in which we operate, any changes in our geographical earnings mix, including those resulting from our intercompany transfer pricing or from changes in the rules governing transfer pricing, could materially impact our effective tax rate. Furthermore, a change in the tax law of the jurisdictions where we do business, including an increase in tax rates or an adverse change in the treatment of an item of income or expense, could result in a material increase in our tax expense and impact our financial position and cash flows.

On December 22, 2017, the President of the United States signed into law the Tax Cuts and Jobs Act (Tax Act), which significantly changed prior U.S. tax law and includes numerous provisions that affect our business in the current year and future years. Accounting for certain of these provisions requires the exercise of significant judgment. As regulations and guidance evolve with respect to the Tax Act, and as we gather more information and perform more analysis, our results may materially differ from previous estimates, and those differences may materially affect our financial position. In addition, the Tax Act includes certain new provisions that will affect our income from foreign operations beginning in fiscal 2019, as well as a lower corporate tax rate on income from domestic operations. Because guidance continues to evolve, however, the net impact of these changes is uncertain, and while we believe such changes will have an overall favorable impact on our effective tax rate, certain interpretations of the international provisions of the Tax Act could adversely affect our tax rate and cash flow in future years.

In fiscal 2018, we incurred foreign taxes of $67.7 million as a result of reorganizing certain rights related to use of our intellectual property in our international business. Such tax was recorded as a prepaid tax on our balance sheet, in accordance with current accounting rules. The amount of tax is subject to audit by the Hungarian Tax Authority (HTA) and could increase, along with the imposition of penalties and interest, and could materially affect our financial results and cash flow.

Further changes in the tax laws of foreign jurisdictions could arise as a result of the base erosion and profit shifting (BEPS) project undertaken by the Organisation for Economic Co-operation and Development (OECD), which represents a coalition of member countries. On October 5, 2015, the OECD issued a series of reports recommending changes to numerous long-standing tax principles. Many of these recommendations are being adopted by various countries in which we do business and may increase our taxes in these countries. Changes to these and other areas in relation to international tax reform, including future actions taken by foreign governments in response to the Tax Act, could increase uncertainty and may adversely affect our tax rate and cash flow in future years.

Our income and non-income tax filings are subject to review or audit by the Internal Revenue Service and state, local and foreign taxing authorities. We are currently under examination by the tax authorities in a number of jurisdictions. We exercise significant judgment in determining our worldwide provision for income taxes and, in the ordinary course of our business, there may be transactions and calculations where the ultimate tax determination is

uncertain. For example, we may be liable for additional withholding tax on payments made to us by customers in certain jurisdictions, and we may also be liable for potential tax liabilities of businesses we acquire, including future taxes payable related to the transition tax on earnings from their foreign operations, if any, under the Tax Act. Although we believe our tax estimates are reasonable, the final determination in an audit may be materially different than the treatment reflected in our historical income tax provisions and accruals. An assessment of additional taxes because of an audit could adversely affect our income tax provision and net income in the periods for which that determination is made.

In July 2017, the HTA issued a final assessment against our Hungarian subsidiary (Synopsys Hungary) for fiscal years 2011 through 2013. The HTA has disallowed Synopsys Hungary's tax positions taken during those years regarding the timing of the deduction of research expenses and applied withholding taxes on certain payments made to affiliates, resulting in an aggregate tax assessment of approximately $44.5 million and interest and penalties of $18.0 million. We paid the tax assessments, penalties and interest in the first quarter of fiscal 2018 as required by law and recorded these amounts as prepaid taxes on our balance sheet. We continue to appeal the assessment through the Hungarian Administrative Court. If the assessment is ultimately canceled, the Hungarian statutory accounting treatment could have an indirect adverse impact on certain tax benefits in the year of the cancellation. For further discussion of the Hungary audit, see Note 11 of *Notes to Consolidated Financial Statements* under the heading "Non-US Examinations."

We maintain significant deferred tax assets related to certain tax credits. Our ability to use these credits is dependent upon having sufficient future taxable income in the relevant jurisdiction and in the case of foreign tax credits, how such credits are treated under provisions of the Tax Act. Changes in our forecasts of future income could result in an adjustment to the deferred tax asset and a related charge to earnings that could materially affect our financial results.

Liquidity requirements in our U.S. operations may require us to raise cash in uncertain capital markets, which could negatively affect our financial condition.

As of October 31, 2018, approximately 75% of our worldwide cash and cash equivalents balance is held by our international subsidiaries. We intend to meet our U.S. cash spending needs, including the Tax Act provisional transition tax, primarily through our existing U.S. cash balances, ongoing U.S. cash flows, and available credit under our term loan and revolving credit facilities. Should our cash spending needs in the U.S. rise and exceed these liquidity sources, we may be required to incur additional debt at higher than anticipated interest rates or access other funding sources, which could negatively affect our results of operations, capital structure or the market price of our common stock.

From time to time we are subject to claims that our products infringe on third-party intellectual property rights.

We are from time to time subject to claims alleging our infringement of third-party intellectual property rights, including patent rights. Under our customer agreements and other license agreements, we agree in many cases to indemnify our customers if our products infringe a third party’s intellectual property rights. Infringement claims can result in costly and time-consuming litigation, require us to enter into royalty arrangements, subject us to damages or injunctions restricting our sale of products, invalidate a patent or family of patents, require us to refund license fees to our customers or to forgo future payments or require us to redesign certain of our products, any one of which could harm our business and operating results.

For example, we were engaged in complex patent litigation with Mentor Graphics Corporation (Mentor) involving several actions in different forums. In June 2018, we settled all outstanding patent litigation with Mentor for a $65.0 million payment made in the third quarter of fiscal 2018 to Siemens, which previously acquired Mentor in March 2017. Further information regarding the lawsuits and settlement are contained in Part I, Item 3, *Legal Proceedings* and Note 7 of *Notes to Consolidated Financial Statements* under the heading “Legal Proceedings.” In conjunction with the settlement, we also amended an existing interoperability agreement with Mentor to collaborate on a wide range of EDA products. The amendment includes a one-time termination charge between $0.0 and $25.0 million, payable to Mentor under certain conditions. In the event such conditions are met, the termination charge could have an adverse effect on our operating results.

We may be subject to litigation proceedings that could harm our business.

We may be subject to legal claims or regulatory matters involving stockholder, consumer, employment, customer, supplier, competition, and other issues on a global basis. Litigation is subject to inherent uncertainties, and unfavorable rulings could occur. An unfavorable ruling could include monetary damages or, in cases for which injunctive relief is sought, an injunction prohibiting us from manufacturing or selling one or more products. If we were to receive an unfavorable ruling on a matter, our business and results of operations could be materially harmed. Further information regarding certain of these matters is contained in Part I, Item 3, *Legal Proceedings*.

Product errors or defects could expose us to liability and harm our reputation and we could lose market share.

Software products frequently contain errors or defects, especially when first introduced, when new versions are released, or when integrated with technologies developed by acquired companies. Product errors, including those resulting from third-party suppliers, could affect the performance or interoperability of our products, could delay the development or release of new products or new versions of products and could adversely affect market acceptance or perception of our products. In addition, allegations of manufacturability issues resulting from use of our IP products could, even if untrue, adversely affect our reputation and our customers' willingness to license IP products from us. Any such errors or delays in releasing new products or new versions of products or allegations of unsatisfactory performance could cause us to lose customers, increase our service costs, subject us to liability for damages and divert our resources from other tasks, any one of which could materially and adversely affect our business and operating results.

We may not be able to continue to obtain licenses to third-party software and intellectual property on reasonable terms or at all, which may disrupt our business and harm our financial results.

We license third-party software and other intellectual property for use in product research and development and, in several instances, for inclusion in our products. We also license third-party software, including the software of our competitors, to test the interoperability of our products with other industry products and in connection with our professional services. These licenses may need to be renegotiated or renewed from time to time, or we may need to obtain new licenses in the future. Third parties may stop adequately supporting or maintaining their technology, or they or their technology may be acquired by our competitors. If we are unable to obtain licenses to these third-party software and intellectual property on reasonable terms or at all, we may not be able to sell the affected products, our customers' use of the products may be interrupted, or our product development processes and professional services offerings may be disrupted, which could in turn harm our financial results, our customers, and our reputation.

The inclusion of third-party intellectual property in our products can also subject us and our customers to infringement claims. Although we seek to mitigate this risk contractually, we may not be able to sufficiently limit our potential liability. Regardless of outcome, infringement claims may require us to use significant resources and may divert management's attention.

Some of our products and technology, including those we acquire, may include software licensed under open source licenses. Some open source licenses could require us, under certain circumstances, to make available or grant licenses to any modifications or derivative works we create based on the open source software. Although we have tools and processes to monitor and restrict our use of open source software, the risks associated with open source usage may not be eliminated and may, if not properly addressed, result in unanticipated obligations that harm our business.

If we fail to timely recruit and retain senior management and key employees, our business may be harmed.

We depend in large part upon the services of key members of our senior management team to drive our future success. If we were to lose the services of any member of our senior management team, our business could be adversely affected. To be successful, we must also attract and retain key technical, sales and managerial employees, including those who join us in connection with acquisitions. There are a limited number of qualified EDA and IC design engineers, and competition for these individuals is intense and has increased. Our employees are often recruited aggressively by our competitors and our customers. Any failure to recruit and retain key technical, sales and managerial employees could harm our business, results of operations and financial condition. Additionally, efforts to recruit and retain qualified employees could be costly and negatively impact our operating expenses.

We issue equity awards from employee equity plans as a key component of our overall compensation. We face pressure to limit the use of such equity-based compensation due to its dilutive effect on stockholders. If we are unable to grant attractive equity-based packages in the future, it could limit our ability to attract and retain key employees.

Our business is subject to evolving corporate governance and public disclosure regulations that have increased both our compliance costs and the risk of noncompliance, which could have an adverse effect on our stock price.

We are subject to changing rules and regulations promulgated by a number of governmental and self-regulatory organizations, including the SEC, the Nasdaq Stock Market, and the FASB. These rules and regulations continue to evolve in scope and complexity and many new requirements have been created in response to laws enacted by Congress, making compliance more difficult and uncertain. For example, our efforts to comply with the Dodd-Frank Wall Street Reform and Consumer Protection Act and other regulations, including "conflict minerals" regulations affecting our hardware products, have resulted in, and are likely to continue to result in, increased general and administrative expenses and a diversion of management time and attention from revenue-generating activities to compliance activities.

There are inherent limitations on the effectiveness of our controls and compliance programs.

Regardless of how well designed and operated it is, a control system can provide only reasonable assurance that its objectives will be met. Further, the design of a control system must reflect the fact that there are resource constraints, and the benefits of controls must be considered relative to their costs. Because of the inherent limitations in all control systems, no evaluation of controls can provide absolute assurance that all control issues and instances of fraud, if any, have been detected. Moreover, although we have implemented compliance programs and compliance training for employees, such measures may not prevent our employees, contractors or agents from breaching or circumventing our policies or violating applicable laws and regulations. Failure of our control systems and compliance programs to prevent error, fraud or violations of law could have a material adverse impact on our business.

Our investment portfolio may be impaired by any deterioration of capital markets.

From time to time, our cash equivalent and short-term investment portfolio consists of investment-grade U.S. government agency securities, asset-backed securities, corporate debt securities, commercial paper, certificates of deposit, money market funds, municipal securities and other securities, and bank deposits. Our investment portfolio carries both interest rate risk and credit risk. Fixed rate debt securities may have their market value adversely impacted due to a credit downgrade or a rise in interest rates, while floating rate securities may produce less income than expected if interest rates fall or a credit downgrade occurs. As a result of capital pressures on certain banks, especially in Europe, and the continuing low interest rate environment, some of our financial instruments may become impaired.

Our future investment income may fall short of expectations due to changes in interest rates or if the decline in fair value of investments held by us is judged to be other-than-temporary. In addition, we may suffer losses in principal if we are forced to sell securities that decline in market value due to changes in the issuer’s credit quality or changes in interest rates.

In preparing our financial statements we make certain assumptions, judgments and estimates that affect amounts reported in our consolidated financial statements, which, if not accurate, may significantly impact our financial results.

We make assumptions, judgments and estimates for a number of items, including the fair value of financial instruments, goodwill, long-lived assets and other intangible assets, the realizability of deferred tax assets, the recognition of revenue and the fair value of stock awards. We also make assumptions, judgments and estimates in determining the accruals for employee-related liabilities, including commissions and variable compensation, and in determining the accruals for uncertain tax positions, valuation allowances on deferred tax assets, allowances for doubtful accounts, and legal contingencies. These assumptions, judgments and estimates are drawn from historical experience and various other factors that we believe are reasonable under the circumstances as of the date of the consolidated financial statements. Actual results could differ materially from our estimates, and such differences could significantly impact our financial results.

Catastrophic events may disrupt our business and harm our operating results.

Due to the global nature of our business, our operating results may be negatively impacted by catastrophic events throughout the world. We rely on a global network of infrastructure applications, enterprise applications and technology systems for our development, marketing, operational, support and sales activities. A disruption or failure of these systems in the event of a major earthquake, fire, telecommunications failure, cybersecurity attack, terrorist attack, epidemic, or other catastrophic event could cause system interruptions, delays in our product development and loss of critical data and could prevent us from fulfilling our customers' orders. Moreover, our corporate headquarters, a significant portion of our research and development activities, our data centers, and certain other critical business operations are located in California, near major earthquake faults. A catastrophic event that results in the destruction or disruption of our data centers or our critical business or information technology systems would severely affect our ability to conduct normal business operations and, as a result, our operating results would be adversely affected.

Item 1B. *Unresolved Staff Comments*

None.

Item 2. *Properties*

Our principal offices are located in two adjacent buildings in Mountain View, California, which together provide approximately 341,000 square feet of available space. This space is leased through August 2030, and we have two options to extend the lease term, the first to extend the term by ten years, followed by a second option to extend by approximately nine additional years. We also lease approximately 238,000 square feet of space in three separate buildings in Sunnyvale, California, with lease expiration dates ranging from September 2019 to October 2019. We are in the process of consolidating the space in these three separate buildings into a single location in Sunnyvale, California in 2019. We own one building in Sunnyvale, California with approximately 120,000 square feet of space. These buildings in Mountain View and Sunnyvale are used for research and development, sales and support, marketing, and administrative activities.

We currently lease 33 other offices throughout the United States, and own 2 office buildings in Oregon, one of which is leased to a tenant. These offices are used primarily for sales and support activities as well as research and development.

International Facilities

We lease additional space for sales, service, and research and development activities in approximately 29 countries throughout the world, including 25,000 square feet in Dublin, Ireland for our international headquarters, as well as significant sites in Yerevan, Armenia, Bangalore, India, Shanghai and Wuhan, China. In addition, we own two buildings in Hsinchu, Taiwan with approximately 212,000 square feet of combined space.

We believe that our existing facilities, including both owned and leased properties, are in good condition and suitable for the current conduct of our business.

Item 3. *Legal Proceedings*

We are subject to routine legal proceedings, as well as demands, claims and threatened litigation that arise in the normal course of our business. The ultimate outcome of any litigation is often uncertain and unfavorable outcomes could have a negative impact on our results of operations and financial condition. Regardless of outcome, litigation can have an adverse impact on Synopsys because of the defense costs, diversion of management resources and other factors.

We regularly review the status of each significant matter and assess its potential financial exposure. If the potential loss from any claim or legal proceeding is considered probable and the amount is estimable, we accrue a liability for the estimated loss. Legal proceedings are inherently uncertain and as circumstances change, it is possible that the amount of any accrued liability may increase, decrease, or be eliminated.

Mentor Patent Litigation

Prior to the legal settlement as further described below, we were engaged in complex patent litigation with Mentor Graphics Corporation (Mentor) involving several actions in different forums. We succeeded to the litigation when we acquired Emulation & Verification Engineering S.A. on October 4, 2012.

Legal Settlement

In March 2017, Siemens PLM Software (Siemens) acquired Mentor. On June 29, 2018, Synopsys, Siemens and Mentor settled all outstanding patent litigation between Synopsys and Mentor for a $65.0 million payment made in the third quarter from Synopsys to Mentor. Synopsys had previously accrued $39.0 million and recorded the remaining $26.0 million as an expense in the quarter ended July 31, 2018. As a result of the settlement, the litigation with Mentor was dismissed and the injunction entered in connection with that litigation was vacated.

The settlement included mutual seven-year patent cross-licenses between Synopsys and Siemens, and between Synopsys and Mentor. Synopsys and Mentor also amended an existing interoperability agreement to collaborate on a wide range of EDA products for the benefit of their mutual customers. The amendment includes a one-time termination charge between $0.0 and $25.0 million, payable to Mentor under certain conditions.

Other Proceedings

In July 2017, the Hungarian Tax Authority (HTA) issued a final assessment against Synopsys' Hungarian subsidiary (Synopsys Hungary) for fiscal years 2011 through 2013. The HTA has disallowed Synopsys Hungary's tax positions taken during these years regarding the timing of the deduction of research expenses and applied withholding taxes on certain payments made to affiliates, resulting in an aggregate tax assessment of approximately $44.5 million and interest and penalties of $18.0 million. On August 2, 2017, Synopsys Hungary filed a claim contesting the final assessment with the Hungarian Administrative Court. On November 16, 2017, Synopsys Hungary paid the assessment as required by law, while continuing its challenge to the assessment in court. Hearings were held in February and July 2018, and Synopsys expects further hearings to be scheduled after the court’s expert submits an opinion relevant to the withholding tax issue in January 2019. On December 10, 2018, Synopsys withdrew its claim contesting the final assessment with regard to the timing of the deduction of research expenses.

For further discussion of the Hungary audit, see Note 11 of *Notes to Consolidated Financial Statements* under the heading "Non-US Examinations."

Item 4. *Mine Safety Disclosures*

Not applicable.

PART II

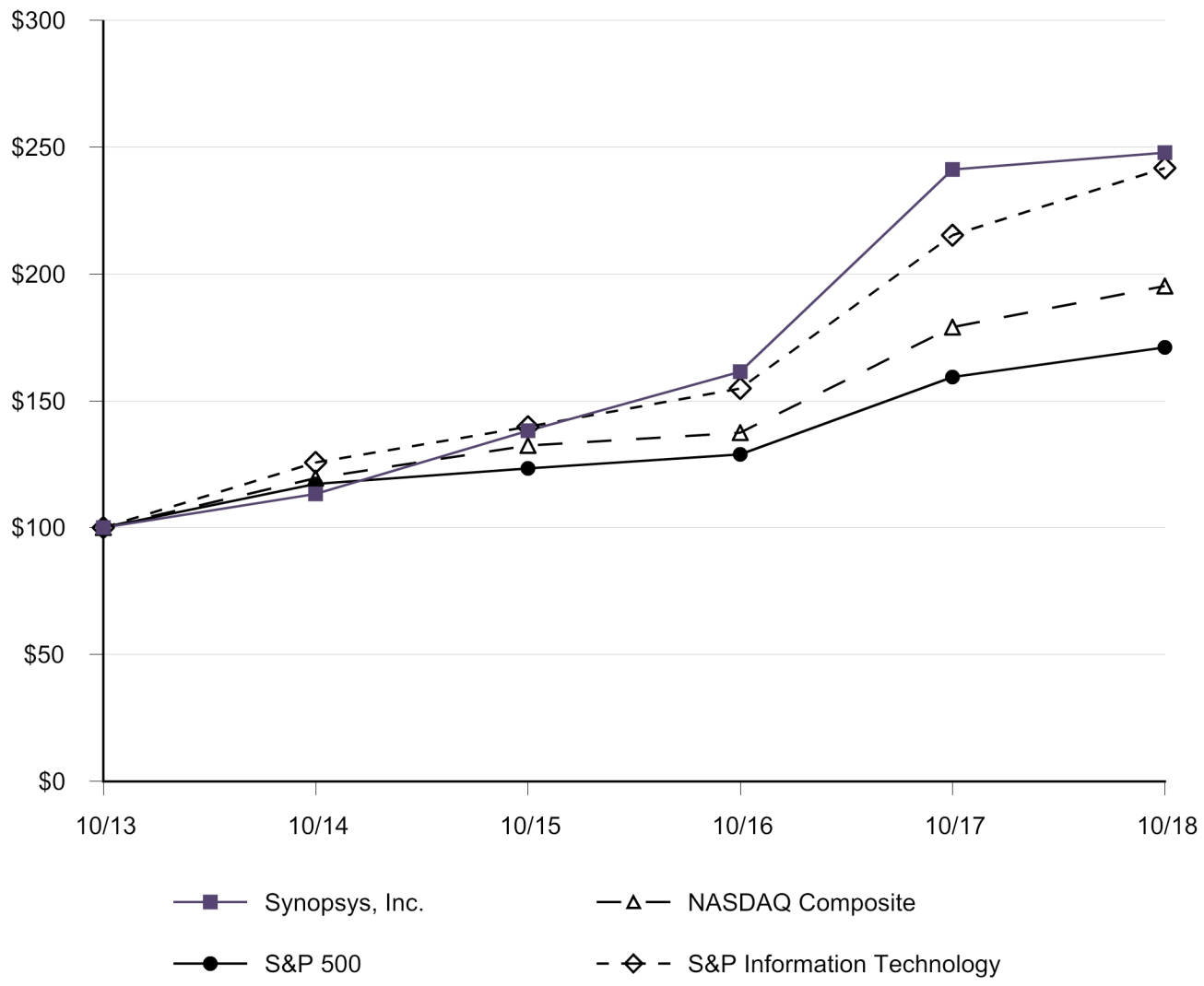
Item 5. *Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities*

Our common stock trades on the Nasdaq Global Select Market under the symbol "SNPS." As of December 12, 2018, we had 278 stockholders of record.

Performance Graph

The following graph compares the five-year total return to stockholders of our common stock relative to the cumulative total returns of the S&P 500 Index, the S&P Information Technology Index and the Nasdaq Composite Index. The graph assumes that $100 was invested in Synopsys common stock on October 31, 2013 (the last trading day before the beginning of our fifth preceding fiscal year) and in each of the indexes on October 31, 2013 (the closest month end) and that all dividends were reinvested. No cash dividends were declared on our common stock during such time. The comparisons in the table are not intended to forecast or be indicative of possible future performance of our common stock.

COMPARISON OF 5 YEAR CUMULATIVE TOTAL RETURN*



*$100 invested on October 31, 2013 in stock or index, including reinvestment of dividends.

The information presented above in the stock performance graph shall not be deemed to be “soliciting material” or to be “filed” with the SEC or subject to Regulation 14A or 14C, except to the extent that we subsequently specifically request that such information be treated as soliciting material or specifically incorporate it by reference into a filing under the Securities Act or Exchange Act.

Stock Repurchase Program

Our Board of Directors (Board) previously approved a stock repurchase program pursuant to which we were authorized to purchase up to $500.0 million of our common stock, and has periodically replenished the stock repurchase program to such amount. Our Board replenished the stock repurchase program up to $500.0 million on April 5, 2018. The program does not obligate us to acquire any particular amount of common stock, and the program may be suspended or terminated at any time by our Chief Financial Officer or our Board. We repurchase shares to offset dilution caused by ongoing stock issuances from existing equity plans for equity compensation awards and issuances related to acquisitions, and when management believes it is a good use of cash. Repurchases are transacted in accordance with Rule 10b-18 of the Securities Exchange Act of 1934, as amended (the Exchange Act) and may be made through any means including, but not limited to, open market purchases, plans executed under Rule 10b5-1(c) of the Exchange Act and structured transactions. As of October 31, 2018, $325.0 million remained available for further repurchases under the program.

In September 2017, we entered into an accelerated share repurchase agreement (the September 2017 ASR) to repurchase an aggregate of $100.0 million of our common stock. Pursuant to the September 2017 ASR, we made a prepayment of $100.0 million and received initial share deliveries valued at $80.0 million. The remaining balance of $20.0 million was settled in November 2017. Total shares repurchased under the September 2017 ASR were approximately 1.2 million shares, at an average purchase price of $83.80 per share.

In December 2017, we entered into two simultaneous accelerated share repurchase agreements (the December 2017 ASRs) to repurchase an aggregate of $200.0 million of our common stock. Pursuant to the December 2017 ASRs, we made a prepayment of $200.0 million and received initial share deliveries of shares valued at $160.0 million. In February 2018, we received additional deliveries of shares valued at $20.0 million for one of the two December 2017 ASRs. The remaining balance of $20.0 million was settled in March 2018. Total shares repurchased under the December 2017 ASRs were approximately 2.3 million shares, at an average purchase price of $87.08 per share.

In May 2018, we entered into an accelerated share repurchase agreement (the May 2018 ASR) to repurchase an aggregate of $165.0 million of our common stock. Pursuant to the May 2018 ASR, we made a prepayment of $165.0 million and received initial share deliveries valued at $132.0 million. The remaining balance of $33.0 million was settled in October 2018. Total shares repurchased under the May 2018 ASR were approximately 1.8 million shares, at an average purchase price of $92.42 per share.

The table below sets forth information regarding our repurchases of our common stock during the three months ended October 31, 2018:

Period	Total number of shares purchased (1)	Average price paid per share (1)	Total number of shares purchased as part of publicly announced programs	Maximum dollar value of shares that may yet be purchased under the programs
Month #1				
August 5, 2018 through September 8, 2018	—	$ —	—	$ 325,000,050
Month #2				
September 9, 2018 through October 6, 2018	—	$ —	—	$ 325,000,050
Month #3				
October 7, 2018 through November 3, 2018	276,755	$ 119.24	276,755	$ 325,000,050
Total	276,755	$ 119.24	276,755	$ 325,000,050

(1) Amounts are calculated based on the trade date.

See Note 9 of *Notes to Consolidated Financial Statements* for further information regarding our stock repurchase program.

Item 6. *Selected Financial Data*

	Fiscal Year Ended October 31,(1)				
	2018	2017	2016	2015	2014
	(in thousands, except per share data)				
Revenue	$ 3,121,058	$ 2,724,880	$ 2,422,532	$ 2,242,211	$ 2,057,472
Income before provisions for income taxes	363,543	383,098	329,548	281,610	272,142
Provision (benefit) for income taxes(2)	(68,975)	246,535	62,722	55,676	13,018
Net income	432,518	136,563	266,826	225,934	259,124
Net income per share:					
Basic	2.90	0.91	1.76	1.46	1.67
Diluted	2.82	0.88	1.73	1.43	1.64
Working capital (deficit)(3)	(558,618)	68,484	1,992	(109,546)	6,527
Total assets	6,145,974	5,396,414	5,240,365	5,045,739	4,775,499
Long-term debt	125,535	134,063	—	—	45,000
Stockholders' equity	3,485,015	3,279,724	3,195,146	3,133,989	3,056,170

(1) Our fiscal year ends on the Saturday nearest to October 31 and consists of 52 weeks, with the exception that approximately every five years, we have a 53-week year. Fiscal 2018 was a 53-week year and ended on November 3, 2018. Fiscal 2017, 2016, 2015, and 2014 were 52-week years ending on October 28, 2017, October 29, 2016, October 31, 2015, and November 1, 2014, respectively.

(2) Includes $14.7 million, $7.1 million, $16.5 million, $6.3 million, and $19.6 million in net tax benefits from tax settlements received in fiscal years 2018, 2017, 2016, 2015, and 2014, respectively. Fiscal 2018 additionally includes a $57.8 million net benefit from tax reform and tax restructuring. Fiscal 2017 additionally includes a $166.2 million expense from our repatriation of foreign earnings. See Note 11 of *Notes to Consolidated Financial Statements*.

(3) Includes reclassifications of deferred tax assets and liabilities for fiscal years 2014 through 2015 related to ASU 2015-17 "Income Taxes (Topic 740): Balance Sheet Classification of Deferred Taxes." See Note 11 of *Notes to Consolidated Financial Statements*.

Item 7. *Management's Discussion and Analysis of Financial Condition and Results of Operations*

Overview

The following summary of our financial condition and results of operations is qualified in its entirety by the more complete discussion contained in this Item 7 and by the risk factors set forth in Item 1A of this Form 10-K. Please also see the cautionary language at the beginning of Part I of this Form 10-K regarding forward-looking statements.

Business Summary

Synopsys, Inc. provides products and services used by designers across the entire silicon to software spectrum, from engineers creating advanced semiconductors to software developers seeking to ensure the security and quality of their code. We are a global leader in supplying the electronic design automation (EDA) software that engineers use to design and test integrated circuits (ICs), also known as chips. We also offer semiconductor intellectual property (IP) products, which are pre-designed circuits that engineers use as components of larger chip designs rather than designing those circuits themselves. We provide software and hardware used to validate the electronic systems that incorporate chips and the software that runs on them. To complement these offerings, we provide technical services and support to help our customers develop advanced chips and electronic systems. We

are also a leading provider of software tools and services that improve the security and quality of software code in a wide variety of industries, including electronics, financial services, media, automotive, medicine, energy and industrials.

Our EDA and IP customers are generally semiconductor and electronics systems companies. Our solutions help these companies overcome the challenges of developing increasingly advanced electronics products while also helping them reduce their design and manufacturing costs. While our products are an important part of our customers' development process, their research and development budget and spending decisions may be affected by their business outlook and willingness to invest in new and increasingly complex chip designs. In addition, a number of consolidations have taken place in the semiconductor industry over the past several years. While we do not believe customer consolidations have had a material impact on our results, the future impact of ongoing consolidation is uncertain. For a discussion of potential risks, please see the risk factor titled "Consolidation among our customers and within the industries in which we operate, as well as our dependence on a relatively small number of large customers, may negatively impact our operating results" in Part I, Item 1A. *Risk Factors*.

Despite global economic uncertainty, we have consistently grown our revenue since 2005. We achieved these results not only because of our solid execution, leading technologies and strong customer relationships, but also because of our time-based revenue business model. Under this model, a substantial majority of our customers pay over time and we typically recognize this revenue over the life of the contract, which averages approximately three years. Time-based revenue consists of time-based products, maintenance and service revenue. The revenue we recognize in a particular period generally results from selling efforts in prior periods rather than the current period. Due to our business model, decreases or increases in customer spending do not immediately affect our revenues in a significant way.

Our growth strategy is based on building on our leadership in our EDA products, expanding and proliferating our IP offerings, and driving growth in the software security and quality market. As we continue to expand our product portfolio and our total addressable market, for instance in the software security and quality space, and as hardware product sales grow, we expect to experience increased variability in our total revenue. In addition, due to our adoption of Topic 606 in fiscal 2019, as further described in Note 14 of *Notes to Consolidated Financial Statements*, the way in which we are required to account for certain types of arrangements will increase the variability in our total revenue from period to period. Nevertheless, this accounting impact will not affect our cash generation or change the way we operate our business. Based on our leading technologies, customer relationships, business model, diligent expense management, and acquisition strategy, we believe that we will continue to execute our strategies successfully.

Fiscal Year End

Our fiscal year ends on the Saturday nearest to October 31 and consists of 52 weeks, with the exception that approximately every five years, we have a 53-week year. Fiscal 2018 was a 53-week year and ended on November 3, 2018. Fiscal 2017 and 2016 were 52-week years ending on October 28, 2017 and October 29, 2016, respectively. Fiscal 2019 will be a 52-week year.

For presentation purposes, this Form 10-K refers to the closest calendar month end.

Fiscal 2018 Financial Performance Summary

In fiscal 2018, compared to fiscal 2017, our financial performance reflects the following:

- Revenues were $3.1 billion, an increase of $396.2 million or 15%, primarily driven by the overall growth in our business mainly due to higher TSL revenue, acquisitions, and professional services revenue. The increase also included additional revenue of approximately $46.0 million due to the extra week in fiscal 2018;
- Total cost of revenue and operating expenses were $2.8 billion, an increase of $383.5 million or 16%, primarily due to increases in headcount, including those from acquisitions. The increase also included one additional week of expenses of approximately $33.7 million;
- Higher operating income of $360.2 million, an increase of $12.7 million or 4%; and
- Benefit for income taxes of $69.0 million in fiscal 2018 compared to provision for income taxes of $246.5 million in fiscal 2017, primarily due to the expense recorded for repatriation in fiscal 2017,

compared to the benefit recorded for restructuring of foreign IP rights, and a decrease in the statutory federal corporate income tax rate in fiscal 2018.

Critical Accounting Policies and Estimates

Our discussion and analysis of our financial results under *Results of Operations* below are based on our audited results of operations, which we have prepared in accordance with U.S. GAAP. In preparing these financial statements, we make assumptions, judgments and estimates that can affect the reported amounts of assets, liabilities, revenues and expenses, and net income. On an ongoing basis, we evaluate our estimates based on historical experience and various other assumptions we believe are reasonable under the circumstances. Our actual results may differ from these estimates. For further information on our significant accounting policies, see Note 2 of *Notes to Consolidated Financial Statements*.

The accounting policies that most frequently require us to make assumptions, judgments and estimates, and therefore are critical to understanding our results of operations, are:

- Revenue recognition;
- Valuation of business combinations; and
- Income taxes.

Revenue Recognition

We generate our revenue from the sale of products that include software licenses and to a lesser extent, hardware products, maintenance and services. Time-based products revenue consists of fees associated with the licensing of our software. Maintenance and service revenue consists of maintenance fees associated with perpetual licenses and hardware products, and professional services fees. Upfront products revenue includes hardware revenue consisting of sales of Field Programmable Gate Array (FPGA)-based emulation and prototyping products and perpetual software licenses.

Most of our customer arrangements are complex, involving hundreds of products and various license rights, bundled with post-contract customer support and additional meaningful rights that provide a complete end-to-end solution to the customer. Throughout the contract, our customers are typically using a myriad of products to complete each phase of a chip design and are concurrently working on multiple chip designs, or projects, in different phases of the design. During this time, the customer looks to us to release state-of-the-art technology as we keep up with the pace of change, to address requested enhancements to our tools to meet customer specifications, to provide support at each stage of the customer's design, including the final manufacturing of the chip (the tape-out stage), and other important services.

With respect to software licenses, we primarily utilize two license types:

- *Technology Subscription Licenses (TSLs).* TSLs are time-based licenses for a finite term, and generally provide the customer with limited rights to receive, or to exchange certain quantities of licensed software for, unspecified future technology. The majority of our arrangements are TSLs due to the nature of the business and customer requirements. In addition to the licenses, the arrangements also include: post-contract customer support, which includes providing frequent updates and upgrades to maintain the utility of the software due to rapid changes in technology; other intertwined services such as multiple copies of the tools; assistance to our customers in applying our technology in their development environment; and rights to remix licenses for other licenses.
- *Perpetual licenses.* Perpetual licenses continue as long as the customer renews maintenance plus an additional 20 years. Perpetual licenses do not provide the customer any rights to receive, or to exchange licensed software for, unspecified future technology. Customers purchase maintenance separately for the first year and may renew annually.

For the two software license types, we recognize revenue as follows:

- *TSLs.* We typically recognize revenue from TSL fees ratably over the term of the license period, or as customer installments become due and payable, whichever is later. Revenue attributable to TSLs is reported as "time-based products revenue" in the consolidated statements of operations.
- *Perpetual licenses.* We recognize revenue from perpetual licenses in full upon shipment of the software if payment terms require the customer to pay at least 75% of the license fee and 100% of

the maintenance fee within one year from shipment and all other revenue recognition criteria are met. Revenue attributable to these perpetual licenses is reported as “upfront products revenue” in the consolidated statements of operations. For perpetual licenses in which less than 75% of the license fee and 100% of the maintenance fee is payable within one year from shipment, we recognize revenue as customer installments become due and payable. Such revenue is reported as “time-based products revenue” in the consolidated statements of operations.

Our maintenance and service revenue consists of maintenance fees associated with perpetual licenses and hardware products, and professional services fees. We recognize revenue from maintenance arrangements ratably over the maintenance period to the extent cash has been received or fees become due and payable, and recognize revenue from professional services and training fees as such services are performed and accepted by the customers as needed. Revenue attributable to maintenance, professional services and training is reported as “maintenance and service revenue” in the consolidated statements of operations.

Hardware revenue consists of sales of FPGA-based emulation and prototyping products. We recognize revenue from sales of hardware products in full upon shipment if all other revenue recognition criteria are met. Revenue attributable to these sales is reported as “upfront products revenue” in the consolidated statements of operations.

We also enter into arrangements in which portions of revenue are contingent upon the occurrence of uncertain future events, such as royalty arrangements. We refer to this revenue as “contingent revenue.” Contingent revenue is recognized if and when the event that removes the contingency occurs. Such revenue is reported as “time-based products revenue” in the consolidated statements of operations. These arrangements are not material to our total revenue.

We infrequently enter into multiple-element arrangements that contain both software and non-software deliverables such as hardware. We have determined that the software and non-software deliverables in our contracts are separate units of accounting. We recognize revenue for the separate units of accounting when all revenue recognition criteria are met. Revenue allocated to hardware units of accounting is recognized upon shipment when all other revenue recognition criteria are met. Revenue allocated to software units of accounting is recognized depending on the software license type (TSL or perpetual license). Such arrangements have not had a material effect on our consolidated financial statements and are not expected to have a material effect in future periods.

We also enter into arrangements to deliver software products, either alone or together with other products or services, that require significant modification or customization of the software. We account for such arrangements using the percentage of completion method as we have the ability to make reasonably dependable estimates that relate to the extent of progress toward completion, contract revenues and costs. We measure the progress towards completion using the labor hours incurred to complete the project. Revenue attributable to these arrangements is reported as "maintenance and service revenue" in the consolidated statements of operations.

We determine the fair value of each element in multiple element software arrangements that only contain software and software-related deliverables based on vendor-specific objective evidence (VSOE). We limit our assessment of VSOE of fair value for each element to the price charged when such element is sold separately. We have analyzed all of the elements included in our multiple-element software arrangements and have determined that we have sufficient VSOE to allocate revenue to the maintenance components of our perpetual license products and to professional services. Accordingly, assuming all other revenue recognition criteria are met, we recognize license revenue from perpetual licenses upon delivery using the residual method, recognize revenue from maintenance ratably over the maintenance term, and recognize revenue from professional services as services are performed and accepted by the customer. With respect to TSL arrangements, due to the complexity of the tools, the complexity of the arrangement terms and intertwined services, the license, maintenance and other services are not separable and are considered as a combined unit. Additionally, we do not have sufficient VSOE of fair value to allocate the fee between these services. Therefore, we recognize revenue from TSLs ratably over the term of the license, assuming all other revenue recognition criteria are met.

Revenue recognition involves certain judgments. Specifically, in connection with each transaction involving our products, we must evaluate whether: (1) persuasive evidence of an arrangement exists, (2) delivery of software or services has occurred, (3) the fee for such software or services is fixed or determinable, and (4) collectability of the full license or service fee is probable. All four of these criteria must be met in order for us to recognize revenue with respect to a particular arrangement. We apply these revenue recognition criteria as follows:

- *Persuasive Evidence of an Arrangement Exists.* Prior to recognizing revenue on an arrangement, our customary policy is to have a written contract, signed by both the customer and by us, or a

purchase order from those customers that have previously negotiated a standard end-user license arrangement or purchase agreement.

- *Delivery Has Occurred.* We deliver our products to our customers electronically or physically. For electronic deliveries, delivery occurs when we provide access to our customers to take immediate possession of the software through downloading it to the customer's hardware. For physical deliveries, the standard transfer terms are typically Freight on Board (FOB) shipping point. We generally ship our products or license keys promptly after acceptance of customer orders. However, a number of factors can affect the timing of product shipments and, as a result, timing of revenue recognition, including the delivery dates requested by customers and our operational capacity to fulfill product orders at the end of a fiscal quarter.
- *The Fee Is Fixed or Determinable.* Our determination that an arrangement fee is fixed or determinable depends principally on the arrangement's payment terms. Our standard payment terms for perpetual licenses require 75% or more of the license fee and 100% of the maintenance fee to be paid within one year. If the arrangement includes these terms, we regard the fee as fixed or determinable, and recognize all license revenue under the arrangement in full upon delivery (assuming all other revenue recognition criteria are met). If the arrangement does not include these terms, we do not consider the fee to be fixed or determinable and generally recognize revenue when customer installments are due and payable. In the case of a TSL, because of the right to exchange products or receive unspecified future technology and because VSOE for maintenance services does not exist for a TSL, we recognize revenue ratably over the term of the license, but not in advance of when customers' installments become due and payable.
- *Collectability Is Probable.* We judge collectability of the arrangement fees on a customer-by-customer basis pursuant to our credit review policy. We typically sell to customers with whom we have a history of successful collection. For a new customer, or when an existing customer substantially expands its commitments, we evaluate the customer's financial position and ability to pay and typically assign a credit limit based on that review. We increase the credit limit only after we have established a successful collection history with the customer. If we determine at any time that collectability is not probable under a particular arrangement based upon our credit review process or the customer's payment history, we recognize revenue under that arrangement as customer payments are actually received.

Valuation of Business Combinations

We allocate the fair value of purchase consideration to tangible assets, liabilities including contingencies assumed, and intangible assets acquired in a business combination. Any excess fair value of purchase consideration over the estimated fair value of assets acquired and liabilities assumed is recorded as goodwill. The allocation of the purchase consideration requires management to make estimates and assumptions, based in part on our judgments, in determining the fair value of assets acquired and liabilities assumed, especially with respect to intangible assets. Our estimates and assumptions may include, but are not limited to, future cash flows of an acquired business, other assumptions and the appropriate discount rate. These estimates are inherently difficult, subjective and unpredictable, and if different estimates were used, the fair value allocation to the acquired intangible assets could be different. Therefore, our assessment of the estimated fair value of each of these assets can have a material effect on our consolidated financial statements.

Income Taxes

We recognize deferred tax assets and liabilities for the temporary differences between the book and tax bases of assets and liabilities using enacted tax rates in effect for the year in which we expect the differences to reverse, and for tax loss and credit carryovers. Determining whether a valuation allowance is necessary to reduce deferred tax assets require assumptions, judgments, and estimates. We record a valuation allowance to reduce the deferred tax assets to the amount that is more likely than not to be realized. In evaluating our ability to utilize our deferred tax assets, we consider all available positive and negative evidence, including our past operating results, our forecast of future taxable income on a jurisdiction by jurisdiction basis, as well as feasible and prudent tax planning strategies. In fiscal 2018, we also considered the impact of the Tax Cuts and Jobs Act. We believe that the net deferred tax assets of approximately $397.4 million, which are recorded on our balance sheet as of October 31, 2018, based on current tax law, will ultimately be realized. However, if we determine in the future that it is more likely than not that we will not be able to realize a portion or the full amount of deferred tax assets, we would record an adjustment to the deferred tax asset or a valuation allowance as a charge to earnings in the period that such determination is made.

Uncertain tax positions are recorded by applying a two-step approach. The first step is to evaluate the tax position for recognition by determining whether it is more likely than not that the position will be sustained on audit, including resolution of related appeals or litigation processes, if any. The second step is to measure the tax benefit as the largest amount that is more than 50% likely of being realized upon ultimate settlement. An uncertain tax position is considered effectively settled on completion of an examination by a taxing authority if certain other conditions are satisfied.

Effect of New Accounting Pronouncements Not Yet Adopted

See Note 14 of *Notes to Consolidated Financial Statements.*

Results of Operations

Revenue Background

We generate our revenue from the sale of products that include software licenses, maintenance and services, and to a lesser extent, hardware products. Under current accounting rules and policies, we recognize revenue from orders we receive for software licenses, services and hardware products at varying times.

- In most instances, we recognize revenue on a TSL software license order over the license term and on a perpetual software license order in the quarter in which the license is delivered. The weighted-average term of the TSLs is typically three years, but varies from quarter to quarter due to the nature and timing of the arrangements entered into during the quarter. The weighted-average term of the TSLs we entered into in fiscal 2018, 2017, and 2016 was 2.7 years, 2.7 years and 3.0 years, respectively.
- Revenue on contracts requiring significant modification or development is accounted for using the percentage of completion method over the period of modification or development.
- Revenue on hardware product orders is generally recognized in full at the time the product is shipped and when title is transferred.
- Contingent revenue is recognized if and when the event that removes the contingency occurs.
- Revenue on maintenance orders is recognized ratably over the maintenance period (normally one year).
- Revenue on professional services orders is generally recognized as the services are performed.
- Infrequently, we enter into certain license arrangements wherein licenses are provided for a finite term without any other services or rights, including rights to receive, or to exchange licensed software for, unspecified future technology. We recognize revenue from these term licenses in full upon shipment of the software and when all other revenue recognition criteria are met.

Our revenue in any period is equal to the sum of our time-based products, upfront products, and maintenance and services revenues for the period. We derive time-based products revenue largely from TSL orders received and delivered in prior quarters and to a smaller extent from contracts in which revenue is recognized as customer installments become due and payable and from contingent revenue arrangements. We derive upfront products revenue directly from perpetual license and hardware product orders mostly booked and shipped during the period. We derive maintenance revenue largely from maintenance orders received in prior periods since our maintenance orders generally yield revenue ratably over a term of one year. We also derive professional services revenue primarily from orders received in prior quarters, since we recognize revenue from professional services as those services are delivered and accepted or on percentage of completion for arrangements requiring significant modification of our software, and not when they are booked.

Our revenue is sensitive to the mix of TSLs and perpetual licenses delivered during a reporting period. A TSL order typically yields lower current quarter revenue but contributes to revenue in future periods. For example, a $120,000 order for a three-year TSL delivered on the last day of a quarter typically generates no revenue in that quarter, but $10,000 in each of the 12 succeeding quarters. Conversely, a $120,000 order for perpetual licenses with greater than 75% of the license fee due within one year from shipment typically generates $120,000 in revenue in the quarter the product is delivered, but no future revenue. Additionally, revenue in a particular quarter may also be impacted by perpetual licenses in which less than 75% of the license fees and 100% of the maintenance fees are payable within one year from shipment as the related revenue will be recognized as revenue in the period when customer payments become due and payable.

Most of our customer arrangements are complex, involving hundreds of products and various license rights, and our customers bargain with us over many aspects of these arrangements. For example, they often demand a broader portfolio of solutions, support and services and seek more favorable terms such as expanded license usage, future purchase rights and other unique rights at an overall lower total cost. No single factor typically drives our customers' buying decisions, and we compete on all fronts to serve customers in a highly competitive EDA market. Customers generally negotiate the total value of the arrangement rather than just unit pricing or volumes.

Total Revenue

Year Ended October 31,			$ Change	% Change	$ Change	% Change
2018	2017	2016	2017 to 2018		2016 to 2017	
(dollars in millions)						
$ 3,121.1	$ 2,724.9	$ 2,422.5	$ 396.2	15%	$ 302.4	12%

The overall growth of our business, including contributions from acquisitions, has been the primary driver of the increase in our revenue. Our revenues are subject to fluctuations, primarily due to customer requirements, including payment terms and the timing and value of contract renewals. For example, we experience variability in our revenue due to factors such as the timing of IP consulting projects, royalties, and variability in hardware sales, and due to certain contracts where revenue is recognized when customer installment payments are due. As revenue from hardware sales is recognized upfront, customer demand and timing requirements for such hardware may result in increased variability of our total revenue.

The increase in total revenue for fiscal 2018 compared to fiscal 2017 was primarily attributable to the overall growth of our business, mainly due to higher TSL license revenue from arrangements booked in prior periods, an increase in professional services, additional revenue of approximately $46.0 million due to an extra week in the first quarter of fiscal 2018 compared to fiscal 2017, and contributions from acquired companies.

The increase in total revenue for fiscal 2017 compared to fiscal 2016 was primarily attributable to the overall growth of our business mainly due to higher TSL revenues, hardware sales, and IP consulting projects and, to a lesser extent, due to revenue from acquired companies.

For a discussion of revenue by geographic areas, see Note 13 of *Notes to Consolidated Financial Statements*.

Time-Based Products Revenue

	Year Ended October 31,			$ Change	% Change	$ Change	% Change
	2018	2017	2016	2017 to 2018		2016 to 2017	
	(dollars in millions)						
	$ 2,303.3	$ 2,021.8	$ 1,910.9	$ 281.5	14%	$ 110.9	6%
Percentage of total revenue	74%	74%	79%				

The increase in time-based products revenue for fiscal 2018 compared to fiscal 2017 was primarily attributable to an increase in TSL license revenue due to arrangements booked in prior periods, including contributions from acquired companies, and additional revenue due to an extra week in fiscal 2018 compared to fiscal 2017.

The increase in time-based products revenue for fiscal 2017 compared to fiscal 2016 was primarily attributable to an increase in TSL license revenue due to arrangements booked in prior periods.

Upfront Products Revenue

	Year Ended October 31,			$ Change	% Change	$ Change	% Change
	2018	2017	2016	2017 to 2018		2016 to 2017	
	(dollars in millions)						
	$ 357.7	$ 338.2	$ 248.1	$ 19.5	6%	$ 90.1	36%
Percentage of total revenue	11%	12%	10%				

Changes in upfront products revenue are generally attributable to normal fluctuations in customer requirements, which can drive the amount of upfront orders and revenue in any particular period.

The increase in upfront products revenue for fiscal 2018 compared to fiscal 2017 was primarily attributable to an increase in the sale of IP products driven by higher demand from customers.

The increase in upfront products revenue for fiscal 2017 compared to fiscal 2016 was primarily attributable to an increase in the sale of hardware products driven by timing of customer requirements.

Upfront products revenue as a percentage of total revenue will likely fluctuate modestly based on the timing of IP products and hardware sales. Such fluctuations will continue to be impacted by the timing of shipments due to customer requirements.

Maintenance and Service Revenue

	Year Ended October 31,			$ Change	% Change	$ Change	% Change
	2018	2017	2016	2017 to 2018		2016 to 2017	
	(dollars in millions)						
Maintenance revenue	$ 100.4	$ 84.1	$ 74.4	$ 16.3	19%	$ 9.7	13%
Professional service and other revenue	359.6	280.8	189.1	78.8	28%	91.7	48%
Total	$ 460.0	$ 364.9	$ 263.5	$ 95.1	26%	$ 101.4	38%
Percentage of total revenue	15%	14%	11%				

The increase in maintenance revenue for fiscal 2018 compared to fiscal 2017, and for fiscal 2017 compared to fiscal 2016, was primarily due to an increase in the volume of arrangements that include maintenance.

The increase in professional services and other revenue for fiscal 2018 compared to fiscal 2017 was primarily due to an increase in consulting projects, including contributions from acquisitions, and to a lesser extent, the impact of the extra week in fiscal 2018.

The increase in professional services and other revenue for fiscal 2017 compared to fiscal 2016 was primarily due to an increase in, and the timing of, IP consulting projects that are accounted for using the percentage of completion method and contributions from acquisitions.

Cost of Revenue and Operating Expenses

	Year Ended October 31,			$ Change	% Change	$ Change	% Change
	2018	2017	2016	2017 to 2018		2016 to 2017	
	(dollars in millions)						
Cost of revenue	$ 735.9	$ 654.2	$ 543.0	$ 81.7	12%	$ 111.2	20%
Operating expenses	2,024.9	1,723.1	1,562.2	301.8	18%	160.9	10%
Total	$ 2,760.8	$ 2,377.3	$ 2,105.2	$ 383.5	16%	$ 272.1	13%
Total expenses as a percentage of total revenue	88%	87%	87%				

Our expenses are generally impacted by changes in personnel-related costs including salaries, benefits, stock-based compensation and variable compensation; changes in amortization; and changes in selling and marketing expenses. The increase in our expenses compared to prior fiscal years was primarily due to an increase in personnel-related costs, driven by increased headcount from our overall growth, including those from acquisitions, and related fixed charges including facilities, as well as higher product costs due to increased hardware sales. We allocate certain human resource programs, information technology and facility expenses among our functional income statement categories based on headcount within each functional area. Annually, or upon a significant change in headcount (such as a workforce reduction, realignment or acquisition) or other factors, management reviews the allocation methodology and expenses included in the allocation pool.

Foreign currency fluctuations, net of hedging, did not have a significant impact on expenses during fiscal 2018 as compared to fiscal 2017, or fiscal 2017 as compared to fiscal 2016. See Note 5 of *Notes to Consolidated Financial Statements* for details on our foreign exchange hedging programs.

Cost of Revenue

	Year Ended October 31,			$ Change	% Change	$ Change	% Change
	2018	2017	2016	2017 to 2018		2016 to 2017	
	(dollars in millions)						
Cost of products revenue	$ 448.4	$ 413.2	$ 346.9	$ 35.2	9%	$ 66.3	19 %
Cost of maintenance and service revenue	203.5	164.9	94.0	38.6	23%	70.9	75 %
Amortization of intangible assets	84.0	76.1	102.1	7.9	10%	(26.0)	(25)%
Total	$ 735.9	$ 654.2	$ 543.0	$ 81.7	12%	$ 111.2	20 %
Percentage of total revenue	24%	24%	22%				

We divide cost of revenue into three categories: cost of products revenue, cost of maintenance and service revenue, and amortization of intangible assets. We segregate expenses directly associated with consulting and training services from cost of products revenue associated with internal functions providing license delivery and post-customer contract support services. We then allocate these group costs between cost of products revenue and cost of maintenance and service revenue based on products and maintenance and service revenue reported.

Cost of products revenue. Cost of products revenue includes costs related to products sold and software licensed, allocated operating costs related to product support and distribution costs, royalties paid to third-party vendors, and the amortization of capitalized research and development costs associated with software products that had reached technological feasibility.

Cost of maintenance and service revenue. Cost of maintenance and service revenue includes operating costs related to maintaining the infrastructure necessary to operate our services and costs to deliver our consulting services, such as hotline and on-site support, production services and documentation of maintenance updates. We expect our cost of maintenance and service revenue to increase in future periods because of recent acquisitions, but we do not expect the impact to be material to our total cost of revenue.

Amortization of intangible assets. Amortization of intangible assets, which is recorded to cost of revenue and operating expenses, includes the amortization of core/developed technology, trademarks, trade names, customer relationships, covenants not to compete related to acquisitions and certain contract rights related to acquisitions.

The increase in cost of revenue for fiscal 2018 compared to fiscal 2017 was primarily due to an increase of $47.7 million in personnel-related costs as a result of headcount increases, including those from acquisitions, an increase of $11.3 million in costs related to servicing IP consulting arrangements, and an increase of $7.9 million in amortization of intangible assets, as well as one additional week of expenses of approximately $4.5 million.

The increase in cost of revenue for fiscal 2017 compared to fiscal 2016 was primarily due to an increase of $62.4 million in personnel-related costs as a result of headcount increases, including those from acquisitions, an increase of $37.5 million in hardware product costs due to increases in, and timing of, shipments, an increase of $24.8 million in costs related to servicing IP consulting arrangements, and functionally allocated expenses that were higher by $8.6 million. The increases were partially offset by decreases of $26.0 million in amortization of intangible assets.

Changes in other cost of revenue categories for the above-mentioned periods were not individually material.

Operating Expenses

Research and Development

	Year Ended October 31,			$ Change	% Change	$ Change	% Change
	2018	2017	2016	2017 to 2018		2016 to 2017	
	(dollars in millions)						
	$ 1,084.8	$ 908.8	$ 856.7	$ 176.0	19%	$ 52.1	6%
Percentage of total revenue	35%	33%	35%				

The increase in research and development expense in fiscal 2018 compared to fiscal 2017 was primarily due to an increase of $114.4 million in personnel-related costs as a result of headcount increases, including those from acquisitions, and one additional week of expenses of approximately $19.3 million.

The increase in research and development expense in fiscal 2017 compared to fiscal 2016 was primarily due to an increase of $47.4 million in personnel-related costs as a result of headcount increases, including those from acquisitions.

Changes in other research and development expense categories for the above-mentioned periods were not individually material.

Sales and Marketing

	Year Ended October 31,			$ Change	% Change	$ Change	% Change
	2018	2017	2016	2017 to 2018		2016 to 2017	
	(dollars in millions)						
	$ 623.0	$ 549.2	$ 502.4	$ 73.8	13%	$ 46.8	9%
Percentage of total revenue	20%	20%	21%				

The increase in sales and marketing expense for fiscal 2018 compared to fiscal 2017 was primarily attributable to an increase of $51.0 million in personnel costs as a result of headcount increases, an increase of $7.5 million due to timing of marketing events, and one additional week of expenses of approximately $5.8 million.

The increase in sales and marketing expense for fiscal 2017 compared to fiscal 2016 was primarily attributable to an increase of $40.8 million in personnel costs as a result of higher headcount and higher variable compensation primarily based on timing of shipments.

Changes in other sales and marketing expense categories for the above-mentioned periods were not individually material.

General and Administrative

	Year Ended October 31,			$ Change	% Change	$ Change	% Change
	2018	2017	2016	2017 to 2018		2016 to 2017	
	(dollars in millions)						
	$ 262.6	$ 196.8	$ 166.0	$ 65.8	33%	$ 30.8	19%
Percentage of total revenue	8%	7%	7%				

The increase in general and administrative expenses for fiscal 2018 compared with fiscal 2017 was primarily due to an increase of $21.5 million in personnel-related costs as a result of headcount increases, an increase of $22.1 million in professional service costs primarily due to additional legal, accounting, and tax services related to various projects, an increase of $18.2 million in net litigation settlement costs primarily due to a $26.0 million litigation settlement recorded in fiscal 2018 compared with $7.6 million net litigation charges recorded in fiscal 2017, an increase of $11.0 million in facilities expenses, and one additional week of expenses of approximately $4.1 million.

The increase in general and administrative expenses for fiscal 2017 compared with fiscal 2016 was primarily due to an increase of $38.0 million for accrued loss contingencies as a result of litigation, an increase of $18.8 million in personnel-related costs as a result of headcount increases, and an increase of $5.5 million in facilities expenses, partially offset by a $30.4 million gain as a result of a legal settlement.

Changes in other general and administrative expense categories for the above-mentioned periods were not individually material.

Change in Fair Value of Deferred Compensation

The income or loss arising from the change in fair value of our non-qualified deferred compensation plan obligation is recorded in cost of sales and each functional operating expense, with the offsetting change in the fair value of the related assets recorded in other income (expense), net. These assets are classified as trading securities. There is no overall impact to our net income from the income or loss of our deferred compensation plan obligation and asset.

Amortization of Intangible Assets

Amortization of intangible assets includes the amortization of contract rights and the amortization of core/developed technology, trademarks, trade names, customer relationships, and in-process research and development related to acquisitions completed in prior years. Amortization expense is included in the consolidated statements of operations as follows:

	Year Ended October 31,			$ Change	% Change	$ Change	% Change
	2018	2017	2016	2017 to 2018		2016 to 2017	
	(dollars in millions)						
Included in cost of revenue	$ 84.0	$ 76.1	$ 102.1	$ 7.9	10%	$ (26.0)	(25)%
Included in operating expenses	41.6	31.6	27.5	10.0	32%	4.1	15 %
Total	$ 125.6	$ 107.7	$ 129.6	$ 17.9	17%	$ (21.9)	(17)%
Percentage of total revenue	4%	4%	5%				

The increase in amortization of intangible assets for fiscal 2018 compared to fiscal 2017 was primarily due to the additions of acquired intangible assets, partially offset by certain intangible assets being fully amortized.

The decrease in amortization of intangible assets for fiscal 2017 compared to fiscal 2016 was primarily due to intangible assets that were fully amortized, partially offset by additions of acquired intangible assets.

Restructuring Charges

During fiscal 2018, we recorded $12.9 million of restructuring charges as part of a business realignment. The restructuring actions were undertaken to position us for future growth, reallocate resources to priority areas and, to a lesser extent, eliminate operational redundancy. These charges consisted primarily of severance and benefits. The remaining balance of $8.1 million is expected to be paid in fiscal 2019.

During fiscal 2017, we recorded $36.6 million of restructuring charges for severance and benefits due to involuntary and voluntary employee termination actions. The restructuring actions were undertaken to position us for future growth, reallocate resources to priority areas and, to a lesser extent, eliminate operational redundancy. These charges consisted primarily of severance and retirement benefits. As of the end of fiscal 2018, there were no unpaid balances remaining of the 2017 restructuring charges.

During fiscal 2016, we recorded $9.6 million of restructuring charges for severance and benefits due to involuntary employee terminations, which was fully paid in fiscal 2017.

The following is a summary of our restructuring activities:

Fiscal Year	Balance at Beginning of Period	Costs Incurred (Reduced)	Cash Payments	Others	Balance at End of Period
			(in millions)		
2018	$ 17.5	$ 12.9	$ (22.1)	$ (0.2)	$ 8.1
2017	$ 5.7	$ 36.6	$ (24.8)	$ —	$ 17.5
2016	$ —	$ 9.6	$ (3.9)	$ —	$ 5.7

See Note 2 of *Notes to Consolidated Financial Statements*.

Other Income (Expense), Net

	Year Ended October 31,			$ Change	% Change	$ Change	% Change
	2018	2017	2016	2017 to 2018		2016 to 2017	
			(dollars in millions)				
Interest income	$ 5.3	$ 7.2	$ 3.7	$ (1.9)	(26)%	$ 3.5	95 %
Interest expense	(15.6)	(7.3)	(3.8)	(8.3)	114 %	(3.5)	92 %
Gain (loss) on assets related to executive deferred compensation plan	4.6	29.6	4.4	(25.0)	(84)%	25.2	573 %
Foreign currency exchange gain (loss)	3.6	3.4	0.2	0.2	6 %	3.2	1,600 %
Other, net	5.4	2.6	7.7	2.8	108 %	(5.1)	(66)%
Total	$ 3.3	$ 35.5	$ 12.2	$ (32.2)	(91)%	$ 23.3	191 %

The net decrease in other income (expense) in fiscal 2018 as compared to fiscal 2017 was primarily due to lower gains in the market value of our executive deferred compensation plan assets and higher interest expense due to a higher debt balance.

The net increase in other income (expense) in fiscal 2017 as compared to fiscal 2016 was primarily due to higher gains in the market value of our executive deferred compensation plan assets.

Income Taxes

The Tax Cuts and Jobs Act (Tax Act), enacted on December 22, 2017, lowered the statutory federal corporate income tax rate from 35% to 21% effective on January 1, 2018. Because our fiscal 2018 commenced on November 1, 2017, the annual statutory federal corporate tax rate applicable to fiscal 2018 is a blended rate of 23.4%. Beginning in fiscal 2019, our annual statutory federal corporate tax rate will be 21%.

Our effective tax rate for fiscal 2018 was (19.0%), which included a tax benefit of $172.0 million relating to the restructuring of our foreign intellectual property rights, a U.S. federal research tax credit of $35.1 million, a settlement with the Internal Revenue Service (IRS) of $21.8 million tax benefit for fiscal 2017, and excess tax benefits from stock-based compensation of $31.0 million. These benefits were partially offset by tax expense of $63.1 million for a one-time transition tax on foreign earnings, $51.1 million due to re-measurement of U.S. deferred tax assets as a result of the Tax Act, and tax expense related to the integration of acquired technologies of $27.9 million.

Our effective tax rate for fiscal 2017 was 64.4%, which included income tax expense of $166.2 million relating to a repatriation of foreign earnings of $825 million, $30.5 million due to an increase in valuation allowance on state

deferred tax assets, a settlement with the Korean National Tax Service for the audit of fiscal years 2012 to 2016 of $7.9 million, and tax expense related to the integration of acquired technologies of $36.4 million. These expenses were partially offset by excess tax benefits from stock-based compensation of $38.1 million, a U.S. federal research tax credit of $25.5 million, and a settlement with the Taiwanese tax authorities for fiscal 2014 of $10.9 million.

Our effective tax rate for fiscal 2016 was 19.0%, which included tax benefits from a settlement with the IRS of $20.7 million for fiscal 2015 and the permanent reinstatement of the U.S. federal research tax credit of approximately $37.1 million, partially offset by tax expense from the integration of acquired technologies of $37.5 million, the impact of undistributed foreign earnings of $9.6 million, and an increase in the valuation allowance on deferred tax assets of $14.0 million as a result of changes in the expected utilization of state tax credits. The reinstatement of the research tax credit resulted in an additional tax credit for ten months of fiscal 2015 and the full year of fiscal 2016, which was recorded in fiscal 2016.

The integration of acquired technologies represents the income tax effect resulting from the transfer of certain intangible assets among company-controlled entities. The income tax effect is generally recognized over five years. These intangible assets generally result from the acquisition of technology by a company-controlled entity as part of a business or asset acquisition.

During the year, we made provisional estimates of the accounting impacts of certain provisions of the Tax Act. In the fourth quarter, as a result of further analyzes of certain aspects of the Tax Act, we have finalized the following provisional estimates.

As a result of the reduction in the federal corporate tax rate, we remeasured our deferred taxes, resulting in a first-quarter provisional tax expense of $45.6 million based on the tax rate that will apply when these deferred taxes are settled or realized in future periods. In the fourth quarter, we finalized our calculations resulting in a tax expense for fiscal 2018 of $51.1 million.

As part of the adoption of a new territorial tax system, the Tax Act required us to pay a one-time transition tax on previously untaxed earnings represented by foreign cash and certain other net current assets, and 8% on the remaining earnings. As of the third quarter of fiscal 2018, we had recorded a provisional transition tax expense of $73.4 million, as well as a provisional income tax payable of $17.9 million. In the fourth quarter, we finalized our calculations resulting in a tax expense of $63.1 million and income tax payable of $8.9 million. We intend to elect to pay the transition tax over a period of eight years as permitted by the Tax Act.

We continue to obtain, analyze and interpret additional guidance issued related to the Tax Act. The applicability and impact of the following new tax provisions, are dependent in part on forthcoming IRS guidance.

- A tax on global intangible low-tax income (GILTI), which is determined annually based on our aggregate foreign subsidiaries' income in excess of certain qualified business asset investment return, will be effective for us in fiscal year 2019. We need additional information to complete our analysis on whether to adopt an accounting policy to account for the tax effects of GILTI in the period that we are subject to such tax, or to provide deferred taxes for book and tax basis differences that upon reversal, may be subject to such tax. Accordingly, we have not recorded any tax or deferred tax assets or liabilities with respect to GILTI in fiscal year 2018. We will make our accounting policy decision and complete the required accounting in the first quarter of fiscal 2019.
- A base erosion and anti-abuse tax (BEAT), which functions as a minimum tax that partially disallows deductions for certain related party transactions, that is not effective for us until fiscal year 2019.
- A special tax deduction for foreign-derived intangible income (FDII), which, in general, allows a deduction of certain intangible income earned in the U.S. and derived from foreign sources, that is not effective for us until fiscal year 2019.

As part of the adoption of a territorial tax system, the Tax Act also provides an exemption from federal income taxes for distributions from foreign subsidiaries made after December 31, 2017 that were not subject to the one-time transition tax. We have provided for foreign withholding taxes on undistributed earnings of certain of our foreign subsidiaries to the extent such earnings are no longer considered to be indefinitely reinvested in the operations of those subsidiaries.

In the fourth quarter of 2018, we made significant changes to our international tax structure by transferring intangible assets between certain foreign subsidiaries and changing the tax status of these subsidiaries for U.S. tax purposes. As a result, we recorded a deferred tax benefit of $172.0 million for the future U.S. tax deduction related

to these intangible assets. We paid foreign income tax of $67.7 million associated with the gain recognized on certain of these transactions. The tax liabilities associated with these transfers are treated as prepaid taxes. A portion of these foreign taxes may result in a U.S. foreign tax credit, but the amount expected to be realized cannot be determined at this time. The tax liabilities and benefits are subject to examination by U.S. and foreign tax authorities in future years.

In fiscal 2018, we reevaluated our strategy and subsequently withdrew our contest concerning the Hungary tax litigation related to one issue in the audit of fiscal years 2011 through 2013 and recorded a tax expense of $5.7 million.

For further discussion of the provision for income taxes, impacts related to the Tax Act, the restructuring of our foreign intellectual property rights and the Hungary audit, see Note 11 of *Notes to Condensed Consolidated Financial Statement.*

Liquidity and Capital Resources

Our sources of cash and cash equivalents are funds generated from our business operations and funds that may be drawn down under our revolving credit and term loan facilities.

As of October 31, 2018, we held an aggregate of $177.6 million in cash and cash equivalents in the United States and an aggregate of $545.5 million in our foreign subsidiaries. As a result of the Tax Act, we have recorded a tax liability for the transition tax on foreign earnings, payable over eight years, of $0.7 million and $8.2 million reflected as a short-term and long-term liability, respectively. If we decide to repatriate the undistributed earnings of our foreign subsidiaries for use in the U.S. in the future, the earnings that were subject to the transition tax would not be subject to further U.S. tax. In addition, we have provided foreign deferred taxes on our undistributed earnings sufficient to address the incremental tax that would be due on future foreign earnings. During the fourth quarter of fiscal 2018, we completed a restructuring of our foreign intellectual property rights, resulting in a one-time tax payment of $67.7 million, which is included in current prepaid taxes.

The following sections discuss changes in our consolidated balance sheets and statements of cash flow, and other commitments of our liquidity and capital resources during fiscal 2018.

Cash and Cash Equivalents

	Year Ended October 31,			
	2018	2017	$ Change	% Change
	(dollars in millions)			
Cash and cash equivalents	$ 723.1	$ 1,048.4	$ (325.3)	(31)%

Cash and cash equivalents decreased primarily due to cash used for business combinations and asset acquisitions, and stock repurchases under our accelerated stock repurchase agreements, partially offset by cash from our operations and net proceeds from our credit facilities.

Cash Flows

	Year Ended October 31,			$ Change	$ Change
	2018	2017	2016	2017 to 2018	2016 to 2017
	(dollars in millions)				
Cash provided by operating activities	$ 424.2	$ 634.6	$ 586.6	$ (210.4)	$ 48.0
Cash used in investing activities	(743.5)	(189.3)	(142.7)	(554.2)	(46.6)
Cash provided by (used in) financing activities	5.1	(373.1)	(306.9)	378.2	(66.2)

Cash Provided by Operating Activities

We expect cash from our operating activities to fluctuate as a result of a number of factors, including the timing of our billings and collections, our operating results, and the timing and amount of tax and other liability payments. Cash provided by our operations is dependent primarily upon the payment terms of our license agreements. We generally receive cash from upfront arrangements much sooner than from time-based products revenue, in which the license fee is typically paid either quarterly or annually over the term of the license.

Fiscal 2018 compared to fiscal 2017. The decrease in cash provided by operating activities was primarily driven by higher vendor disbursements, higher income taxes payment, higher accounts receivable due to timing of customer billings, and higher inventory. Disbursements in fiscal 2018 included certain one-time payments of $163.3 million for income taxes and $65.0 million for a litigation settlement.

Fiscal 2017 compared to fiscal 2016. The increase in cash provided by operating activities was primarily driven by higher cash collections, partially offset by higher disbursements for operations, including vendors.

Cash Used in Investing Activities

Fiscal 2018 compared to fiscal 2017. The increase in cash used in investing activities was primarily driven by higher cash paid for acquisitions of $393.4 million and lower proceeds from sales and maturities of short-term investments, net of purchases, of $128.1 million.

Fiscal 2017 compared to fiscal 2016. The increase in cash used in investing activities was primarily driven by higher cash paid for acquisitions and intangible assets of $199.1 million, partially offset by higher proceeds from the sales and maturities of short-term investments of $139.3 million.

Cash Provided by (Used in) Financing Activities

Fiscal 2018 compared to fiscal 2017. Cash provided by financing activity in fiscal 2018 was higher compared to fiscal 2017 primarily due to higher proceeds of $300.6 million from drawdowns of our credit facilities and lower debt repayment of $85.3 million.

Fiscal 2017 compared to fiscal 2016. The increase in cash used in financing activities was primarily due to higher debt repayments of $195.6 million, partially offset by higher proceeds from the drawdown of our senior unsecured revolving credit facility of $135.0 million.

Accounts Receivable, net

Year Ended October 31,			
2018	2017	$ Change	% Change
(dollars in millions)			
$554.2	$451.1	$103.1	23%

Changes in our accounts receivable balance are primarily driven by timing of customer billing, collection activities and to a lesser extent, customer receivables acquired through our acquisitions.

Working Capital

Working capital is comprised of current assets less current liabilities, as shown on our consolidated balance sheets:

	Year Ended October 31,			
	2018	2017	$ Change	% Change
	(dollars in millions)			
Current assets	$ 1,543.8	$ 1,682.6	$ (138.8)	(8)%
Current liabilities	2,102.4	1,614.1	488.3	30 %
Working capital (deficit)	$ (558.6)	$ 68.5	$ (627.1)	(915)%

Decreases in our working capital were primarily due to a decrease in cash and cash equivalents of $325.3 million, an increase in short term debt of $333.8 million, an increase in deferred revenue of $88.3 million, and an increase in accounts payable and accrued liabilities of $78.5 million, partially offset by an increase in accounts receivable of $103.1 million, an increase in inventory of $60.5 million, and an increase in income taxes receivable and prepaid taxes of $28.3 million.

Other

As of October 31, 2018, our cash equivalents consisted of taxable money market mutual funds. We follow an established investment policy and set of guidelines to monitor, manage and limit our exposure to interest rate and credit risk.

We proactively manage our cash equivalents balances and closely monitor our capital and stock repurchase expenditures to ensure ample liquidity. Additionally, we believe the overall credit quality of our portfolio is strong,

with our global excess cash, and our cash equivalents, invested in banks and securities with a weighted-average credit rating exceeding AA. The majority of our investments are classified as Level 1 or Level 2 investments, as measured under fair value guidance. See Notes 5 and 6 of *Notes to Consolidated Financial Statements*.

We believe that our current cash and cash equivalents, cash generated from operations, and available credit under our Revolver (defined below) will satisfy our routine business requirements for at least the next 12 months and the foreseeable future.

Other Commitments — Credit and Term Loan Facilities

In July 2018, we entered into a 220.0 million RMB (approximately $33.0 million) credit agreement with a lender in China to support our facilities expansion. Borrowings bear interest at a floating rate based on the Chinese Central Bank rate plus 10% of such rate. As of October 31, 2018, we had $5.5 million outstanding under the agreement.

On November 28, 2016, we entered into an amended and restated credit agreement with several lenders (the Credit Agreement) providing for (i) a $650.0 million senior unsecured revolving credit facility (the Revolver) and (ii) a $150.0 million senior unsecured term loan facility (the Term Loan). The Credit Agreement amended and restated our previous credit agreement dated May 19, 2015 (the 2015 Agreement), in order to increase the size of the revolving credit facility from $500.0 million to $650.0 million, provide a new $150.0 million senior unsecured term loan facility, and extend the termination date of the revolving credit facility from May 19, 2020 to November 28, 2021. Subject to obtaining additional commitments from lenders, the principal amount of the loans provided under the Credit Agreement may be increased by us by up to an additional $150.0 million. The Credit Agreement contains financial covenants requiring us to operate within a maximum leverage ratio and maintain a minimum interest coverage ratio, as well as other non-financial covenants. As of October 31, 2018, we were in compliance with all financial covenants.

As of October 31, 2018, we had $133.8 million outstanding balance, net of debt issuance costs, under the Term Loan, of which $120.0 million was classified as long-term liabilities. Outstanding principal payments under the Term Loan are due as follows:

Fiscal year	(in thousands)
2019	$ 14,062
2020	17,813
2021	27,187
2022	75,000
Total	$ 134,062

As of October 31, 2017, we had $144.0 million outstanding balance, net of debt issuance costs, under the Term loan, of which $134.1 million was classified as long-term liabilities, and no outstanding balance under the Revolver.

The total outstanding balance of the Revolver as of October 31, 2018 was $330.0 million, which was included in short-term liabilities. We expect the borrowings under the Revolver will fluctuate from quarter to quarter. Borrowings bear interest at a floating rate based on a margin over our choice of market observable base rates as defined in the Credit Agreement. As of October 31, 2018, borrowings under the Term Loan bore interest at LIBOR +1.125% and the applicable interest rate for the Revolver was LIBOR +1.000%. In addition, commitment fees are payable on the Revolver at rates between 0.125% and 0.200% per year based on our leverage ratio on the daily amount of the revolving commitment.

Subsequent to fiscal year 2018, we drew down $150.0 million under the Revolver. The total outstanding balance of the Revolver as of December 14, 2018 is $430.0 million, net of repayments.

Contractual Obligations

The following table summarizes our contractual obligations as of October 31, 2018:

	Total	Fiscal 2019	Fiscal 2020/ Fiscal 2021	Fiscal 2022/ Fiscal 2023	Thereafter	Other
			(in thousands)			
Lease Obligations:						
Operating Leases(1)	$ 589,900	$ 61,819	$ 116,784	$ 93,162	$ 318,135	$ —
Purchase Obligations(2)	456,823	272,979	183,526	318	—	—
Revolver(3)	335,535	335,535	—	—	—	—
Term Loan(3)	134,062	14,062	45,000	75,000	—	—
Other Long-Term Obligations(4)	2,588	863	1,725	—	—	—
Long term accrued income taxes(5)	50,590	—	1,429	1,429	5,357	42,375
Total	$1,569,498	$ 685,258	$ 348,464	$ 169,909	$ 323,492	$ 42,375

(1) See Note 7 of *Notes to Consolidated Financial Statements*.

(2) Purchase obligations represent an estimate of all open purchase orders and contractual obligations in the ordinary course of business for which we have not received the goods or services as of October 31, 2018. Although open purchase orders are considered enforceable and legally binding, the terms generally allow us the option to cancel, reschedule and adjust our requirements based on our business needs prior to the delivery of goods or performance of services.

(3) These commitments relate to the principal of the Revolver, the Term Loan, and a credit facility as discussed in *Other Commitments* above.

(4) These other obligations include fees associated with our Revolver.

(5) Long-term accrued income taxes represent uncertain tax benefits and transition tax liability as of October 31, 2018. Currently, a reasonably reliable estimate of timing of payments related to uncertain tax benefits in individual years beyond fiscal 2018 cannot be made due to uncertainties in timing of the commencement and settlement of potential tax audits.

The expected timing of payments of the obligations discussed above is estimated based on current information. Timing of payment and actual amounts paid may be different depending on the time of receipt of goods or services or changes to agreed-upon amounts for some obligations.

Off-Balance Sheet Arrangements

As of October 31, 2018, we did not have any off-balance sheet arrangements, as defined in Item 303(a)(4)(ii) of SEC Regulation S-K.

Item 7A. *Quantitative and Qualitative Disclosures About Market Risk*

Interest Rate Risk. Our exposure to market risk for changes in interest rates relates to our cash, cash equivalents, and outstanding debt. As of October 31, 2018, all of our cash, cash equivalents and debt were at short-term variable and fixed interest rates. While par value generally approximates fair value on variable instruments, rising interest rates over time would increase both our interest income and our interest expense. The primary objective of our investment activities is to preserve the principal while at the same time maximizing yields without significantly increasing the risk. To achieve this objective, we maintain our portfolio of investments in a mix of tax-exempt and taxable instruments that meet high credit quality standards, as specified in our investment policy. None of these investments are held for trading purposes. Our policy also limits the amount of credit exposure to any one issue, issuer and type of instrument.

The following table presents our cash equivalents and debt by fiscal year of expected maturity and average interest rates:

As of October 31, 2018

	Maturing in Year Ending October 31,						
	2019	2020	2021	2021	2022	Total	Fair Value
	(in thousands)						
Cash & Cash equivalent (variable rate)	$574,959					$ 574,959	$ 574,959
Average interest rate	0.93%						
Short-term debt (variable rate):							
Revolver	$330,000					$ 330,000	$ 330,000
Average interest rate	LIBOR + 1.000%						
Term Loan	$ 14,062	$ 17,813	$ 27,187	$ 75,000		$ 134,062	$ 134,062
Average interest rate	LIBOR + 1.125%						
Credit Facility in China	$ 5,535					$ 5,535	$ 5,535
Average interest rate	Chinese Central Bank rate + 10% of such rate						

Foreign Currency Risk. We operate internationally and are exposed to potentially adverse movements in currency exchange rates. The functional currency of the majority of our active foreign subsidiaries is the foreign subsidiary's local currency. We enter into hedges in the form of foreign currency forward contracts to reduce our exposure to foreign currency rate changes on non-functional currency denominated forecasted transactions and balance sheet positions including: (1) certain assets and liabilities, (2) shipments forecasted to occur within approximately one month, (3) future billings and revenue on previously shipped orders, and (4) certain future intercompany invoices denominated in foreign currencies. The foreign currency contracts are carried at fair value and denominated in various currencies as listed in the tables below. The duration of forward contracts usually ranges from one month to 21 months. A description of our accounting for foreign currency contracts is included in Note 2 and Note 5 of *Notes to Consolidated Financial Statements.*

The success of our hedging activities depends upon the accuracy of our estimates of various balances and transactions denominated in non-functional currencies. To the extent our estimates are correct, gains and losses on our foreign currency contracts will be offset by corresponding losses and gains on the underlying transactions. For example, if the Euro were to depreciate by 10% compared to the U.S. dollar prior to the settlement of the Euro forward contracts listed in the table below providing information as of October 31, 2018, the fair value of the contracts would decrease by approximately $12.4 million, and we would be required to pay approximately $12.4 million to the counterparty upon contract maturity. At the same time, the U.S. dollar value of our Euro-based expenses would decline, resulting in a gain and positive cash flow of approximately $12.4 million that would offset the loss and negative cash flow on the maturing forward contracts.

Net unrealized loss of approximately $23.9 million and gain of $4.4 million, net of tax, are included in accumulated other comprehensive income (loss) in our consolidated balance sheets as of October 31, 2018 and 2017, respectively.

If estimates of our balances and transactions prove inaccurate, we will not be completely hedged, and we will record a gain or loss, depending upon the nature and extent of such inaccuracy.

We do not use foreign currency forward contracts for speculative or trading purposes. We enter into foreign exchange forward contracts with financial institutions and have not experienced nonperformance by counterparties. Further, we anticipate performance by all counterparties to such agreements.

The following table provides information about the gross notional values of our foreign currency contracts as of October 31, 2018:

	Gross Notional Amount in U.S. Dollars	Average Contract Rate
	(in thousands)	
Forward Contract Values:		
Japanese yen	$ 291,495	109.506
Hungarian forint	188,192	284.365
Indian rupee	131,679	71.319
Euro	124,091	1.206
Chinese renminbi	113,860	6.756
Taiwanese dollar	85,383	29.476
Canadian dollar	56,496	1.282
Korean won	41,342	1,124.225
Israeli shekel	36,100	3.604
British pound sterling	28,247	1.359
Armenian dram	20,967	475.367
Singapore dollar	9,224	1.368
Swiss franc	8,473	0.953
	$ 1,135,549	

Equity Risk. We have approximately $10.9 million and $7.8 million of non-marketable equity securities in privately held companies as of October 31, 2018 and 2017, respectively. These investments are accounted for under the cost or equity methods. The cost basis of securities sold is based on the specific identification method. The securities of privately held companies are reported at carrying value. Investments are written down to the fair value if there are any events or changes in circumstances that indicate any other than temporary decline in the value. We did not recognize any impairment during fiscal 2018 and recorded $1.3 million of other-than-temporary impairment during fiscal 2017. None of our investments are held for speculation purposes.

Item 8. *Financial Statements and Supplementary Data*

Report of Independent Registered Public Accounting Firm

To the Stockholders and Board of Directors

Synopsys, Inc.:

Opinions on the Consolidated Financial Statements and Internal Control Over Financial Reporting

We have audited the accompanying consolidated balance sheets of Synopsys, Inc. and its subsidiaries (the Company) as of November 3, 2018 and October 28, 2017, the related consolidated statements of operations, comprehensive income, stockholders' equity, and cash flows for each of the years in the three-year period ended November 3, 2018, and the related notes (collectively, the consolidated financial statements). We also have audited the internal control over financial reporting of Synopsys, Inc. as of November 3, 2018, based on criteria established in *Internal Control - Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission.

In our opinion, the consolidated financial statements referred to above present fairly, in all material respects, the financial position of the Company as of November 3, 2018 and October 28, 2017, and the results of its operations and its cash flows for each of the years in the three-year period ended November 3, 2018, in conformity with U.S. generally accepted accounting principles. Also in our opinion, Synopsys, Inc. maintained, in all material respects, effective internal control over financial reporting as of November 3, 2018, based on criteria established in *Internal Control - Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission.

Basis for Opinions

The Company's management is responsible for these consolidated financial statements, for maintaining effective internal control over financial reporting, and for its assessment of the effectiveness of internal control over financial reporting, included in the accompanying Management's Report on Internal Control Over Financial Reporting appearing under item 9A(b). Our responsibility is to express an opinion on the Company's consolidated financial statements and an opinion on the internal control over financial reporting of Synopsys, Inc. based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) (PCAOB) and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

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

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

Definition and Limitations of Internal Control Over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail,

accurately and fairly reflect the transactions and dispositions of the assets of the company; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

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

/s/ KPMG LLP

We have served as the Company's auditor since 1992.

Santa Clara, California
December 14, 2018

SYNOPSYS, INC.
CONSOLIDATED BALANCE SHEETS
(In thousands, except par value amounts)

	October 31, 2018	October 31, 2017
ASSETS		
Current assets:		
Cash and cash equivalents	$ 723,115	$ 1,048,356
Accounts receivable, net of allowances of $5,613 and $5,165, respectively	554,217	451,144
Inventories	122,407	61,884
Income taxes receivable and prepaid taxes	76,525	48,257
Prepaid and other current assets	67,533	72,952
Total current assets	1,543,797	1,682,593
Property and equipment, net	309,310	266,014
Goodwill	3,143,249	2,706,974
Intangible assets, net	360,404	253,843
Long-term prepaid taxes	138,312	20,157
Deferred income taxes	404,166	243,989
Other long-term assets	246,736	222,844
Total assets	$ 6,145,974	$ 5,396,414
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current liabilities:		
Accounts payable and accrued liabilities	$ 578,326	$ 499,846
Accrued income taxes	27,458	39,811
Deferred revenue	1,152,862	1,064,528
Short-term debt	343,769	9,924
Total current liabilities	2,102,415	1,614,109
Long-term accrued income taxes	50,590	33,239
Long-term deferred revenue	116,859	83,252
Long-term debt	125,535	134,063
Other long-term liabilities	265,560	252,027
Total liabilities	2,660,959	2,116,690
Stockholders' equity:		
Preferred Stock, $0.01 par value: 2,000 shares authorized; none outstanding	—	—
Common Stock, $0.01 par value: 400,000 shares authorized; 149,265 and 150,445 shares outstanding, respectively	1,493	1,505
Capital in excess of par value	1,644,830	1,622,429
Retained earnings	2,543,688	2,143,873
Treasury stock, at cost: 7,996 and 6,817 shares, respectively	(597,682)	(426,208)
Accumulated other comprehensive income (loss)	(113,177)	(65,979)
Total Synopsys stockholders' equity	3,479,152	3,275,620
Non-controlling interest	5,863	4,104
Total stockholders' equity	3,485,015	3,279,724
Total liabilities and stockholders' equity	$ 6,145,974	$ 5,396,414

See accompanying notes to consolidated financial statements.

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

	Year Ended October 31,		
	2018	2017	2016
Revenue:			
Time-based products	$ 2,303,317	$ 2,021,812	$ 1,910,902
Upfront products	357,698	338,204	248,137
Maintenance and service	460,043	364,864	263,493
Total revenue	3,121,058	2,724,880	2,422,532
Cost of revenue:			
Products	448,430	413,203	346,825
Maintenance and service	203,434	164,872	94,019
Amortization of intangible assets	84,034	76,109	102,118
Total cost of revenue	735,898	654,184	542,962
Gross margin	2,385,160	2,070,696	1,879,570
Operating expenses:			
Research and development	1,084,822	908,841	856,705
Sales and marketing	622,978	549,248	502,368
General and administrative	262,560	196,844	165,962
Amortization of intangible assets	41,630	31,614	27,507
Restructuring charges	12,945	36,586	9,633
Total operating expenses	2,024,935	1,723,133	1,562,175
Operating income	360,225	347,563	317,395
Other income (expense), net	3,318	35,535	12,153
Income (loss) before provision for income taxes	363,543	383,098	329,548
Provision (benefit) for income taxes	(68,975)	246,535	62,722
Net income	$ 432,518	$ 136,563	$ 266,826
Net income per share:			
Basic	$ 2.90	$ 0.91	$ 1.76
Diluted	$ 2.82	$ 0.88	$ 1.73
Shares used in computing per share amounts:			
Basic	149,036	150,457	152,017
Diluted	153,393	154,874	154,721

See accompanying notes to consolidated financial statements.

SYNOPSYS, INC.

CONSOLIDATED STATEMENTS OF COMPREHENSIVE INCOME

(In thousands)

	Year Ended October 31,		
	2018	2017	2016
Net income	$ 432,518	$ 136,563	$ 266,826
Other comprehensive income (loss):			
Change in foreign currency translation adjustment	(18,882)	14,293	5,808
Change in unrealized gains (losses) on investments, net of tax of $0, for fiscal years 2017 and 2016	—	(19)	47
Cash flow hedges:			
Deferred gains (losses), net of tax of $4,675, $(4,380), and $4,372 for fiscal years 2018, 2017 and 2016, respectively	(17,428)	20,760	(25,767)
Reclassification adjustment on deferred (gains) losses included in net income, net of tax of $2,207, $(168), and $(6,253) for fiscal years 2018, 2017 and 2016, respectively	(10,888)	3,564	20,710
Other comprehensive income (loss), net of tax effects	(47,198)	38,598	798
Comprehensive income	$ 385,320	$ 175,161	$ 267,624

See accompanying notes to consolidated financial statements.

SYNOPSYS, INC.
CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY
(In thousands)

	Common Stock		Capital in Excess of Par Value	Retained Earnings	Treasury Stock	Accumulated Other Comprehensive Income (Loss)	Total Synopsys Stockholders' Equity	Non-controlling Interest	Stockholders' Equity
	Shares	Amount							
Balance at October 31, 2015	155,157	$ 1,552	$1,610,460	$1,725,727	$ (98,375)	$ (105,375)	$ 3,133,989	$ —	$ 3,133,989
Net income				266,826			266,826		266,826
Other comprehensive income (loss), net of tax effects						798	798		798
Purchases of treasury stock	(8,506)	(85)	20,085		(420,000)		(400,000)		(400,000)
Common stock issued, net of shares withheld for employee taxes	4,803	48	(80,735)	(44,968)	224,323		98,668		98,668
Stock-based compensation			97,583				97,583		97,583
Other			(2,718)				(2,718)		(2,718)
Balance at October 31, 2016	151,454	$ 1,515	$1,644,675	$1,947,585	$ (294,052)	$ (104,577)	$ 3,195,146	$ —	$ 3,195,146
Net income				136,563			136,563		136,563
Retained earnings adjustment due to adoption of an accounting standard related to stock-based compensation			382	106,107			106,489		106,489
Other comprehensive income (loss), net of tax effects						38,598	38,598		38,598
Purchases of treasury stock	(5,413)	(54)	54		(380,000)		(380,000)		(380,000)
Equity forward contract			(20,000)				(20,000)		(20,000)
Common stock issued, net of shares withheld for employee taxes	4,404	44	(110,976)	(46,382)	247,844		90,530		90,530
Stock-based compensation			108,294				108,294		108,294
Non-controlling interest in an equity investment							—	4,104	4,104
Balance at October 31, 2017	150,445	$ 1,505	$1,622,429	$2,143,873	$ (426,208)	$ (65,979)	$ 3,275,620	$ 4,104	$ 3,279,724
Net income				432,518			432,518		432,518
Retained earnings adjustment due to adoption of an accounting standard related to reclassification of certain tax effects from accumulated other comprehensive income				(293)			(293)		(293)
Other comprehensive income (loss), net of tax effects						(47,198)	(47,198)		(47,198)
Purchases of treasury stock	(4,688)	(47)	47		(420,000)		(420,000)		(420,000)
Equity forward contract			20,000				20,000		20,000
Common stock issued, net of shares withheld for employee taxes	3,508	35	(136,522)	(32,410)	248,526		79,629		79,629
Stock-based compensation			138,876				138,876		138,876
Non-controlling interest in an equity investment							—	1,759	1,759
Balance at October 31, 2018	149,265	$ 1,493	$1,644,830	$2,543,688	$ (597,682)	$ (113,177)	$ 3,479,152	$ 5,863	$ 3,485,015

See accompanying notes to consolidated financial statements.

SYNOPSYS, INC.
CONSOLIDATED STATEMENTS OF CASH FLOWS
(In thousands)

	Year Ended October 31,		
	2018	2017	2016
Cash flow from operating activities:			
Net income	$ 432,518	$ 136,563	$ 266,826
Adjustments to reconcile net income to net cash provided by operating activities:			
Amortization and depreciation	209,207	189,442	207,032
Stock-based compensation	140,032	108,294	97,583
Allowance for doubtful accounts	3,368	2,149	950
(Gain) loss on sale of property and investments	(93)	8	(18)
Write-down of long-term investments	—	1,300	—
Deferred income taxes	(210,310)	123,052	(14,037)
Net changes in operating assets and liabilities, net of acquired assets and liabilities:			
Accounts receivable	(95,785)	2,296	(43,269)
Inventories	(66,509)	(20,137)	(32,072)
Prepaid and other current assets	(12,835)	(8,818)	(5,569)
Other long-term assets	(25,892)	(40,236)	(3,770)
Accounts payable and accrued liabilities	49,043	137,631	18,977
Income taxes	(103,841)	19,665	7,098
Deferred revenue	105,329	(16,644)	86,904
Net cash provided by operating activities	424,232	634,565	586,635
Cash flows from investing activities:			
Proceeds from sales and maturities of short-term investments	12,449	295,633	156,350
Purchases of short-term investments	—	(155,098)	(168,712)
Proceeds from sales of long-term investments	494	839	1,785
Purchases of long-term investments	(3,561)	—	(1,002)
Proceeds from sale of property and equipment	1,662	—	—
Purchases of property and equipment	(98,976)	(70,328)	(66,909)
Cash paid for acquisitions and intangible assets, net of cash acquired	(652,643)	(259,202)	(60,056)
Capitalization of software development costs	(2,950)	(3,226)	(4,131)
Other	—	2,100	—
Net cash used in investing activities	(743,525)	(189,282)	(142,675)
Cash flows from financing activities:			
Proceeds from credit facility	620,635	320,000	185,000
Repayment of debt	(295,313)	(380,625)	(185,000)
Issuances of common stock	123,829	126,337	125,283
Payments for taxes related to net share settlement of equity awards	(45,772)	(36,730)	(26,562)
Purchase of equity forward contract	—	(20,000)	—
Purchases of treasury stock	(400,000)	(380,000)	(400,000)
Other	1,759	(2,102)	(5,658)
Net cash provided by (used in) financing activities	5,138	(373,120)	(306,937)
Effect of exchange rate changes on cash and cash equivalents	(11,086)	(427)	3,409
Net change in cash and cash equivalents	(325,241)	71,736	140,432
Cash and cash equivalents, beginning of year	1,048,356	976,620	836,188
Cash and cash equivalents, end of year	$ 723,115	$ 1,048,356	$ 976,620
Supplemental disclosure of cash flow information:			
Cash paid for income taxes during the year:	$ 252,522	$ 103,478	$ 69,447
Interest payments during the year:	$ 15,307	$ 7,095	$ 3,708

See accompanying notes to consolidated financial statements.

Note 1. Description of Business

Synopsys, Inc. (Synopsys or the Company) provides products and services used by designers across the entire silicon to software spectrum, from engineers creating advanced semiconductors to software developers seeking to ensure the security and quality of their code. The Company is a global leader in supplying the electronic design automation (EDA) software that engineers use to design and test integrated circuits (ICs), also known as chips. The Company also offers semiconductor intellectual property (IP) products, which are pre-designed circuits that engineers use as components of larger chip designs rather than designing those circuits themselves. The Company provides software and hardware used to validate the electronic systems that incorporate chips and the software that runs on them. To complement these offerings, the Company provides technical services and support to help its customers develop advanced chips and electronic systems. The Company is also a leading provider of software tools and services that improve the security and quality of software code in a wide variety of industries, including electronics, financial services, media, automotive, medicine, energy and industrials.

Note 2. Summary of Significant Accounting Policies

Fiscal Year End. The Company's fiscal year ends on the Saturday nearest to October 31 and consists of 52 weeks, with the exception that approximately every five years, the Company has a 53-week year. Fiscal 2018 was a 53-week year and ended on November 3, 2018. Fiscal 2017 and 2016 were 52-week years ending on October 28, 2017 and October 29, 2016, respectively. For presentation purposes, the consolidated financial statements and accompanying notes refer to the closest calendar month end. Fiscal 2019 will be a 52-week year.

Principles of Consolidation. The consolidated financial statements include the accounts of the Company and all of its subsidiaries. All significant intercompany accounts and transactions have been eliminated.

Use of Estimates. To prepare financial statements in conformity with U.S. generally accepted accounting principles (U.S. GAAP), management must make estimates and assumptions that affect the amounts reported in the consolidated financial statements and accompanying notes. Actual results could differ from these estimates and may result in material effects on the Company's operating results and financial position.

Foreign Currency Translation. The functional currency of the majority of the Company's active foreign subsidiaries is the foreign subsidiary's local currency. Assets and liabilities that are not denominated in the functional currency are remeasured into the functional currency with any related gain or loss recorded in earnings. The Company translates assets and liabilities of its non-U.S. dollar functional currency foreign operations into the U.S. dollar reporting currency at exchange rates in effect at the balance sheet date. The Company translates income and expense items of such foreign operations into the U.S. dollar reporting currency at average exchange rates for the period. Accumulated translation adjustments are reported in stockholders' equity, as a component of accumulated other comprehensive income (loss).

Foreign Currency Contracts. The Company operates internationally and is exposed to potentially adverse movements in currency exchange rates. The Company enters into hedges in the form of foreign currency forward contracts to reduce its exposure to foreign currency rate changes on non-functional currency denominated forecasted transactions and balance sheet positions. The assets or liabilities associated with the forward contracts are recorded at fair value in other current assets or accrued liabilities in the consolidated balance sheet.

The accounting for gains and losses resulting from changes in fair value depends on the use of the foreign currency forward contract and whether it is designated and qualifies for hedge accounting. See *Note 5. Financial Assets and Liabilities*.

Fair Values of Financial Instruments. The Company's cash equivalents and foreign currency contracts are carried at fair value. The fair value of the Company's accounts receivable and accounts payable approximates the carrying amount due to their short duration. Non-marketable equity securities are carried at cost, net of impairments. The Company performs periodic impairment analysis on these non-marketable equity securities. The carrying amount of the short-term debt approximates the estimated fair value. See *Note 6. Fair Value Measures*.

Cash and Cash Equivalents. The Company classifies investments with original maturities of three months or less when acquired as cash equivalents.

Concentration of Credit Risk. Financial instruments that potentially subject the Company to significant concentrations of credit risk consist principally of cash equivalents, marketable securities, foreign currency

contracts, and accounts receivable from trade customers. The Company maintains cash equivalents primarily in highly rated taxable and tax-exempt money market funds located in the U.S. and in various overseas locations.

The Company sells its products worldwide primarily to customers in the global electronics market. The Company performs on-going credit evaluations of its customers' financial condition and does not require collateral. The Company establishes reserves for potential credit losses and such losses have been within management's expectations and have not been material in any year presented.

Accounts Receivable, Net. The balances consist of accounts receivable billed and unbilled. Unbilled accounts receivable represent amounts recorded as revenue which will be invoiced within one year of the balance sheet date. The following table represents the components of accounts receivable, net:

	October 31,	
	2018	2017
	(in thousands)	
Accounts receivable	$ 495,763	$ 393,229
Unbilled accounts receivable	64,067	63,080
Total accounts receivable	559,830	456,309
Less allowance for doubtful accounts	(5,613)	(5,165)
Total accounts receivable, net	$ 554,217	$ 451,144

Allowance for Doubtful Accounts. Trade accounts receivable are recorded at the invoiced amount and do not bear interest. The Company maintains allowances for doubtful accounts to reduce the Company's receivables to their estimated net realizable value. The Company provides a general reserve on all accounts receivable based on a review of customer accounts. The following table presents the changes in the allowance for doubtful accounts:

Fiscal Year	Balance at Beginning of Period	Provisions	Write-offs(1)	Balance at End of Period
	(in thousands)			
2018	$ 5,165	$ 3,368	$ (2,920)	$ 5,613
2017	$ 3,201	$ 2,149	$ (185)	$ 5,165
2016	$ 2,561	$ 950	$ (310)	$ 3,201

(1) Balances written off, net of recoveries.

Inventories. Inventories primarily include components and parts used in emulation and prototyping hardware systems. Inventory cost is computed using standard costs, which approximate actual costs, on a first-in, first-out basis and recorded at lower of cost or net realizable value. A charge is recorded to cost of product when inventory is determined to be in excess of anticipated demand or considered obsolete.

Income Taxes. The Company accounts for income taxes using the asset and liability method. Deferred tax assets and liabilities are recognized for the future tax consequences attributable to differences between the financial statement carrying amounts of existing assets and liabilities and their respective tax bases and operating loss and tax credit carryforwards. Deferred tax assets and liabilities are measured using enacted tax rates expected to apply to taxable income in the years in which those temporary differences are expected to be recovered or settled. The effect on deferred tax assets and liabilities of a change in tax rates is recognized in income in the period that includes the enactment date.

The Company accounts for uncertainty in income taxes using a two-step approach to recognizing and measuring uncertain tax positions. The first step is to evaluate the tax position for recognition by determining whether it is more likely than not that the position will be sustained on audit, including resolution of related appeals or litigation processes, if any. The second step is to measure the tax benefit as the largest amount which is more than 50% likely of being realized upon ultimate settlement. An uncertain tax position is considered effectively settled on completion of an examination by a taxing authority if certain other conditions are satisfied.

Property and Equipment. Property and equipment is recorded at cost less accumulated depreciation. Assets, excluding land, are depreciated using the straight-line method over their estimated useful lives. Leasehold

improvements are amortized using the straight-line method over the remaining term of the lease or the economic useful life of the asset, whichever is shorter. Depreciation expenses were $72.8 million, $82.8 million and $73.8 million in fiscal 2018, 2017 and 2016, respectively. Repair and maintenance costs are expensed as incurred and such costs were $45.7 million, $40.6 million and $38.8 million in fiscal 2018, 2017 and 2016, respectively.

A summary of property and equipment, at cost less accumulated depreciation and amortization, as of October 31, 2018 and 2017 is as follows:

	October 31,	
	2018	2017
	(in thousands)	
Computer and other equipment	$ 604,117	$ 540,257
Buildings	68,522	68,877
Furniture and fixtures	61,070	54,882
Land	18,849	20,414
Leasehold improvements	183,430	153,619
	935,988	838,049
Less accumulated depreciation and amortization(1)	(626,678)	(572,035)
Total	$ 309,310	$ 266,014

(1) Accumulated depreciation and amortization includes write-offs due to retirement of fully amortized fixed assets.

The useful lives of depreciable assets are as follows:

	Useful Life in Years
Computer and other equipment	3-5
Buildings	30
Furniture and fixtures	5
Leasehold improvements (average)	5

Goodwill. Goodwill represents the excess of the aggregate purchase price over the fair value of the net tangible and identifiable intangible assets acquired by the Company. The carrying amount of goodwill is tested for impairment annually as of October 31 or more frequently if facts and circumstances warrant a review. The Company determined that it is a single reporting unit for the purpose of goodwill impairment tests. For purposes of assessing the impairment of goodwill, the Company estimates the value of the reporting unit using its market capitalization as the best evidence of fair value. This fair value is then compared to the carrying value of the reporting unit. During fiscal 2018, 2017 and 2016, there were no indicators of impairment to goodwill.

Intangible Assets. Intangible assets consist of acquired technology, certain contract rights, customer relationships, trademarks and trade names, capitalized software, and in-process research and development. These intangible assets are acquired through business combinations, direct purchases, or internally developed capitalized software. Intangible assets are amortized on a straight-line basis over their estimated useful lives which range from one to ten years, except for in-process research and development (IPR&D) projects not yet completed. IPR&D assets are amortized over their estimated useful lives upon completion or are written off upon abandonment.

The Company continually monitors events and changes in circumstances that could indicate carrying amounts of long-lived assets, including property and equipment and intangible assets, may not be recoverable. When such events or changes in circumstances occur, the Company assesses the recoverability of long-lived assets by determining whether the carrying value of such asset group will be recovered through the undiscounted future cash flow. If the undiscounted future cash flow is less than the carrying amount of the asset group, the Company recognizes an impairment loss based on the excess of the carrying amount over the fair value of the asset group. The Company had no material impairment charges for long-lived assets in fiscal 2018, and none in fiscal 2017 or 2016.

Restructuring Charges. During fiscal 2018, the Company recorded $12.9 million of restructuring charges for severance and benefits due to involuntary employee termination actions. The restructuring actions were undertaken to position the Company for future growth, reallocate resources to priority areas and, to a lesser extent, eliminate operational redundancy. These charges consisted primarily of severance benefits. As of October 31, 2018, there was an $8.1 million outstanding balance remaining in accounts payable and accrued liabilities in the consolidated balance sheets. The remaining balance will be paid in fiscal 2019.

During fiscal 2017, the Company recorded $36.6 million of restructuring charges for severance and benefits due to involuntary employee termination actions. The restructuring actions were undertaken to position the Company for future growth, reallocate resources to priority areas, and to a lesser extent, eliminate operational redundancy. These charges consist primarily of severance and retirement benefits. As of October 31, 2017, there was a $17.5 million outstanding balance remaining in accounts payable and accrued liabilities in the consolidated balance sheets, which was paid in fiscal 2018.

During fiscal 2016, the Company recorded $9.6 million of restructuring charges for severance and benefits due to involuntary employee terminations, of which $3.9 million was paid in fiscal 2016. As of October 31, 2016, there was a $5.7 million outstanding balance remaining in accounts payable and accrued liabilities as payroll and related benefits in the consolidated balance sheets. The remaining balance was paid in fiscal 2017.

Accounts Payable and Accrued Liabilities. The balance consists of:

	October 31,	
	2018	2017
	(in thousands)	
Payroll and related benefits	$ 413,307	$ 382,773
Other accrued liabilities	79,973	97,119
Accounts payable	85,046	19,954
Total	$ 578,326	$ 499,846

Other Long-term Liabilities. The balance consists of:

	October 31,	
	2018	2017
	(in thousands)	
Deferred compensation liability (See *Note 10*)	$ 212,165	$ 197,542
Other long-term liabilities	53,395	54,485
Total	$ 265,560	$ 252,027

Other Comprehensive Income (Loss). Other comprehensive income (loss) (OCI) includes all changes in equity during a period, such as accumulated net translation adjustments, unrealized gain (loss) on certain foreign currency forward contracts that qualify as cash flow hedges, reclassification adjustments related to cash flow hedges and unrealized gain (loss) on investments. See *Note 8. Accumulated Other Comprehensive Income (Loss)*.

Revenue Recognition. The Company generates revenue from the sale of products that include software licenses and to a lesser extent, hardware products, maintenance and services. Time-based products revenue consists of fees associated with the licensing of the Company's software. Maintenance and service revenue consists of maintenance fees associated with perpetual licenses, hardware products, and professional services fees. Upfront products revenue includes hardware revenue consisting of sales of Field Programmable Gate Array (FPGA)-based emulation and prototyping products and perpetual software licenses.

Most of the Company's customer arrangements are complex, involving hundreds of products and various license rights, bundled with post-contract customer support and additional meaningful rights that provide a complete end-to-end solution to the customer. Throughout the contract, the Company's customers are typically using a myriad of products to complete each phase of a chip design and are concurrently working on multiple chip designs, or projects, in different phases of the design. During this time, the customer looks to the Company to release state-of-the-art technology as the Company constantly invests to keep up with the rapid change, to address requested

enhancements to the Company's tools to meet customer specifications, to provide support at each stage of the customer's design, including the final manufacturing of the chip (the tape out stage), and other important services.

With respect to software licenses, the Company utilizes primarily two license types:

- Technology Subscription Licenses (TSLs). TSLs are time-based licenses for a finite term, and generally provide the customer with limited rights to receive, or to exchange certain quantities of licensed software for, unspecified future technology. The majority of the Company's arrangements are TSLs due to the nature of the business and customer requirements. In addition to the licenses, the arrangements also include: post-contract customer support, which includes providing frequent updates and upgrades to maintain the utility of the software due to rapid changes in technology; other intertwined services such as multiple copies of the tools; assistance to the Company's customers in applying the Company's technology in their development environment; and rights to remix licenses for other licenses.
- Perpetual licenses. Perpetual licenses continue as long as the customer renews maintenance plus an additional 20 years. Perpetual licenses do not provide the customer any rights to receive, or to exchange licensed software for, unspecified future technology. Customers purchase maintenance separately for the first year and may renew annually.

For the two software license types, the Company recognizes revenue as follows:

- TSLs. The Company typically recognizes revenue from TSL fees ratably over the term of the license period, or as customer installments become due and payable, whichever is later. Revenue attributable to TSLs is reported as "time-based products revenue" in the consolidated statements of operations.
- Perpetual licenses. The Company recognizes revenue from perpetual licenses in full upon shipment of the software if payment terms require the customer to pay at least 75% of the license fee and 100% of the maintenance fee within one year from shipment and all other revenue recognition criteria are met. Revenue attributable to these perpetual licenses is reported as "upfront products revenue" in the consolidated statements of operations. For perpetual licenses in which less than 75% of the license fee and 100% of the maintenance fee is payable within one year from shipment, the Company recognizes revenue as customer installments become due and payable. Such revenue is reported as "time-based products revenue" in the consolidated statements of operations.

The Company's maintenance and service revenue primarily consists of maintenance fees associated with perpetual licenses and hardware products, and professional services fees. The Company recognizes revenue from maintenance arrangements ratably over the maintenance period to the extent cash has been received or fees become due and payable, and recognizes revenue from professional services and training fees as such services are performed and accepted by the customers as needed. Revenue attributable to maintenance, professional services and training is reported as "maintenance and service revenue" in the consolidated statements of operations.

Hardware revenue consists of sales of FPGA-based emulation and prototyping products. The Company recognizes revenue from sales of hardware products in full upon shipment if all other revenue recognition criteria are met. Revenue attributable to these sales is reported as "upfront products revenue" in the consolidated statements of operations.

Infrequently, the Company enters into certain license arrangements wherein licenses are provided for a finite term without any other services or rights, including rights to receive, or to exchange licensed software for, unspecified future technology. The Company recognizes revenue from these term licenses in full upon shipment of the software and when all other revenue recognition criteria are met.

The Company also enters into arrangements in which portions of revenue are contingent upon the occurrence of uncertain future events, such as royalty arrangements. The Company refers to this revenue as "contingent revenue." Contingent revenue is recognized if and when the event that removes the contingency occurs. Such revenue is reported as "time-based products revenue" in the consolidated statements of operations. These arrangements are not material to the Company's total revenue.

The Company infrequently enters into multiple-element arrangements that contain both software and non-software deliverables such as hardware. The Company has determined that the software and non-software deliverables in the Company's contracts are separate units of accounting. The Company recognizes revenue for the separate units of accounting when all revenue recognition criteria are met. Revenue allocated to hardware units of accounting is recognized upon shipment when all other revenue recognition criteria are met. Revenue allocated to software units of accounting is recognized depending on the software license type (TSL or perpetual license). Such arrangements have not had a material effect on the Company's consolidated financial statements and are not expected to have a material effect in future periods.

The Company also enters into arrangements to deliver software products, either alone or together with other products or services, that require significant modification or customization of the software. The Company accounts for such arrangements using the percentage of completion method as the Company has the ability to make reasonably dependable estimates that relate to the extent of progress toward completion, contract revenues and costs. The Company measures the progress towards completion using the labor hours incurred to complete the project. Revenue attributable to these arrangements is reported as "maintenance and service revenue" in the consolidated statements of operations.

The Company determines the fair value of each element in multiple element software arrangements that only contain software and software-related deliverables based on vendor-specific objective evidence (VSOE). The Company limits assessment of VSOE of fair value for each element to the price charged when such element is sold separately. The Company has analyzed all of the elements included in multiple-element software arrangements and has determined that the Company has sufficient VSOE to allocate revenue to the maintenance components of the Company's perpetual license products and to professional services. Accordingly, assuming all other revenue recognition criteria are met, the Company recognizes license revenue from perpetual licenses upon delivery using the residual method, recognizes revenue from maintenance ratably over the maintenance term, and recognizes revenue from professional services as services are performed and accepted by the customer. With respect to TSL arrangements, due to the complexity of the tools, the complexity of the arrangement terms and intertwined services, the license, maintenance and other services are not separable and are considered as a combined unit. Additionally, the Company does not have sufficient VSOE of fair value to allocate the fee between these services. Therefore, the Company recognizes revenue from TSLs ratably over the term of the license, assuming all other revenue recognition criteria are met.

Revenue recognition involves certain judgments. Specifically, in connection with each transaction involving the Company's products, the Company must evaluate whether: (1) persuasive evidence of an arrangement exists, (2) delivery of software or services has occurred, (3) the fee for such software or services is fixed or determinable, and (4) collectability is probable. All four of these criteria must be met in order for the Company to recognize revenue with respect to a particular arrangement. The Company applies these revenue recognition criteria as follows:

- Persuasive Evidence of an Arrangement Exists. Prior to recognizing revenue on an arrangement, the Company's customary policy is to have a written contract, signed by both the customer and by the Company or a purchase order from those customers that have previously negotiated a standard end-user license arrangement or purchase agreement.
- Delivery Has Occurred. The Company delivers its products to its customers electronically or physically. For electronic deliveries, delivery occurs when the Company provides access to its customers to take immediate possession of the software through downloading it to the customer's hardware. For physical deliveries, the standard transfer terms are typically Freight on Board (FOB) shipping point. The Company generally ships its products or license keys promptly after acceptance of customer orders. However, a number of factors can affect the timing of product shipments and, as a result, timing of revenue recognition, including the delivery dates requested by customers and the Company's operational capacity to fulfill product orders at the end of a fiscal quarter.
- The Fee is Fixed or Determinable. The Company's determination that an arrangement fee is fixed or determinable depends principally on the arrangement's payment terms. The Company's standard payment terms for perpetual licenses require 75% or more of the license fee and 100% of the maintenance fee to be paid within one year. If the arrangement includes these terms, the Company regards the fee as fixed or determinable, and recognizes all license revenue under the arrangement in full upon delivery (assuming all other revenue recognition criteria are met). If the arrangement does

not include these terms, the Company does not consider the fee to be fixed or determinable and generally recognizes revenue when customer installments are due and payable. In the case of a TSL, because of the right to exchange products or receive unspecified future technology and because VSOE for maintenance services does not exist for a TSL, the Company recognizes revenue ratably over the term of the license, but not in advance of when customers' installments become due and payable.

- Collectability is Probable. The Company judges collectability of the arrangement fees on a customer-by-customer basis pursuant to its credit review policy. The Company typically sells to customers with whom it has a history of successful collection. For a new customer, or when an existing customer substantially expands its commitments, the Company evaluates the customer's financial position and ability to pay and typically assigns a credit limit based on that review. The Company increases the credit limit only after it has established a successful collection history with the customer. If the Company determines at any time that collectability is not probable under a particular arrangement based upon its credit review process or the customer's payment history, the Company recognizes revenue under that arrangement as customer payments are actually received.

Warranties and Indemnities. The Company generally warrants its products to be free from defects in media and to substantially conform to material specifications for a period of 90 days for software products and for up to six months for hardware systems. In certain cases, the Company also provides its customers with limited indemnification with respect to claims that their use of the Company's software products infringes on United States patents, copyrights, trademarks or trade secrets. The Company is unable to estimate the potential impact of these commitments on the future results of operations. To date, the Company has not been required to pay any material warranty claims.

Net Income Per Share. The Company computes basic income per share by dividing net income available to common shareholders by the weighted average number of common shares outstanding during the period. Diluted net income per share reflects the dilution from potential common shares outstanding such as stock options and unvested restricted stock units and awards during the period using the treasury stock method.

The table below reconciles the weighted average common shares used to calculate basic net income per share with the weighted average common shares used to calculate diluted net income per share:

	Year Ended October 31,		
	2018	2017	2016
	(in thousands, except per share amounts)		
Numerator:			
Net income	$ 432,518	$ 136,563	$ 266,826
Denominator:			
Weighted average common shares for basic net income per share	149,036	150,457	152,017
Dilutive effect of common share equivalents from equity-based compensation	4,357	4,417	2,704
Weighted average common shares for diluted net income per share	153,393	154,874	154,721
Net income per share:			
Basic	$ 2.90	$ 0.91	$ 1.76
Diluted	$ 2.82	$ 0.88	$ 1.73
Anti-dilutive employee stock-based awards excluded(1)	850	345	1,971

(1) These stock options and unvested restricted stock units were anti-dilutive for the respective periods and are excluded in calculating diluted net income per share. While such awards were anti-dilutive for the respective periods, they could be dilutive in the future.

Note 3. Business Combinations

Fiscal 2018 Acquisitions

During fiscal 2018, the Company completed several acquisitions with aggregate cash consideration of $637.0 million, net of cash, cash equivalents and short-term investments acquired. The Company does not consider these acquisitions to be material, individually or in the aggregate, to the Company's consolidated statements of operations. The Company funded these acquisitions with cash.

Acquisition of Black Duck Software (Black Duck)

On December 11, 2017, the Company acquired 100% of the outstanding shares of Black Duck, a privately-held leader in automated solutions for securing and managing open source software, for $565.1 million total purchase consideration.

As of October 31, 2018, the total purchase consideration and the purchase allocation was as follows:

	(in thousands)
Cash paid	$ 563,500
Fair value of assumed equity awards allocated to purchase consideration	1,588
Total purchase consideration	$ 565,088
Goodwill	$ 395,395
Identifiable intangibles assets acquired	178,000
Cash, cash equivalents and short-term investments	19,491
Other tangible liabilities acquired, net	(12,298)
Deferred revenue	(15,500)
Total purchase allocation	$ 565,088

Goodwill of $395.4 million is primarily attributable to the assembled workforce and expectation of sales growth due to the Company's new technology offerings in the security, quality and compliance testing space. The goodwill is not deductible for tax purposes. The acquired identifiable intangible assets of $178.0 million were valued using the income or cost methods. The intangible assets, except for in-process research and development project not yet completed, are being amortized over their respective useful lives ranging from one to ten years. The acquisition-related costs directly attributable to the business combination of $15.5 million, including compensation expenses, professional fees and other direct expenses, were expensed as incurred in the consolidated statement of operations during fiscal year 2018. The Company funded the acquisition with cash of $544.0 million, net of acquired cash, cash equivalents and short-term investments.

The Company also assumed unvested restricted stock units (RSUs) and stock options with a fair value of $15.6 million. The Black-Scholes option-pricing model was used to determine the fair value of these stock options, whereas the fair value of the RSUs was based on the market price on the grant date of the instruments. Of the total fair value of the RSU and stock options assumed, $1.6 million was allocated to the purchase consideration and $14.0 million was allocated to future services to be expensed over their remaining service periods on a straight-line basis.

Other Fiscal 2018 Acquisitions

During fiscal 2018, the Company completed other acquisitions for a total purchase consideration of $93.0 million, net of cash acquired. The Company does not consider these acquisitions to be material to the Company's consolidated financial statements. The preliminary purchase allocations resulted in $47.6 million of goodwill, which is not deductible for tax purposes, and $51.9 million of acquired identifiable intangible assets valued using the income or cost methods. The intangible assets, except for in-process research and development projects not yet completed, are being amortized over their respective useful lives ranging from one to seven years. The acquisition-related costs for these acquisitions, totaling $3.8 million, were expensed as incurred in the consolidated statement of operations.

Note 4. Goodwill and Intangible Assets

Goodwill:

	(in thousands)
Balance at October 31, 2016	$ 2,518,245
Additions	178,545
Effect of foreign currency translation	10,184
Balance at October 31, 2017	$ 2,706,974
Additions	443,007
Effect of foreign currency translation	(6,732)
Balance at October 31, 2018(1)	$ 3,143,249

(1) There is no impairment of goodwill for periods presented.

Intangible assets as of October 31, 2018 consist of the following:

	Gross Assets	Accumulated Amortization	Net Assets
		(in thousands)	
Core/developed technology	$ 773,147	$ 598,956	$ 174,191
Customer relationships	358,524	204,382	154,142
Contract rights intangible	183,953	177,191	6,762
Trademarks and trade names	42,929	21,944	20,985
In-process research and development (IPR&D)(2)	1,200	—	1,200
Capitalized software development costs	35,818	32,694	3,124
Total	$ 1,395,571	$ 1,035,167	$ 360,404

(2) IPR&D is reclassified to core/developed technology upon completion or is written off upon abandonment.

Intangible assets as of October 31, 2017 consist of the following:

	Gross Assets	Accumulated Amortization	Net Assets
		(in thousands)	
Core/developed technology	$ 647,975	$ 526,796	$ 121,179
Customer relationships	278,811	166,886	111,925
Contract rights intangible	174,615	172,178	2,437
Trademarks and trade names	25,329	17,401	7,928
In-process research and development (IPR&D)(2)	6,600	—	6,600
Capitalized software development costs	32,868	29,094	3,774
Total	$ 1,166,198	$ 912,355	$ 253,843

Amortization expense related to intangible assets consisted of the following:

	Year Ended October 31,		
	2018	2017	2016
		(in thousands)	
Core/developed technology	$ 78,820	$ 65,916	$ 85,331
Customer relationships	37,395	27,340	24,594
Contract rights intangible	4,906	10,886	16,543
Trademarks and trade names	4,543	3,580	3,156
Capitalized software development costs(3)	3,599	3,986	3,697
Total	$ 129,263	$ 111,708	$ 133,321

(3) Amortization of capitalized software development costs is included in cost of products revenue in the consolidated statements of operations.

The following table presents the estimated future amortization of intangible assets:

Fiscal Year	(in thousands)
2019	$ 102,605
2020	78,074
2021	55,850
2022	44,009
2023	29,219
2024 and thereafter	49,447
IPR&D(4)	1,200
Total	$ 360,404

(4) IPR&D assets are amortized over their useful lives upon completion or are written off upon abandonment.

Note 5. Financial Assets and Liabilities

Cash equivalents. The Company classifies time deposits and other investments with original maturities less than three months as cash equivalents.

As of October 31, 2018, the balances of the Company's cash equivalents and non-marketable equity securities investments were:

	Cost	Gross Unrealized Gains	Gross Unrealized Losses Less Than 12 Continuous Months	Gross Unrealized Losses 12 Continuous Months or Longer	Estimated Fair Value(1)
			(in thousands)		
Cash equivalents:					
Money market funds	$ 165,296	$ —	$ —	$ —	$ 165,296
Total:	$ 165,296	$ —	$ —	$ —	$ 165,296
Other long-term assets:					
Non-marketable equity securities	$ 10,892	$ —	$ —	$ —	$ 10,892
Total:	$ 10,892	$ —	$ —	$ —	$ 10,892

(1) See *Note 6. Fair Value Measures* for further discussion on fair values of cash equivalents.

As of October 31, 2017, the balances of our cash equivalents and non-marketable equity securities investments were:

	Cost	Gross Unrealized Gains	Gross Unrealized Losses Less Than 12 Continuous Months	Gross Unrealized Losses 12 Continuous Months or Longer	Estimated Fair Value(1)
			(in thousands)		
Cash equivalents:					
Money market funds	$ 560,594	$ —	$ —	$ —	$ 560,594
Total:	$ 560,594	$ —	$ —	$ —	$ 560,594
Other long-term assets:					
Non-marketable equity securities	$ 7,826	$ —	$ —	$ —	$ 7,826
Total:	$ 7,826	$ —	$ —	$ —	$ 7,826

(1) See *Note 6. Fair Value Measures* for further discussion on fair values of cash equivalents.

Non-marketable equity securities. The Company's strategic investment portfolio consists of non-marketable equity securities in privately held companies. The securities accounted for as cost method investments are reported at cost, net of impairment losses. Securities accounted for as equity method investments are recorded at cost plus the proportional share of the issuers' income or loss, which is recorded in the Company's other income (expense), net. The cost basis of securities sold is based on the specific identification method. Refer to *Note 6. Fair Value Measures.*

Derivatives. The Company recognizes derivative instruments as either assets or liabilities in the consolidated financial statements at fair value and provides qualitative and quantitative disclosures about such derivatives. The Company operates internationally and is exposed to potentially adverse movements in foreign currency exchange rates. The Company enters into hedges in the form of foreign currency forward contracts to reduce its exposure to foreign currency rate changes on non-functional currency denominated forecasted transactions and balance sheet positions including: (1) certain assets and liabilities, (2) shipments forecasted to occur within approximately one month, (3) future billings and revenue on previously shipped orders, and (4) certain future intercompany invoices denominated in foreign currencies.

The duration of forward contracts ranges from approximately one month to 21 months, the majority of which are short-term. The Company does not use foreign currency forward contracts for speculative or trading purposes. The Company enters into foreign exchange forward contracts with high credit quality financial institutions that are rated 'A' or above and to date has not experienced nonperformance by counterparties. Further, the Company anticipates continued performance by all counterparties to such agreements.

The assets or liabilities associated with the forward contracts are recorded at fair value in other current assets or accrued liabilities in the consolidated balance sheets. The accounting for gains and losses resulting from changes in fair value depends on the use of the foreign currency forward contract and whether it is designated and qualifies for hedge accounting.

Cash Flow Hedging Activities

Certain foreign exchange forward contracts are designated and qualify as cash flow hedges. These contracts have durations of approximately 21 months or less. Certain forward contracts are rolled over periodically to capture the full length of exposure to the Company's foreign currency risk, which can be up to three years. To receive hedge accounting treatment, all hedging relationships are formally documented at the inception of the hedge, and the hedges must be highly effective in offsetting changes to future cash flows on the hedged transactions. The effective portion of gains or losses resulting from changes in fair value of these hedges is initially reported, net of tax, as a

component of other comprehensive income (loss) (OCI), in stockholders' equity and reclassified into revenue or operating expenses, as appropriate, at the time the hedged transactions affect earnings. The Company expects a majority of the hedge balance in OCI to be reclassified to the statements of operations within the next twelve months.

Hedging effectiveness is evaluated monthly using spot rates, with any gain or loss caused by hedging ineffectiveness recorded in other income (expense), net. The premium/discount component of the forward contracts is recorded to other income (expense), net, and is not included in evaluating hedging effectiveness.

Non-designated Hedging Activities

The Company's foreign exchange forward contracts that are used to hedge non-functional currency denominated balance sheet assets and liabilities are not designated as hedging instruments. Accordingly, any gains or losses from changes in the fair value of the forward contracts are recorded in other income (expense), net. The gains and losses on these forward contracts generally offset the gains and losses associated with the underlying assets and liabilities, which are also recorded in other income (expense), net. The duration of the forward contracts for hedging the Company's balance sheet exposure is approximately one month.

The Company also has certain foreign exchange forward contracts for hedging certain international revenues and expenses that are not designated as hedging instruments. Accordingly, any gains or losses from changes in the fair value of the forward contracts are recorded in other income (expense), net. The gains and losses on these forward contracts generally offset the gains and losses associated with the foreign currency in operating income. The duration of these forward contracts is usually less than one year. The overall goal of the Company's hedging program is to minimize the impact of currency fluctuations on its net income over its fiscal year.

The effects of the changes in the fair values of non-designated forward contracts for fiscal years 2018, 2017, and 2016 are summarized as follows:

	October 31,		
	2018	2017	2016
	(in thousands)		
Gain (loss) recorded in other income (expense), net	$ 3,361	$ 1,359	$ (4,533)

The notional amounts in the table below for derivative instruments provide one measure of the transaction volume outstanding:

	As of October 31, 2018	As of October 31, 2017
	(in thousands)	
Total gross notional amount	$ 1,135,549	$ 955,139
Net fair value	$ (18,120)	$ 14,052

The notional amounts for derivative instruments do not represent the amount of the Company's exposure to market gain or loss. The Company's exposure to market gain or loss will vary over time as a function of currency exchange rates. The amounts ultimately realized upon settlement of these financial instruments, together with the gains and losses on the underlying exposures, will depend on actual market conditions during the remaining life of the instruments.

The following represents the balance sheet location and amount of derivative instrument fair values segregated between designated and non-designated hedge instruments:

	Fair Values of derivative instruments designated as hedging instruments	Fair Values of derivative instruments not designated as hedging instruments
	(in thousands)	
As of October 31, 2018		
Other current assets	$ 4,771	$ 131
Accrued liabilities	$ 22,890	$ 132
As of October 31, 2017		
Other current assets	$ 16,582	$ 15
Accrued liabilities	$ 2,485	$ 59

The following table represents the income statement location and amount of gains and losses on derivative instrument fair values for designated hedge instruments, net of tax:

	Location of gain (loss) recognized in OCI on derivatives	Amount of gain (loss) recognized in OCI on derivatives (effective portion)	Location of gain (loss) reclassified from OCI	Amount of gain (loss) reclassified from OCI (effective portion)
		(in thousands)		
Fiscal year ended October 31, 2018				
Foreign exchange contracts	Revenue	$ 693	Revenue	$ 1,103
Foreign exchange contracts	Operating expenses	(18,121)	Operating expenses	9,785
Total		$ (17,428)		$ 10,888
Fiscal year ended October 31, 2017				
Foreign exchange contracts	Revenue	$ 7,582	Revenue	$ (2,759)
Foreign exchange contracts	Operating expenses	13,346	Operating expenses	(805)
Total		$ 20,928		$ (3,564)
Fiscal year ended October 31, 2016				
Foreign exchange contracts	Revenue	$ (14,580)	Revenue	$ (8,585)
Foreign exchange contracts	Operating expenses	(11,259)	Operating expenses	(12,125)
Total		$ (25,839)		$ (20,710)

The following table represents the ineffective portions and portions excluded from effectiveness testing of the hedge gains (losses) for derivative instruments designated as hedging instruments, which are recorded in other income (expense) income, net:

Foreign exchange contracts	Amount of gain (loss) recognized in income statement on derivatives (ineffective portion)(1)	Amount of gain (loss) recognized in income statement on derivatives (excluded from effectiveness testing)(2)
	(in thousands)	
Fiscal year ended October 31, 2018	$ 467	$ 2,848
Fiscal year ended October 31, 2017	$ 311	$ 3,018
Fiscal year ended October 31, 2016	$ 1,468	$ 6,058

(1) The ineffective portion includes forecast inaccuracies.

(2) The portion excluded from effectiveness testing includes the discount earned or premium paid for the contracts.

Other Commitments - Credit and Term Loan Facilities

In July 2018, the Company entered into a 220.0 million RMB (approximately $33.0 million) credit agreement with a lender in China to support its facilities expansion. Borrowings bear interest at a floating rate based on the Chinese Central Bank rate plus 10% of such rate. As of October 31, 2018, the Company had $5.5 million outstanding under the agreement.

On November 28, 2016, the Company entered into an amended and restated credit agreement with several lenders (the Credit Agreement) providing for (i) a $650.0 million senior unsecured revolving credit facility (the Revolver) and (ii) a $150.0 million senior unsecured term loan facility (the Term Loan). The Credit Agreement amended and restated the Company's previous credit agreement dated May 19, 2015 (the 2015 Agreement), in order to increase the size of the revolving credit facility from $500.0 million to $650.0 million, provide a new $150.0 million senior unsecured term loan facility, and to extend the termination date of the revolving credit facility from May 19, 2020 to November 28, 2021. Subject to obtaining additional commitments from lenders, the principal amount of the loans provided under the Credit Agreement may be increased by the Company by up to an additional $150.0 million. The Credit Agreement contains financial covenants requiring the Company to operate within a maximum leverage ratio and maintain a minimum interest coverage ratio, as well as other non-financial covenants. As of October 31, 2018, the Company was in compliance with all financial covenants.

As of October 31, 2018, the Company had $133.8 million outstanding balance, net of debt issuance costs, under the Term Loan, of which $120.0 million was classified as long-term liabilities. Outstanding principal payments under the Term Loan are due as follows:

Fiscal year	(in thousands)
2019	$ 14,062
2020	17,813
2021	27,187
2022	75,000
Total	$ 134,062

As of October 31, 2017, the Company had $144.0 million outstanding balance, net of debt issuance costs, under the Term Loan, of which $134.1 million was classified as long-term liabilities, and no outstanding balance under the Revolver.

The total outstanding balance of the Revolver as of October 31, 2018 was $330.0 million, which was included in short-term liabilities. The Company expects its borrowings under the Revolver will fluctuate from quarter to quarter. Borrowings bear interest at a floating rate based on a margin over the Company's choice of market observable base rates as defined in the Credit Agreement. As of October 31, 2018, borrowings under the Term Loan bore interest at LIBOR +1.125% and the applicable interest rate for the Revolver was LIBOR +1.000%. In addition, commitment fees are payable on the Revolver at rates between 0.125% and 0.200% per year based on the Company's leverage ratio on the daily amount of the revolving commitment.

Subsequent to fiscal year 2018, the Company drew down $150.0 million under the Revolver. The total outstanding balance of the Revolver as of December 14, 2018 is $430.0 million, net of repayments.

The carrying amount of the short-term and long-term debt approximates the estimated fair value. These borrowings under the Credit Agreement have a variable interest rate structure and are classified within Level 2 of the fair value hierarchy.

Note 6. Fair Value Measures

Accounting Standards Codification (ASC) 820-10, *Fair Value Measurements and Disclosures*, defines fair value, establishes guidelines and enhances disclosure requirements for fair value measurements. The accounting guidance requires an entity to maximize the use of observable inputs and minimize the use of unobservable inputs when measuring fair value. The accounting guidance also establishes a fair value hierarchy based on the independence of the source and objective evidence of the inputs used. There are three fair value hierarchies based upon the level of inputs that are significant to fair value measurement:

Level 1—Observable inputs that reflect quoted prices (unadjusted) for identical instruments in active markets;

Level 2—Observable inputs other than quoted prices included in Level 1 for similar instruments in active markets, quoted prices for identical or similar instruments in markets that are not active, and model-driven valuations in which all significant inputs and significant value drivers are observable in active markets; and

Level 3—Unobservable inputs to the valuation derived from fair valuation techniques in which one or more significant inputs or significant value drivers are unobservable.

On a recurring basis, the Company measures the fair value of certain of its assets and liabilities, which include cash equivalents, non-qualified deferred compensation plan assets, and foreign currency derivative contracts.

The Company's cash equivalents are classified within Level 1 or Level 2 because they are valued using quoted market prices in an active market or alternative independent pricing sources and models utilizing market observable inputs.

The Company's non-qualified deferred compensation plan assets consist of money market and mutual funds invested in domestic and international marketable securities that are directly observable in active markets and are therefore classified within Level 1.

The Company's foreign currency derivative contracts are classified within Level 2 because these contracts are not actively traded and the valuation inputs are based on quoted prices and market observable data of similar instruments.

The Company's borrowings under its credit and term loan facilities are classified within Level 2 because these borrowings are not actively traded and have a variable interest rate structure based upon market rates currently available to the Company for debt with similar terms and maturities. Refer to *Note 5. Financial Assets and Liabilities.*

Assets/Liabilities Measured at Fair Value on a Recurring Basis

Assets and liabilities measured at fair value on a recurring basis are summarized below as of October 31, 2018:

		Fair Value Measurement Using		
	Total	Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
	(in thousands)			
Assets				
Cash equivalents:				
Money market funds	$ 165,296	$ 165,296	$ —	$ —
Prepaid and other current assets:				
Foreign currency derivative contracts	4,902	—	4,902	—
Other long-term assets:				
Deferred compensation plan assets	212,165	212,165	—	—
Total assets	$ 382,363	$ 377,461	$ 4,902	$ —
Liabilities				
Accounts payable and accrued liabilities:				
Foreign currency derivative contracts	$ 23,022	$ —	$ 23,022	$ —
Other long-term liabilities:				
Deferred compensation plan liabilities	212,165	212,165	—	—
Total liabilities	$ 235,187	$ 212,165	$ 23,022	$ —

Assets and liabilities measured at fair value on a recurring basis are summarized below as of October 31, 2017:

		Fair Value Measurement Using		
	Total	Quoted Prices in Active Markets for Identical Assets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
		(in thousands)		
Assets				
Cash equivalents:				
Money market funds	$ 560,594	$ 560,594	$ —	$ —
Prepaid and other current assets:				
Foreign currency derivative contracts	16,596	—	16,596	—
Other long-term assets:				
Deferred compensation plan assets	197,542	197,542	—	—
Total assets	$ 774,732	$ 758,136	$ 16,596	$ —
Liabilities				
Accounts payable and accrued liabilities:				
Foreign currency derivative contracts	$ 2,544	$ —	$ 2,544	$ —
Other long-term liabilities:				
Deferred compensation plan liabilities	197,542	197,542	—	—
Total liabilities	$ 200,086	$ 197,542	$ 2,544	$ —

Assets/Liabilities Measured at Fair Value on a Non-Recurring Basis

Non-Marketable Equity Securities

Equity investments in privately-held companies, also called non-marketable equity securities, are accounted for using either the cost or equity method of accounting.

The non-marketable equity securities are measured and recorded at fair value when an event or circumstance which impacts the fair value of these securities indicates an other-than-temporary decline in value has occurred. In such events, these equity investments would be classified within Level 3 as they are valued using significant unobservable inputs or data in an inactive market, and the valuation requires management judgment due to the absence of market price and inherent lack of liquidity. The Company monitors these investments and generally uses the income approach to assess impairments based primarily on the financial conditions of these companies.

The Company did not recognize any impairment during fiscal 2018 and 2016. The Company recorded $1.3 million of other-than-temporary impairment during fiscal 2017.

The following table presents the non-marketable equity securities that were measured and recorded at fair value within other long-term assets on a non-recurring basis and the loss recorded in other income (expense), net:

	Balance as of October 31, 2017	Significant Unobservable Inputs (Level 3)	Total (losses) for Fiscal 2017
		(in thousands)	
Non-marketable equity securities	$ —	$ —	$ (1,300)

Note 7. Commitments and Contingencies

Lease Commitments

The Company leases certain of its domestic and foreign facilities and certain office equipment under non-cancelable lease agreements. The lease agreements generally require the Company to pay property taxes, insurance, maintenance and repair costs. Rent expenses were $75.7 million, $68.1 million and $63.9 million in fiscal 2018, 2017 and 2016, respectively. The Company charges operating lease payments to expense using the straight-line method. The Company subleases portions of its facilities and records sublease payments as a reduction of rent expense.

The Company's principal offices are located in two office buildings in Mountain View, California. The buildings together provide approximately 341,000 square feet. This space is leased through August 2030, and the Company has two options to extend the lease term, the first to extend the term by ten years, followed by a second option to extend by approximately nine additional years.

As of October 31, 2018, anticipated future minimum lease payments on all non-cancellable operating leases with an initial term in excess of one year, net of sublease income are as follows:

	Minimum Lease Payments	Sublease Income	Net
		(in thousands)	
Fiscal Year			
2019	$ 61,819	$ 3,160	$ 58,659
2020	58,220	3,052	55,168
2021	58,564	5,976	52,588
2022	49,805	7,517	42,288
2023	43,357	6,523	36,834
Thereafter	318,135	49,961	268,174
Total	$ 589,900	$ 76,189	$ 513,711

Legal Proceedings

The Company is subject to routine legal proceedings, as well as demands, claims and threatened litigation that arise in the normal course of its business. The ultimate outcome of any litigation is often uncertain and unfavorable outcomes could have a negative impact on the Company’s results of operations and financial condition. The Company regularly reviews the status of each significant matter and assesses its potential financial exposure. If the potential loss from any claim or legal proceeding is considered probable and the amount is estimable, the Company accrues a liability for the estimated loss. Legal proceedings are inherently uncertain and as circumstances change, it is possible that the amount of any accrued liability may increase, decrease, or be eliminated.

The Company has determined that, except as set forth below, no disclosure of estimated loss is required for a claim against the Company because: (1) there is not a reasonable possibility that a loss exceeding amounts already recognized (if any) may be incurred with respect to such claim; (2) a reasonably possible loss or range of loss cannot be estimated; or (3) such estimate is immaterial.

Mentor Patent Litigation

Prior to the legal settlement as further described below, the Company was engaged in complex patent litigation with Mentor Graphics Corporation (Mentor) involving several actions in different forums. The Company succeeded to the litigation when it acquired Emulation & Verification Engineering S.A. on October 4, 2012.

Legal Settlement

In March 2017, Siemens PLM Software (Siemens) acquired Mentor. On June 29, 2018, the Company, Siemens and Mentor settled all outstanding patent litigation between the Company and Mentor for a $65.0 million payment made in the current quarter from the Company to Mentor. The Company had previously accrued $39.0 million and recorded the remaining $26.0 million as an expense in the quarter ended July 31, 2018. As a result of the settlement, the litigation with Mentor was dismissed and the injunction entered in connection with that litigation was vacated.

The settlement included mutual seven-year patent cross-licenses between the Company and Siemens, and between the Company and Mentor. The Company and Mentor also amended an existing interoperability agreement to collaborate on a wide range of EDA products for the benefit of their mutual customers. The amendment includes a one-time termination charge between $0.0 and $25.0 million, payable to Mentor under certain conditions.

Tax Matters

The Company undergoes examination from time to time by U.S. and foreign authorities for non-income based taxes, such as sales, use and value-added taxes, and is currently under examination by tax authorities in certain jurisdictions. If the potential loss from such examinations is considered probable and the amount or the range of loss could be estimated, the Company would accrue a liability for the estimated expense.

In addition to the foregoing, the Company is, from time to time, party to various other claims and legal proceedings in the ordinary course of its business, including with tax and other governmental authorities. For a description of certain of these other matters, refer to *Note 11. Income Taxes.*

Note 8. Accumulated Other Comprehensive Income (Loss)

Components of accumulated other comprehensive income (loss), on an after-tax basis where applicable, were as follows:

	Year Ended October 31,	
	2018	2017
	(in thousands)	
Cumulative currency translation adjustments	$ (89,289)	$ (70,407)
Unrealized gain (loss) on derivative instruments, net of taxes	(23,888)	4,428
Total accumulated other comprehensive income (loss)	$ (113,177)	$ (65,979)

The effect of amounts reclassified out of each component of accumulated other comprehensive income (loss) into net income was as follows:

	Year Ended October 31,		
	2018	2017	2016
		(in thousands)	
Reclassifications from accumulated other comprehensive income (loss) into consolidated statement of operations:			
Gain (loss) on cash flow hedges, net of taxes			
Revenues	$ 1,103	$ (2,759)	$ (8,585)
Operating expenses	9,785	(805)	(12,125)
Gain (loss) on available-for-sale securities			
Other income (expense)	—	(8)	18
Total reclassifications into net income	$ 10,888	$ (3,572)	$ (20,692)

Amounts reclassified in fiscal 2018, 2017, and 2016 primarily consisted of gains (losses) from the Company's cash flow hedging activities. See *Note 5. Financial Assets and Liabilities.*

Note 9. Stock Repurchase Program

The Company's Board of Directors (Board) previously approved a stock repurchase program pursuant to which the Company was authorized to purchase up to $500.0 million of its common stock, and has periodically replenished the stock repurchase program to such amount. The Board replenished the stock repurchase program up to $500.0 million on April 5, 2018. The program does not obligate the Company to acquire any particular amount of common stock, and the program may be suspended or terminated at any time by the Company's Chief Financial Officer or the Board. The Company repurchases shares to offset dilution caused by ongoing stock issuances from existing equity plans for equity compensation awards and issuances related to acquisitions, and when management believes it is a good use of cash. Repurchases are transacted in accordance with Rule 10b-18 of the Securities Exchange Act of 1934, as amended (the Exchange Act) and may be made through any means including, but not limited to, open market purchases, plans executed under Rule 10b5-1(c) of the Exchange Act and structured transactions. As of October 31, 2018, $325 million remained available for further repurchases under the program.

In September 2017, the Company entered into an accelerated share repurchase agreement (the September 2017 ASR) to repurchase an aggregate of $100.0 million of the Company's common stock. Pursuant to the September 2017 ASR, the Company made a prepayment of $100.0 million and received initial share deliveries valued at $80.0 million. The remaining balance of $20.0 million was settled in the first quarter of 2018. Total shares repurchased under the September 2017 ASR were approximately 1.2 million shares, at an average purchase price of $83.80 per share.

In December 2017, the Company entered into two simultaneous accelerated share repurchase agreements (the December 2017 ASRs) to repurchase an aggregate of $200.0 million of the Company's common stock. Pursuant to the December 2017 ASRs, the Company made a prepayment of $200.0 million and received initial share deliveries of shares valued at $160.0 million. In February 2018, the Company received additional deliveries of shares valued at $20.0 million for one of the two December 2017 ASRs. The remaining balance of $20.0 million was settled in March 2018. Total shares repurchased under the December 2017 ASR were approximately 2.3 million shares, at an average purchase price of $87.08 per share.

In May 2018, the Company entered into an accelerated share repurchase agreement (the May 2018 ASR) to repurchase an aggregate of $165.0 million of the Company's common stock. Pursuant to the May 2018 ASR, the Company made a prepayment of $165.0 million and received initial share deliveries valued at $132.0 million. The remaining balance of $33.0 million was settled in October 2018. Total shares repurchased under the May 2018 ASR were approximately 1.8 million shares, at an average purchase price of $92.42 per share.

The following table summarizes stock repurchase activities as well as the reissuance of treasury stock for employee stock-based compensation purposes:

	Year Ended October 31,		
	2018	2017	2016
	(in thousands, except per share price)		
Shares repurchased(1)	4,688	5,413	8,506
Average purchase price per share(1)	$ 89.59	$ 70.21	$ 49.37
Aggregate purchase price(1)	$ 420,000	$ 380,000	$ 420,000
Reissuance of treasury stock	3,508	4,404	4,803

(1) The first quarter of fiscal 2018 includes the settlement of the $20.0 million equity forward contract related to the September 2017 ASR.

Note 10. Employee Benefit Plans

Employee Stock Purchase Plan

Under the Company's Employee Stock Purchase Plan (ESPP), participating employees are granted the right to purchase shares of common stock at a price per share that is 85% of the lesser of the fair market value of the shares at (1) the beginning of an offering period (generally, a rolling two year period) or (2) the purchase date (generally occurring at the end of each semi-annual purchase period), subject to the terms of the plan, including a plan limit on the number of shares that may be purchased in a purchase period.

On April 5, 2018, the Company's stockholders approved an amendment to the ESPP to increase the number of shares of common stock authorized for issuance under the plan by 5.0 million shares. During fiscal 2018, 2017 and 2016, the Company issued 1.2 million, 1.6 million, and 1.6 million shares, respectively, under the ESPP at average per share prices of $62.52, $40.85 and $37.77, respectively. As of October 31, 2018, 10.9 million shares of common stock were reserved for future issuance under the ESPP.

Equity Compensation Plans

2006 Employee Equity Incentive Plan. On April 25, 2006, the Company's stockholders approved the 2006 Employee Equity Incentive Plan (2006 Employee Plan), which provides for the grant of incentive stock options, non-statutory stock options, restricted stock awards, restricted stock unit awards, stock appreciation rights and other forms of equity compensation, including performance stock awards and performance cash awards, as determined by the plan administrator. The terms and conditions of each type of award are set forth in the 2006 Employee Plan and in the award agreements governing particular awards. Options granted under this plan generally have a contractual term of seven years and generally vest over four years. On April 5, 2018, the Company's stockholders approved an amendment to, among other things, increase the number of shares of common stock reserved for future issuance under the 2006 Employee Plan by 3.0 million shares. As of October 31, 2018, an aggregate of 5.9 million stock options and 3.6 million restricted stock units were outstanding, and 12.4 million shares were available for future issuance under the 2006 Employee Plan.

2005 and 2017 Non-Employee Directors Equity Incentive Plans. On April 6, 2017, the Company's stockholders approved the 2017 Non-Employee Directors Equity Incentive Plan (2017 Directors Plan). In connection with stockholder approval of the 2017 Directors Plan, the 2005 Non-Employee Directors Equity Incentive Plan (2005 Directors Plan) was terminated as of April 6, 2017, and no awards can be granted under the 2005 Directors Plan after that date.

Under the 2005 Directors Plan, the Company granted options to purchase 188,709 shares of common stock, which vest over a period of three to four years, with an aggregate grant date fair value of $6.7 million, to non-employee directors during fiscal 2007, fiscal 2011, fiscal 2015, and fiscal 2017. As of October 31, 2018, 5,178 shares of restricted stock were unvested and 65,060 stock options were outstanding under the 2005 Directors Plan.

The 2017 Directors Plan provides for equity awards to non-employee directors in the form of stock options, restricted stock units, restricted stock or a combination thereof. On April 6, 2017, the Company's stockholders approved an aggregate of 0.45 million shares of common stock reserved under the 2017 Directors Plan.

For the fiscal year ended October 31, 2018, the Company issued an aggregate of 14,763 shares of restricted stock awards with an aggregate grant date fair value of approximately $1.2 million under the 2017 Directors Plan. Restricted stock awards generally vest on an annual basis under the 2017 Directors Plan. As of October 31, 2018, 14,763 shares of restricted stock were unvested and no stock options were outstanding, and a total of 415,613 shares of common stock were reserved for future grant under the 2017 Directors Plan.

Other Assumed Stock Plans through Acquisitions. In connection with the Company's acquisitions in fiscal 2008, fiscal 2010, fiscal 2012, fiscal 2014, fiscal 2015, fiscal 2017, and fiscal 2018, the Company assumed certain outstanding stock awards of acquired companies. If these assumed equity awards are canceled, forfeited or expire unexercised, the underlying shares do not become available for future grant. As of October 31, 2018, 0.5 million shares of the Company's common stock remained subject to such outstanding assumed equity awards.

Restricted Stock Units. Since fiscal 2007, restricted stock units are granted under the 2006 Employee Plan as part of the Company's new hire and annual incentive compensation program. Restricted stock units are valued based on the closing price of the Company's common stock on the grant date. In general, restricted stock units vest over

three to four years and are subject to the employee's continuing service with the Company. For each restricted stock unit granted under the 2006 Employee Plan, a share reserve ratio is applied for the purpose of determining the remaining number of shares reserved for future grants under the plan. On April 3, 2012, the Company's stockholders approved an amendment of the 2006 Employee Plan to prospectively change the share reserve ratio from 1.25 to 1.50. On April 2, 2015, the stockholders approved amending the share reserve ratio from 1.50 to 1.60. On March 29, 2016, the stockholders approved amending the share reserve ratio from 1.60 to 1.70.

The following table contains information concerning activities related to restricted stock units:

	Restricted Stock Units	Weighted Average Grant Date Fair Value	Weighted Average Remaining Contractual Life (In Years)	Aggregate Fair Value
	(in thousands, except per share and life amounts)			
Balance at October 31, 2015	3,928	$ 41.61	1.54	
Granted	1,765	$ 49.59		
Vested(1)	(1,547)	$ 38.33		$ 79,558
Forfeited	(111)	$ 43.12		
Balance at October 31, 2016	4,035	$ 46.37	1.56	
Granted	1,584	$ 70.49		
Vested(1)	(1,536)	$ 43.53		$ 110,103
Forfeited	(240)	$ 49.36		
Balance at October 31, 2017	3,843	$ 57.26	1.54	
Granted(2)	1,679	$ 89.35		
Vested(1)	(1,495)	$ 52.55		$ 136,417
Forfeited	(258)	$ 67.04		
Balance at October 31, 2018	3,769	$ 72.75	1.46	

(1) The number of vested restricted stock units includes shares that were withheld on behalf of employees to satisfy the minimum statutory tax withholding requirements.

(2) The Company assumed unvested restricted stock units from acquisitions including Black Duck.

SYNOPSYS, INC.

NOTES TO CONSOLIDATED FINANCIAL STATEMENTS—Continued

The following table contains additional information concerning activities related to stock options and restricted stock units under all equity plans, other than shares available for grant under the 2017 Directors Plan:

		Options(2)			
	Available for Grant(3)	Options Outstanding	Weighted-Average Exercise Price per Share	Weighted-Average Remaining Contractual Life (In Years)	Aggregate Intrinsic Value
		(in thousands, except per share and life amounts)			
Balance at October 31, 2015	11,883	7,289	$ 34.94	4.67	$ 109,627
Options granted	(1,685)	1,685	$ 47.39		
Options exercised		(2,154)	$ 30.06		
Options canceled/forfeited/expired	33	(65)	$ 35.31		
Restricted stock units granted(1)	(2,967)				
Restricted stock units forfeited(1)	180				
Additional shares reserved	3,800				
Balance at October 31, 2016	11,244	6,755	$ 39.59	4.65	$ 126,850
Options granted	(1,505)	1,536	$ 68.18		
Options assumed(2)		154	$ 34.52		
Options exercised		(1,770)	$ 34.56		
Options canceled/forfeited/expired	129	(145)	$ 47.17		
Restricted stock units granted(1)	(2,694)				
Restricted stock units forfeited(1)	409				
Additional shares reserved	5,000				
Balance at October 31, 2017	12,583	6,530	$ 46.83	4.60	$ 263,555
Options granted	(1,134)	1,134	$ 89.52		
Options assumed(2)		141	$ 18.66		
Options exercised		(1,336)	$ 38.18		
Options canceled/forfeited/expired	157	(178)	$ 51.82		
Restricted stock units granted(1)	(2,541)				
Restricted stock units forfeited(1)	374				
Additional shares reserved	3,000				
Balance at October 31, 2018	12,439	6,291	$ 55.63	4.39	$ 214,432
Exercisable at October 31, 2018		3,387	$ 44.43	3.42	$ 152,837

(1) These amounts do not reflect the actual number of restricted stock units granted or forfeited but rather the effect on the total remaining shares available for future grants after the application of the share reserve ratio. For more information about the share reserve ratio, please see *Restricted Stock Units* above.

(2) The Company assumed options outstanding under various plans through acquisitions.

(3) Excluding shares reserved for future issuance under the 2017 Directors Plan.

The aggregate intrinsic value in the preceding table represents the pretax intrinsic value based on stock options with an exercise price less than the Company's closing stock price of $89.56 as of October 31, 2018. The pretax intrinsic value of options exercised and their average exercise prices were:

	Year Ended October 31,		
	2018	2017	2016
	(in thousands, except per share price)		
Intrinsic value	$ 71,840	$ 67,089	$ 51,408
Average exercise price per share	$ 38.18	$ 34.56	$ 30.06

Restricted stock award activities during fiscal 2018 under the 2005 Directors Plan and 2017 Directors Plan are summarized as follows:

	Restricted Shares	Weighted-Average Grant Date Fair Value
	(in thousands, except per share)	
Unvested at October 31, 2017	38	$ 59.89
Granted	15	$ 82.96
Vested	(32)	$ 62.09
Forfeited	(1)	$ 48.27
Unvested at October 31, 2018	20	$ 73.95

Valuation and Expense of Stock-Based Compensation. The Company estimates the fair value of stock-based awards in the form of stock options and employee stock purchase rights under employee stock purchase plans on the grant date. The value of awards expected to vest is recognized as expense over the applicable service periods. The Company uses the straight-line attribution method to recognize stock-based compensation costs over the service period of the award. The Company uses the Black-Scholes option-pricing model to determine the fair value of stock options, stock appreciation rights and employee stock purchase plan awards. The Black-Scholes option-pricing model incorporates various subjective assumptions including expected volatility, expected term and interest rates. The expected volatility for both stock options and stock purchase rights under the ESPP is estimated by a combination of implied volatility for publicly traded options of the Company's common stock with a term of six months or longer and the historical stock price volatility over the estimated expected term of the Company's stock-based awards. The expected term of the Company's stock-based awards is based on historical experience.

The assumptions presented in the following table were used to estimate the fair value of stock options and employee stock purchase rights granted under the Company's stock plans or stock plans assumed from acquisitions:

	Year Ended October 31,		
	2018	2017	2016
Stock Options			
Expected life (in years)	4.1	4.1	4.1
Risk-free interest rate	2.10% - 2.95%	1.73% - 2.06%	1.06% - 1.63%
Volatility	20.22% - 21.04%	18.51% - 19.67%	19.21%-21.62%
Weighted average estimated fair value	$23.55	$13.56	$8.97
ESPP			
Expected life (in years)	0.5 - 2.0	0.5 - 2.0	0.5 - 2.0
Risk-free interest rate	1.80% - 2.73%	0.82% - 1.37%	0.53% - 0.86%
Volatility	19.99% - 21.54%	17.20% - 19.99%	17.03% - 25.46%
Weighted average estimated fair value	$23.34	$18.77	$12.75

The following table presents stock-based compensation expense for fiscal 2018, 2017, and 2016, respectively:

	Year Ended October 31,		
	2018	2017	2016
	(in thousands)		
Cost of products	$ 14,648	$ 12,553	$ 11,006
Cost of maintenance and service	5,467	3,918	2,418
Research and development expense	67,355	52,933	49,511
Sales and marketing expense	28,069	21,001	19,690
General and administrative expense	24,493	17,889	14,958
Stock-based compensation expense before taxes	140,032	108,294	97,583
Income tax benefit	(26,578)	(30,950)	(25,967)
Stock-based compensation expense after taxes	$ 113,454	$ 77,344	$ 71,616

As of October 31, 2018, the Company had $260.0 million of total unrecognized stock-based compensation expense relating to options and restricted stock units and awards, which is expected to be recognized over a weighted average period of 2.4 years.

Deferred Compensation Plan. The Company maintains the Synopsys Deferred Compensation Plan (Deferred Plan), which permits eligible employees to defer up to 50% of their annual cash base compensation and up to 100% of their eligible cash variable compensation. Amounts may be withdrawn from the Deferred Plan pursuant to elections made by the employees in accordance with the terms of the plan. Since the inception of the Deferred Plan, the Company has not made any matching or discretionary contributions to the Deferred Plan. There are no Deferred Plan provisions that provide for any guarantees or minimum return on investments. Undistributed amounts under the Deferred Plan are subject to the claims of the Company's creditors. The securities held by the Deferred Plan are classified as trading securities.

Deferred plan assets and liabilities are as follows:

	As of October 31, 2018	As of October 31, 2017
	(in thousands)	
Plan assets recorded in other long-term assets	$ 212,165	$ 197,542
Plan liabilities recorded in other long-term liabilities(1)	$ 212,165	$ 197,542

(1) Undistributed deferred compensation balances due to participants.

Income or loss from the change in fair value of the Deferred Plan assets is recorded in other income (expense), net. The increase or decrease in the fair value of the undistributed Deferred Plan obligation is recorded in total cost of revenue and operating expense. The following table summarizes the impact of the Deferred Plan:

	Year Ended October 31,		
	2018	2017	2016
	(in thousands)		
Increase (reduction) to cost of revenue and operating expense	$ 4,636	$ 29,606	$ 4,400
Other income (expense), net	4,636	29,606	4,400
Net increase (decrease) to net income	$ —	$ —	$ —

Other Retirement Plans. The Company sponsors various retirement plans for its eligible U.S. and non-U.S. employees. Total contributions to these plans were $56.5 million, $57.4 million, and $53.4 million in fiscal 2018, 2017, and 2016, respectively. For employees in the United States and Canada, the Company matches pretax employee contributions up to a maximum of U.S. $3,000 and Canadian $4,000, respectively, per participant per year.

Note 11. Income Taxes

The domestic and foreign components of the Company's total income (loss) before provision for income taxes are as follows:

	Year Ended October 31,		
	2018	2017	2016
		(in thousands)	
United States	$ (18,029)	$ (2,702)	$ 22,134
Foreign	381,572	385,800	307,414
Total income (loss) before provision for income taxes	$ 363,543	$ 383,098	$ 329,548

The components of the provision (benefit) for income taxes were as follows:

	Year Ended October 31,		
	2018	2017	2016
		(in thousands)	
Current:			
Federal	$ (1,120)	$ 25,420	$ (6,106)
State	2,025	5,565	2,670
Foreign	140,430	92,498	80,195
	141,335	123,483	76,759
Deferred:			
Federal	(139,547)	95,003	(23,510)
State	(25,661)	24,440	11,950
Foreign	(45,102)	3,609	(2,477)
	(210,310)	123,052	(14,037)
Provision (benefit) for income taxes	$ (68,975)	$ 246,535	$ 62,722

The provision (benefit) for income taxes differs from the taxes computed with the statutory federal income tax rate as follows:

	Year Ended October 31,		
	2018	2017	2016
	(in thousands)		
Statutory federal tax	$ 85,142	$ 134,084	$ 115,343
State tax (benefit), net of federal effect	(32,351)	(20,071)	(14,492)
Tax credits	(35,142)	(24,365)	(36,979)
Tax on foreign earnings less than U.S. statutory tax	(104,252)	(52,413)	(68,246)
Tax settlements	(14,691)	(7,057)	(16,479)
Stock-based compensation	(19,293)	(26,205)	5,709
Changes in valuation allowance	78,192	47,745	25,590
Integration of acquired technologies	27,927	36,443	37,525
Undistributed earnings of foreign subsidiaries	(974)	(9,610)	9,940
Tax impact of repatriation	—	166,152	—
Impact of tax restructuring	(171,979)	—	—
Impact of Tax Act rate change	51,075	—	—
Transition tax	63,107	—	—
Other	4,264	1,832	4,811
Provision (benefit) for income taxes	$ (68,975)	$ 246,535	$ 62,722

The integration of acquired technologies represents the income tax effect resulting from the transfer of certain intangible assets among company-controlled entities. The income tax effect is generally recognized over five years. These intangible assets generally result from the acquisition of technology by a company-controlled entity as part of a business or asset acquisition.

The Tax Cuts and Jobs Act (Tax Act), enacted on December 22, 2017, lowered the statutory federal corporate income tax rate from 35% to 21% effective on January 1, 2018. Because the Company's fiscal 2018 commenced on November 1, 2017, the annual statutory federal corporate tax rate applicable to fiscal 2018 is a blended rate of 23.4%. Beginning in the Company's fiscal 2019, the annual statutory federal corporate tax rate will be 21%.

During the year, the Company made provisional estimates of the accounting impacts of certain provisions of the Tax Act. In the fourth quarter, as a result of further analyses of certain aspects of the Tax Act, the Company finalized the following provisional estimates.

As a result of the reduction in the federal corporate tax rate, the Company remeasured its deferred taxes, resulting in a first-quarter provisional tax expense of $45.6 million based on the tax rate that will apply when these deferred taxes are settled or realized in future periods. In the fourth quarter, the Company finalized its calculations resulting in a tax expense for fiscal 2018 of $51.1 million.

As part of the adoption of a new territorial tax system, the Tax Act required the Company to pay a one-time transition tax of 15.5% on previously untaxed earnings represented by foreign cash and certain other net current assets, and 8% on the remaining earnings. As of the third quarter of fiscal 2018, the Company had recorded a provisional transition tax expense of $73.4 million, as well as a provisional income tax payable of $17.9 million. In the fourth quarter, the Company finalized its calculations, resulting in a tax expense of $63.1 million and income tax payable of $8.9 million. The Company intends to elect to pay the transition tax over a period of eight years as permitted by the Tax Act.

The Company continues to obtain, analyze and interpret additional guidance issued related to the Tax Act. The applicability and impact of the following new tax provisions, are dependent in part on forthcoming Internal Revenue Service guidance.

- A tax on global intangible low-tax income (GILTI), which is determined annually based on the Company's aggregate foreign subsidiaries' income in excess of certain qualified business asset investment return, will be effective for the Company in its fiscal year 2019. The Company needs additional information to complete its analysis on whether to adopt an accounting policy to account for the tax effects of GILTI in the period that it is subject to such tax, or to provide deferred taxes for book and tax basis differences that upon reversal, may be subject to such tax. Accordingly, the Company has not recorded any tax or deferred tax assets or liabilities with respect to GILTI in fiscal year 2018. The Company will make its accounting policy decision and complete the required accounting in the first quarter of fiscal 2019.
- A base erosion and anti-abuse tax (BEAT), which functions as a minimum tax that partially disallows deductions for certain related party transactions, that is not effective for the Company until its fiscal year 2019.
- A special tax deduction for foreign-derived intangible income (FDII), which, in general, allows a deduction of certain intangible income earned in the U.S. and derived from foreign sources, that is not effective for the Company until its fiscal year 2019.

As part of the adoption of a territorial tax system, the Tax Act also provides an exemption from federal income taxes for distributions from foreign subsidiaries made after December 31, 2017, that were not subject to the one-time transition tax. The Company has provided for foreign withholding taxes on undistributed earnings of certain of its foreign subsidiaries to the extent such earnings are no longer considered to be indefinitely reinvested in the operations of those subsidiaries.

In the fourth quarter of 2018, the Company made significant changes to its international tax structure by transferring intangible assets between certain foreign subsidiaries and changing the tax status of these subsidiaries for U.S. tax purposes. As a result, the Company recorded a deferred tax benefit of $172.0 million for the future U.S. tax deduction related to these intangible assets. The Company paid foreign income tax of $67.7 million associated with the gain recognized on certain of these transactions. The tax liabilities associated with these transfers are treated as prepaid taxes. A portion of these foreign taxes may result in a U.S. foreign tax credit, but the amount realized cannot be determined at this time. The tax liabilities and benefits are subject to examination by U.S. and foreign tax authorities in future years.

The significant components of deferred tax assets and liabilities were as follows:

	October 31,	
	2018	2017
	(in thousands)	
Net deferred tax assets:		
Deferred tax assets:		
Accruals and reserves	$ 17,766	$ 36,906
Deferred revenue	37,072	42,420
Deferred compensation	50,096	67,145
Intangible and depreciable assets	185,940	51,679
Capitalized research and development costs	4,817	12,508
Stock-based compensation	19,825	23,679
Tax loss carryovers	37,029	23,623
Foreign tax credit carryovers	64,803	7,662
Research and other tax credit carryovers	250,069	157,817
Other	4,480	—
Gross deferred tax assets	671,897	423,439
Valuation allowance	(201,258)	(121,770)
Total deferred tax assets	470,639	301,669
Deferred tax liabilities:		
Intangible assets	72,682	62,299
Undistributed earnings of foreign subsidiaries	523	1,300
Other	—	1,758
Total deferred tax liabilities	73,205	65,357
Net deferred tax assets	$ 397,434	$ 236,312

It is more likely than not that the results of future operations will be able to generate sufficient taxable income to realize the net deferred tax assets. The valuation allowance provided against the Company's deferred tax assets as of October 31, 2018 is mainly attributable to U.S. and international foreign tax credits and the California research credit. The valuation allowance increased by a net of $79.5 million in fiscal 2018 primarily related to the realizability of approximately $50.8 million U.S. foreign tax credits generated as a result of the foreign tax on the transfer of intangibles associated with the tax restructuring. Proposed regulations providing guidance related to the foreign tax credit were issued on November 28, 2018. If these regulations were to be finalized in their current form, the Company could release all or a portion of the valuation allowance on these foreign tax credits. The remainder of the increase in the valuation allowance was primarily due to the amount of California research credits that the Company does not expect to be realized, taking into account the impact of certain provisions of the Tax Act.

The Company has the following tax loss and credit carryforwards available to offset future income tax liabilities:

Carryforward	Amount	Expiration Date
	(in thousands)	
Federal net operating loss carryforward	$ 139,526	2019-2037
Federal research credit carryforward	109,760	2019-2037
Federal foreign tax credit carryforward	2,427	2019-2027
International foreign tax credit carryforward	12,943	Indefinite
California research credit carryforward	188,826	Indefinite
Other state research credit carryforward	10,873	2023-2033
State net operating loss carryforward	104,174	2024-2037

The federal and state net operating loss carryforward is from acquired companies and the annual use of such loss is subject to significant limitations under Internal Revenue Code Section 382 and certain provisions of the Tax Act.

Foreign tax credits may only be used to offset tax attributable to foreign source income. The federal research tax credit was permanently reinstated in fiscal 2016.

The gross unrecognized tax benefits increased by approximately $39.3 million during fiscal 2018 resulting in gross unrecognized tax benefits of $131.0 million as of October 31, 2018. A reconciliation of the beginning and ending balance of gross unrecognized tax benefits is summarized as follows:

	As of October 31, 2018	As of October 31, 2017
	(in thousands)	
Beginning balance	$ 91,637	$ 106,542
Increases in unrecognized tax benefits related to prior year tax positions	2,572	3,117
Decreases in unrecognized tax benefits related to prior year tax positions	(27,615)	(49,456)
Increases in unrecognized tax benefits related to current year tax positions	67,961	31,007
Decreases in unrecognized tax benefits related to settlements with taxing authorities	(175)	(784)
Reductions in unrecognized tax benefits due to lapse of applicable statute of limitations	(8,828)	(2,635)
Increases in unrecognized tax benefits acquired	7,886	1,934
Changes in unrecognized tax benefits due to foreign currency translation	(2,419)	1,912
Ending balance	$ 131,019	$ 91,637

As of October 31, 2018 and 2017, approximately $120.9 million and $88.5 million, respectively, of the unrecognized tax benefits would affect the Company's effective tax rate if recognized upon resolution of the uncertain tax positions.

Interest and penalties related to estimated obligations for tax positions taken in the Company's tax returns are recognized as a component of income tax expense (benefit) in the consolidated statements of operations and totaled approximately $9.4 million, $0.2 million and $0.8 million for fiscal years 2018, 2017 and 2016, respectively. As of October 31, 2018 and 2017, the combined amount of accrued interest and penalties related to tax positions taken on the Company's tax returns was approximately $12.6 million and $3.2 million, respectively.

The timing of the resolution of income tax examinations, and the amounts and timing of various tax payments that are part of the settlement process, are highly uncertain. Variations in such amounts and/or timing could cause large fluctuations in the balance sheet classification of current and non-current assets and liabilities. The Company believes that in the coming 12 months, it is reasonably possible that either certain audits will conclude or the statute of limitations on certain state and foreign income and withholding taxes will expire, or both. Given the uncertainty as to ultimate settlement terms, the timing of payment and the impact of such settlements on other uncertain tax positions, the range of the estimated potential decrease in underlying unrecognized tax benefits is between $0.0 and $7.0 million.

The Company and/or its subsidiaries remain subject to tax examination in the following jurisdictions:

Jurisdiction	Year(s) Subject to Examination
United States	Fiscal 2018
California	Fiscal years after 2014
Hungary and Ireland	Fiscal years after 2013
Japan and Taiwan	Fiscal years after 2011

In addition, the Company has made acquisitions with operations in several of its significant jurisdictions which may have years subject to examination different from the years indicated in the above table.

On July 27, 2015, the United States Tax Court (Tax Court) issued an opinion (*Altera Corp. et al. v. Commissioner*) regarding the treatment of stock-based compensation expense in intercompany cost-sharing arrangements. In view of the Tax Court opinion, the Company amended its cost-sharing arrangement effective February 1, 2016 to exclude

stock-based compensation expense on a prospective basis and has reflected the corresponding benefits in its income tax expense for fiscal 2016 and 2017 and in its effective annual rate for fiscal year 2018. On July 24, 2018, the United States Court of Appeals for the Ninth Circuit (Ninth Circuit) reversed the decision of the Tax Court, but subsequently withdrew the decision on August 7, 2018. A rehearing of the case was held on October 16, 2018, but a decision has not yet been issued. As the final resolution with respect to historical cost-sharing of stock-based compensation, and the potential impact on the Company, is unclear, the Company is recording no impact at this time and will continue to monitor developments related to this opinion and the potential impact of those developments on the Company's prior fiscal years. The Company's intercompany cost-sharing arrangement was terminated at the end of fiscal 2018 as part of the tax restructuring.

IRS Examinations

In fiscal 2018, the Company reached final settlement with the Examination Division of the IRS for fiscal 2017 and recognized approximately $21.8 million in unrecognized tax benefits, primarily due to the allowance of certain foreign tax credits, and research tax credits from acquired companies.

In fiscal 2017, the Company reached final settlement with the Examination Division of the IRS for fiscal 2016 and recognized approximately $4.6 million in unrecognized tax benefits.

In fiscal 2016, the Company reached final settlement with the Examination Division of the IRS for fiscal 2015 and recognized approximately $20.7 million in unrecognized tax benefits.

State Examinations

In fiscal 2017, the Company reached an agreement with the California Franchise Tax Board for fiscal 2014, 2013, and 2012. As a result of the agreement, the Company recognized tax expense of $0.4 million, reduced its deferred tax assets by $1.1 million, recognized $14.6 million in unrecognized tax benefits, and increased its valuation allowance by $13.2 million.

In fiscal 2016, the Company reached final settlement with the California Franchise Tax Board for fiscal 2011, 2010, and 2009. As a result of the settlement, the Company reduced its deferred tax assets by $4.9 million, recognized $10.3 million in unrecognized tax benefits, and increased its valuation allowance by $5.4 million.

Non-U.S. Examinations

Hungary

In July 2017, the Hungarian Tax Authority (HTA) issued a final assessment against the Company's Hungarian subsidiary (Synopsys Hungary) for fiscal years 2011 through 2013. The HTA has disallowed Synopsys Hungary's tax positions taken during these years regarding the timing of the deduction of research expenses and applied withholding taxes on certain payments made to affiliates, resulting in an aggregate tax assessment of approximately $44.5 million and interest and penalties of $18.0 million (at current exchange rates). On August 2, 2017, Synopsys Hungary filed a claim contesting the final assessment with the Hungarian Administrative Court. On November 16, 2017, Synopsys Hungary paid the assessment as required by law, which was recorded as a prepaid tax on its balance sheet, while continuing its challenge to the assessment in court. In fiscal 2018, the Company reevaluated its strategy and subsequently withdrew its contest concerning the Hungary tax litigation for the issue related to the timing of the deduction of research expenses and recorded a tax expense of $5.7 million. The Company's position regarding the applied withholding taxes on certain payments made to affiliates has not changed. If the Company prevails on the remaining issue, the remaining assessment of $36.2 million including the associated interest and penalties would be canceled, but the Hungarian statutory accounting treatment could have an indirect adverse impact on certain tax benefits in the year of the cancellation.

Korea

In fiscal 2017, the Company settled certain transfer pricing issues with the Korea National Tax Service for fiscal years 2012 to 2016. As a result of the settlement, the Company recognized income tax expense of $7.9 million.

Taiwan

In fiscal 2017, the Company reached an agreement with the Taiwanese tax authorities on certain tax positions for fiscal year 2014 resulting in an income tax benefit of $10.9 million.

In fiscal 2016, the Company reached final settlement with the Taiwanese tax authorities for fiscal 2011, with regard to certain transfer pricing issues. As a result of the settlement, the Company paid $0.3 million of tax and recognized $0.7 million in unrecognized tax benefits.

India

In fiscal 2016, the Company agreed to settle certain transfer pricing issues with the Indian tax authorities for various fiscal years. As a result of the settlement, the Company recognized income tax expense, net of foreign tax credits, of $4.6 million.

Note 12. Other Income (Expense), Net

The following table presents the components of other income (expense), net:

	Year Ended October 31,		
	2018	2017	2016
		(in thousands)	
Interest income	$ 5,323	$ 7,241	$ 3,715
Interest expense	(15,607)	(7,303)	(3,771)
Gain (loss) on assets related to deferred compensation plan	4,636	29,606	4,400
Foreign currency exchange gain (loss)	3,557	3,354	156
Other, net	5,409	2,637	7,653
Total	$ 3,318	$ 35,535	$ 12,153

Note 13. Segment Disclosure

ASC 280, *Segment Reporting,* requires disclosures of certain information regarding operating segments, products and services, geographic areas of operation and major customers. Segment reporting is based upon the "management approach," i.e., how management organizes the Company's operating segments for which separate financial information is (1) available and (2) evaluated regularly by the Chief Operating Decision Makers (CODMs) in deciding how to allocate resources and in assessing performance. Synopsys' CODMs are the Company's two Co-Chief Executive Officers.

The Company operates in a single segment to provide software products and consulting services primarily in the EDA software industry. In making operating decisions, the CODMs primarily consider consolidated financial information, accompanied by disaggregated information about revenues by geographic region. Specifically, the CODMs consider where individual "seats" or licenses to the Company's products are located in allocating revenue to particular geographic areas. Revenue is defined as revenues from external customers. Goodwill is not allocated since the Company operates in one reportable operating segment. Revenues and property and equipment, net, related to operations in the United States and other by geographic areas were:

	Year Ended October 31,		
	2018	2017	2016
		(in thousands)	
Revenue:			
United States	$ 1,508,224	$ 1,357,364	$ 1,205,880
Europe	369,125	308,419	287,381
Japan	283,337	247,631	239,964
Asia Pacific and Other	960,372	811,466	689,307
Consolidated	$ 3,121,058	$ 2,724,880	$ 2,422,532

	As of October 31,	
	2018	2017
	(in thousands)	
Property and Equipment, net:		
United States	$ 210,914	$ 189,379
Other countries	98,396	76,635
Total	$ 309,310	$ 266,014

Geographic revenue data for multi-regional, multi-product transactions reflect internal allocations and are therefore subject to certain assumptions and to the Company's methodology.

One customer, including its subsidiaries, through multiple agreements accounted for 15.4%, 17.9%, and 15.9% of the Company's consolidated revenue in fiscal 2018, 2017, and 2016, respectively.

Note 14. Effect of New Accounting Pronouncements

In May 2014, the Financial Accounting Standards Board (FASB) issued Accounting Standards Update (ASU) 2014-09, "Revenue from Contracts with Customers (Topic 606)," which supersedes the revenue recognition requirements in "Revenue Recognition (Topic 605)." This ASU requires an entity to recognize revenue when goods are transferred or services are provided to customers in an amount that reflects the consideration to which the entity expects to be entitled to in exchange for those goods or services. This ASU also requires disclosures enabling users of financial statements to understand the nature, amount, timing, and uncertainty of revenue and cash flows arising from contracts with customers.

Since the issuance of Topic 606, the FASB has issued several amendments to the ASU, including amendments that defer the initially proposed adoption date, clarify accounting for licenses of intellectual property, and identify performance obligations.

Topic 606 is effective for the Company beginning in fiscal 2019, including interim periods within that reporting period. The ASU permits two retrospective methods for adoption. The Company will adopt Topic 606 using the modified retrospective method under which the cumulative effect of initially applying the guidance is recognized at the date of initial application.

Under the modified retrospective transition method, the Company evaluated each contract that is effective on the adoption date as if that contract had been accounted for under Topic 606 from contract inception. Some revenue that would have been recognized in future periods under Topic 605 will be recast under Topic 606 as if the revenue had been recognized in prior periods. As this transition method requires that the Company does not adjust historical reported revenue amounts, the revenue that would have been recognized under this method prior to the adoption date will be a cumulative adjustment to retained earnings and will not be recognized as revenue in future periods as previously planned. Hence, the Company expects an immaterial percentage of its year-end backlog to be adjusted to retained earnings upon adoption. The Company will also have related changes to its accounts receivable and deferred revenue balances.

The Company derives the majority of its revenue from Technology Subscription License (TSL) contracts. The Company believes that the promised licenses of software (i.e., functional intellectual property) and the promise to provide substantive, timely, and technologically relevant updates and services in the Company's TSL contracts reflect inputs to a combined item that represent a single overall promise to provide customer access to a suite of EDA software in an integrated solution that will evolve as the Company's customers' industries evolve through rapid technology changes. Accordingly, the Company has concluded that this single overall promise will be recognized as revenue over the term of the contract period. Accordingly, the Company expects that there will not be a material change in the nature and timing of revenue recognition for its TSL contracts under Topic 606.

The timing of revenue recognition for the Company's upfront products, maintenance and professional services will remain substantially unchanged.

Since VSOE for undelivered elements is not a requirement for separation, revenue for IP products will be recognized upon delivery as opposed to over the contract period.

Topic 606 also requires the deferral of incremental costs of obtaining a contract with a customer. This will require the Company to capitalize incremental costs such as commissions and other costs directly related to obtaining customer contracts and amortize those costs over the period the assets are expected to contribute future cash flows. As commissions paid for renewals are commensurate with the amounts paid for initial contracts, the deferred incremental costs will be recognized over the contract term. Under the existing rules, the Company expenses commissions as incurred. There will be an immaterial balance sheet impact at the date of adoption from recognizing the deferred incremental costs of obtaining contracts with customers. This change will not have a material impact to the Company's commission expenses as the amortization of capitalized commissions under Topic 606 will be similar to the amount of commissions expense for fiscal year 2019 under Topic 605.

In February 2016, the FASB issued ASU 2016-2, "Leases (Topic 842)," which supersedes the lease requirements in "Leases (Topic 840)." This ASU requires a lessee to recognize a right-of-use asset and a lease payment liability for most leases in the Consolidated Statement of Financial Position. This ASU also makes minor changes to lessor accounting and aligns with the new revenue recognition guidance. This ASU will be effective for fiscal 2020, including interim periods within that reporting period, and earlier adoption is permitted. The Company is currently evaluating its lease portfolio and the impact of adoption is expected to be material to the consolidated balance sheet.

In October 2016, the FASB issued ASU 2016-16, "Income Taxes (Topic 740), Intra-Entity Transfers of Assets Other Than Inventory." This ASU requires the immediate recognition of current and deferred income tax effects of intra-entity transfers of assets other than inventory. This ASU will be effective for fiscal 2019, including interim periods within that reporting period, and earlier adoption is permitted. As a result of the adoption, the Company expects to record a decrease of approximately $129.8 million in retained earnings as of the beginning of the period of adoption, with a corresponding decrease in prepaid taxes related to the unamortized tax expense attributed to intra-entity transfers of assets (other than inventory) previously deferred. Upon adoption, the Company will recognize the income tax consequences of any new intra-entity transfer of assets other than inventory in the consolidated statement of income in the period when the transaction takes place.

Supplementary Data - Selected Unaudited Quarterly Financial Data

The table below includes certain unaudited financial information for the last eight fiscal quarters. Refer to Note 2 of *Notes to Consolidated Financial Statements* for information on the Company's fiscal year end.

	Quarter Ended			
	January 31,	April 30,	July 31,	October 31,
	(in thousands, except per share amounts)			
2018				
Revenue	$ 769,426	$ 776,836	$ 779,714	$ 795,082
Gross margin	588,270	598,057	594,333	604,500
Income before provision for income taxes	120,103	119,299	71,893	52,248
Net (loss) income	(3,691)	102,472	79,409	254,328
Net (loss) income per share				
Basic	$ (0.02)	$ 0.69	$ 0.53	$ 1.71
Diluted(1)	(0.02)	0.67	0.52	1.66
2017				
Revenue	$ 652,786	$ 680,069	$ 695,381	$ 696,644
Gross margin	497,040	518,041	525,835	529,780
Income before provision for income taxes	108,361	62,020	112,791	99,926
Net income (loss)	86,588	53,306	116,751	(120,082)
Net income (loss) per share				
Basic	$ 0.57	$ 0.35	$ 0.78	$ (0.80)
Diluted	0.56	0.34	0.75	(0.80)

(1) Net income (loss) per share is computed independently. Therefore, the sum of the quarterly net income per share may not equal to the total computed for the year or any cumulative interim period.

Item 9. *Changes in and Disagreements with Accountants on Accounting and Financial Disclosure*

Not applicable.

Item 9A. *Controls and Procedures*

(a) *Evaluation of Disclosure Controls and Procedures.* As of October 31, 2018, Synopsys carried out an evaluation under the supervision and with the participation of Synopsys' management, including the Co-Chief Executive Officers and Chief Financial Officer, of the effectiveness of the design and operation of Synopsys' disclosure controls and procedures (as such term is defined in Rules 13a-15(e) and 15d-15(e) under the Exchange Act). There are inherent limitations to the effectiveness of any system of disclosure controls and procedures. Accordingly, even effective disclosure controls and procedures can only provide reasonable, not absolute, assurance of achieving their control objectives. Our Co-Chief Executive Officers and Chief Financial Officer have concluded that, as of October 31, 2018, Synopsys' disclosure controls and procedures were effective to provide reasonable assurance that information required to be disclosed in the reports Synopsys files and submits under the Exchange Act is recorded, processed, summarized and reported as and when required, and that such information is accumulated and communicated to Synopsys' management, including the Co-Chief Executive Officers and Chief Financial Officer, to allow timely decisions regarding its required disclosure.

(b) *Management's Report on Internal Control Over Financial Reporting*. Our management is responsible for establishing and maintaining adequate internal control over financial reporting (as defined in Rules 13a-15(f) and 15d-15(f) under the Exchange Act) for Synopsys.

Under the supervision and with the participation of our management, including our Co-Chief Executive Officers and Chief Financial Officer, we conducted an evaluation of the effectiveness of our internal control over financial reporting as of October 31, 2018. In assessing the effectiveness of our internal control over financial reporting, our management used the framework established in *Internal Control Integrated Framework (2013)* issued by The Committee of Sponsoring Organizations of the Treadway Commission (COSO).

Our management has concluded that, as of October 31, 2018, our internal control over financial reporting was effective based on these criteria. Our independent registered public accounting firm, KPMG LLP, has issued an auditors' report on the effectiveness of our internal control over financial reporting, which is included herein.

(c) *Changes in Internal Control Over Financial Reporting.* There were no changes in Synopsys' internal control over financial reporting during the fiscal quarter ended October 31, 2018 that have materially affected, or are reasonably likely to materially affect, Synopsys' internal control over financial reporting.

Item 9B. *Other Information*

On December 12, 2018, the Board of Directors of the Company amended and restated the Company's Bylaws (as so amended, the Amended and Restated Bylaws), effective immediately. The Amended and Restated Bylaws amend the Company's prior Bylaws to (i) add a forum selection provision for the adjudication of certain disputes and (ii) make certain immaterial and administrative updates.

The new forum selection provision, set forth in Article IX of the Amended and Restated Bylaws, provides that, unless the Company consents in writing to the selection of an alternative forum, the Court of Chancery of the State of Delaware shall be the sole and exclusive forum for (i) any derivative action or proceeding brought on behalf of the Company, (ii) any action asserting a claim of breach of a fiduciary duty owed by any director, officer, employee or agent of the Company to the Company or the Company's stockholders, (iii) any action asserting a claim arising pursuant to any provision of the General Corporation Law of Delaware, the certificate of incorporation of the Company or the Company's bylaws, or (iv) any action asserting a claim governed by the internal affairs doctrine.

The foregoing description is qualified in its entirety by reference to the Amended and Restated Bylaws, a copy of which is attached hereto as Exhibit 3.2 and incorporated herein by reference.

PART III

Item 10. *Directors, Executive Officers and Corporate Governance*

For information with respect to our executive officers, see *Executive Officers of the Registrant* in Part I, Item 1 of this Annual Report.

All other information required by this Item is incorporated herein by reference from our definitive Proxy Statement for the 2019 Annual Meeting of Stockholders (the Proxy Statement) scheduled to be held on April 8, 2019, as provided under the headings “Proposal 1: Election of Directors,” “Audit Committee Report,” “Corporate Governance,” and “Section 16(a) Beneficial Ownership Reporting Compliance.”

Item 11. *Executive Compensation*

The information required by this Item is incorporated herein by reference from the Proxy Statement, as provided under the headings “Compensation Discussion and Analysis” (and all subheadings thereunder), "Executive Compensation Tables" (and all subheadings thereunder), "Director Compensation," “Compensation Committee Interlocks and Insider Participation,” and “Compensation Committee Report.”

Item 12. *Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters*

The information required by this Item is incorporated herein by reference from the Proxy Statement, as provided under the headings “Equity Compensation Plan Information” and “Security Ownership of Certain Beneficial Owners and Management.”

Item 13. *Certain Relationships and Related Transactions and Director Independence*

The information required by this Item is incorporated herein by reference from the Proxy Statement, as provided under the headings “Certain Relationships and Related Transactions” and “Corporate Governance” (under the subheading “Director Independence”).

Item 14. *Principal Accountant Fees and Services*

The information required by this Item is incorporated herein by reference from the Proxy Statement, as provided under the subheadings "Fees and Services of Independent Registered Public Accounting Firm" and "Audit Committee Pre-Approval Policies and Procedures" under the proposal titled “Ratification of Selection of Independent Registered Public Accounting Firm.”

PART IV

Item 15. *Exhibits and Financial Statement Schedules*

(a) The following documents are filed as part of this Form 10-K:

(1) Financial Statements

The following documents are included as Part II, Item 8 of this Form 10-K:

	Page
Report of Independent Registered Public Accounting Firm	47
Consolidated Balance Sheets	49
Consolidated Statements of Operations	50
Consolidated Statements of Comprehensive Income	51
Consolidated Statements of Stockholders' Equity	52
Consolidated Statements of Cash Flows	50
Notes to Consolidated Financial Statements	54

(2) Financial Statement Schedules

Schedules not listed above have been omitted because the information required to be set forth therein is not applicable or is shown in the financial statements or notes herein.

(3) Exhibits

See Item 15(b) below.

(b) Exhibits

EXHIBIT INDEX

Exhibit Number	Exhibit Description	Incorporated By Reference				Filed or Furnished Herewith
		Form	File No.	Exhibit	Filing Date	
3.1	Amended and Restated Certificate of Incorporation	10-Q	000-19807	3.1	9/15/2003	
3.2	Amended and Restated Bylaws					X
4.1	Specimen Common Stock Certificate	S-1	33-45138	4.3	2/24/1992 (effective date)	

Exhibit Number	Exhibit Description	Incorporated By Reference				Filed or Furnished Herewith
		Form	File No.	Exhibit	Filing Date	
10.1	Amended and Restated Credit Agreement, dated November 28, 2016, among Synopsys as Borrower, the several Lenders from time to time parties thereto, Bank of America, N.A., the Bank of Tokyo-Mitsubishi UFJ, Ltd. and Wells Fargo Bank, N.A. as Co-Syndication Agents, HSBC Bank USA, N.A. and U.S. Bank N.A. as Co-Documentation Agents, JPMorgan Chase Bank, N.A., as Administrative Agent, and JPMorgan Chase Bank, N.A., Merrill Lynch, Pierce, Fenner & Smith Incorporated, the Bank of Tokyo-Mitsubishi UFJ, Ltd. and Wells Fargo Securities, LLC, as Co-Lead Arrangers and Co-Bookrunners	8-K	000-19807	10.1	11/30/2016	
10.2	Lease Agreement dated October 14, 2011 between Synopsys, Inc. and 690 E. Middlefield Road Fee, LLC, (“The October 14, 2011 Lease”)	10-K	000-19807	10.19	12/16/2011	
10.2(i)†	Notification of Change of Ownership of Leased Premises under The October 14, 2011 Lease—Effective May 9, 2012	10-K	000-19807	10.10(i)	12/20/2012	
10.2(ii)	First Amendment to The October 14, 2011 Lease	10-Q	000-19807	10.10(ii)	3/4/2013	
10.2(iii)	Second Amendment to The October 14, 2011 Lease	10-Q	000-19807	10.10(iii)	5/22/2015	
10.3	Lease Agreement, dated January 2, 1996 between Synopsys, Inc. and Tarigo-Paul, a California Limited Partnership, (“The January 2, 1996 Lease”)	10-Q	000-19807	10.28	5/14/1996	
10.3(i)	First Amendment to The January 2, 1996 Lease	8-K	000-19807	10.42	9/12/2006	
10.3(ii)	Second Amendment to The January 2, 1996 Lease	8-K	000-19807	10.41	9/12/2006	
10.3(iii)	Third Amendment to The January 2, 1996 Lease	10-K	000-19807	10.8(iii)	12/20/2012	
10.3(iv)	Fourth Amendment to The January 2, 1996 Lease	10-K	000-19807	10.8(iv)	12/20/2012	
10.3(v)†	Notification of Change of Ownership of Leased Premises under The January 2, 1996 Lease—Effective September 25, 2012	10-K	000-19807	10.8(v)	12/20/2012	
10.4*	2006 Employee Equity Incentive Plan, as amended	8-K	000-19807	10.4	4/6/2018	

Exhibit Number	Exhibit Description	Incorporated By Reference				Filed or Furnished Herewith
		Form	File No.	Exhibit	Filing Date	
10.5*	Form of Restricted Stock Unit Grant Notice and Award Agreement under 2006 Employee Equity Incentive Plan	8-K	000-19807	10.5	4/6/2018	
10.6*	Form of Notice of Grant of Stock Options and Option Agreement under 2006 Employee Equity Incentive Plan	8-K	000-19807	10.6	4/6/2018	
10.7*	Employee Stock Purchase Plan, as amended	8-K	000-19807	10.7	4/6/2018	
10.8*	2017 Non-Employee Directors Equity Incentive Plan	8-K	000-19807	10.8	4/10/2017	
10.9*	Form of Restricted Stock Grant Notice and Award Agreement under 2017 Non-Employee Directors Equity Incentive Plan	10-K	000-19807	10.90	12/14/2017	
10.10*	Form of Stock Options Grant Notice and Option Agreement under 2017 Non-Employee Directors Equity Incentive Plan	10-K	000-19807	10.10	12/14/2017	
10.11*	Deferred Compensation Plan as restated effective August 1, 2002	10-Q	000-19807	10.5	6/10/2004	
10.12*	Synopsys Amended and Restated Deferred Compensation Plan II	10-Q	000-19807	10.23	3/9/2009	
10.13	Form of Indemnification Agreement for directors and executive officers	8-K	000-19807	99.2	7/14/2011	
10.14*	Director's and Officer's Insurance and Company Reimbursement Policy	S-1	33-45138	10.2	2/24/1992 (effective date)	
10.15*	Amended and Restated Employment Agreement, dated December 15, 2016 between Synopsys, Inc. and Dr. Aart de Geus	8-K	000-19807	10.16	12/21/2016	
10.16*	Amended and Restated Employment Agreement, dated December 15, 2016 between Synopsys, Inc. and Dr. Chi-Foon Chan	8-K	000-19807	10.17	12/21/2016	
10.17*	Executive Incentive Plan, as amended	8-K	000-19807	10.18	12/21/2016	
10.18*	Amended and Restated Executive Change of Control Severance Benefit Plan	8-K	000-19807	10.19	12/21/2016	
10.19*	Compensation Recovery Policy	10-K	000-19807	10.46	12/22/2008	
21.1	Subsidiaries of Synopsys, Inc.					X

Exhibit Number	Exhibit Description	Incorporated By Reference				Filed or Furnished Herewith
		Form	File No.	Exhibit	Filing Date	
23.1	Consent of KPMG LLP, Independent Registered Public Accounting Firm					X
24.1	Power of Attorney (see signature page to this Annual Report on Form 10-K)					X
31.1	Certification of Co-Chief Executive Officer pursuant to Rule 13a-14(a) or Rule 15d-14(a) of the Exchange Act					X
31.2	Certification of Co-Chief Executive Officer pursuant to Rule 13a-14(a) or Rule 15d-14(a) of the Exchange Act					X
31.3	Certification of Chief Financial Officer pursuant to Rule 13a-14(a) or Rule 15d-14(a) of the Exchange Act					X
32.1	Certification of Co-Chief Executive Officers and Chief Financial Officer furnished pursuant to Rule 13a-14(b) or Rule 15d-14(b) of the Exchange Act and Section 1350 of Chapter 63 of Title 18 of the United States Code					X
101.INS	XBRL Instance Document					X
101.SCH	XBRL Taxonomy Extension Schema Document					X
101.CAL	XBRL Taxonomy Extension Calculation Linkbase Document					X
101.DEF	XBRL Taxonomy Extension Definition Linkbase Document					X
101.LAB	XBRL Taxonomy Extension Label Linkbase Document					X
101.PRE	XBRL Taxonomy Extension Presentation Linkbase Document					X

* Indicates a management contract, compensatory plan or arrangement.

† We have requested confidential treatment for certain portions of this document pursuant to an application for confidential treatment sent to the SEC. We omitted such portions from this filing and filed them separately with the SEC.

SIGNATURES

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

SYNOPSYS, INC.

Date: December 14, 2018

By: /s/ Trac Pham

Trac Pham
Chief Financial Officer
(Principal Financial Officer)

POWER OF ATTORNEY

KNOW ALL PERSONS BY THESE PRESENTS, that each person whose signature appears below constitutes and appoints Aart J. de Geus, Chi-Foon Chan and Trac Pham, and each of them, as his true and lawful attorneys-in-fact and agents, with full power of substitution and reconstitution, for him and in his name, place and stead, in any and all capacities, to sign any and all amendments to this Annual Report on Form 10-K, and to file the same, with all exhibits thereto, and other documents in connection therewith, with the Securities and Exchange Commission, granting unto said attorneys-in-fact and agents, and each of them, full power and authority to do and perform each and every act and thing requisite and necessary to be done in connection therewith, as fully to all intents and purposes as he might or could do in person, hereby ratifying and confirming all that said attorneys-in-fact and agents, or any of them, or their or his substitute or substitutes, may lawfully do or cause to be done by virtue hereof.

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

Name	Title	Date
/s/ Aart J. de Geus Aart J. de Geus	Co-Chief Executive Officer (Co-Principal Executive Officer) and Chairman of the Board of Directors	December 14, 2018
/s/ Chi-Foon Chan Chi-Foon Chan	Co-Chief Executive Officer (Co-Principal Executive Officer), President and Director	December 14, 2018
/s/ Trac Pham Trac Pham	Chief Financial Officer (Principal Financial Officer)	December 14, 2018
/s/ Sudhindra Kankanwadi Sudhindra Kankanwadi	Vice President, Corporate Controller (Principal Accounting Officer)	December 14, 2018
/s/ Janice D. Chaffin Janice D. Chaffin	Director	December 14, 2018
/s/ Bruce R. Chizen Bruce R. Chizen	Director	December 14, 2018
/s/ Mercedes Johnson Mercedes Johnson	Director	December 14, 2018
/s/ Chrysostomos L. Nikias Chrysostomos L. Nikias	Director	December 14, 2018
/s/ John G. Schwarz John G. Schwarz	Director	December 14, 2018
/s/ Roy Vallee Roy Vallee	Director	December 14, 2018
/s/ Steven C. Walske Steven C. Walske	Director	December 14, 2018

AMENDED AND RESTATED BYLAWS
OF
SYNOPSYS, INC.

(as amended and restated on December 12, 2018)

ARTICLE I
OFFICES

Section 1. The registered office shall be in the City of Wilmington, County of New Castle, State of Delaware.

Section 2. The corporation may also have offices at such other places both within and without the state of Delaware as the Board of Directors may from time to time determine or the business of the corporation may require.

ARTICLE II

MEETINGS OF STOCKHOLDERS

Section 1. All meetings of the stockholders may be held at such place either within or without the state of Delaware as shall be designated from time to time by the Board of Directors (the "Board") and stated in the notice of the meeting. The Board of Directors may, in its sole discretion, determine that the meeting shall not be held at any place, but may instead be held solely by means of remote communication as provided under the Delaware General Corporation Law ("DGCL").

Section 2. (I) Annual meetings of stockholders, shall be held at such place, if any, date and hour as shall be fixed by the Board and stated in the notice of the meeting, at which the stockholders shall elect a Board of Directors, and transact such other business as may properly be brought before the meeting. At an annual meeting of stockholders, only such business shall be conducted as is a proper matter for stockholder action under the DGCL and as shall have been properly brought before the meeting. Matters may be properly brought before an annual meeting only as follows: (i) specified in the notice of meeting (or any supplement thereto) given by or at the direction of the Board, (ii) otherwise properly brought before the meeting by or at the direction of the Board, or (iii) by any stockholder of the corporation who was a stockholder of record who is entitled to vote at the meeting and who complied with the notice procedures set forth in this Article II, Section 2 of these Bylaws; *provided*, that if such matter is proposed on behalf of a beneficial owner it may only be properly brought before the meeting, if such beneficial owner was the beneficial owner of shares of the corporation at the time of the giving of the stockholder's notice provided for in Article II, Section 2(b) below. Clause (iii) above shall be the exclusive means for a stockholder to make nominations and submit other business (other than matters properly included in the corporation's notice of meeting of stockholders and proxy statement under Rule 14a-8 under the Securities Exchange Act of 1934, as amended, and the rules and regulations thereunder (the "Exchange Act")) before an annual meeting of the stockholders.

(a) At an annual meeting of the stockholders, the following procedures shall apply in order for a matter to be properly brought before the meeting by a stockholder.

(i) For nominations for election to the Board to be properly brought before an annual meeting by a stockholder pursuant to clause (iii) of Article II, Section 2(a) of these Bylaws, the stockholder must deliver written notice to the Secretary at the principal executive offices of the corporation on a timely basis as set forth in Article II, Section 2(b)(iii), and must update and supplement such written notice on a timely basis as set forth in Article II, Section 2(c). Such stockholder's notice shall set forth: (A) as to each nominee such stockholder proposes to nominate at the meeting: (1) the name, age, business address and residence address of such nominee, (2) the principal occupation or employment of such nominee, (3) the class and number of shares of each class of capital stock of the corporation which are owned of record and beneficially by such nominee, (4) the date or dates on which such shares were acquired and the investment intent of such acquisition, (5) a statement whether such nominee, if elected, intends to tender his or her resignation promptly following the next meeting at which such person would face election or re-election (only if such election or re-election is uncontested), if such person receives a greater number of votes "withheld" from his or her election or re-election than votes "for" such election or re-election, such resignation to be effective upon acceptance of such resignation by the Board, in accordance with the corporation's Corporate Governance Guidelines, as may be amended from time to time, (6) with respect to each nominee for election or re-election to the Board, include a completed and signed questionnaire, representation and agreement required by Article II, Section 2(e), and (7) such other information concerning such nominee as would be required to be disclosed in a proxy statement soliciting proxies for the election of such nominee as a director in an election contest (even if an election contest is not involved), or that is otherwise required to be disclosed pursuant to Section 14 of the Exchange Act and the rules and regulations promulgated thereunder (including such person's written consent to being named as a nominee and to serving as a director if elected); and (B) the information required by Article II, Section 2(b)(iv). The corporation may require any proposed nominee to furnish such other information as it may reasonably require to determine the eligibility of such proposed nominee to serve as an independent director of the corporation or that could be material to a reasonable stockholder's understanding of the independence, or lack thereof, of such proposed nominee.

(ii) For business other than nominations for election to the Board of Directors to be properly brought before an annual meeting by a stockholder pursuant to clause (iii) of Article II, Section 2(a) of these Bylaws, the stockholder must deliver written notice to the Secretary at the principal executive offices of the corporation on a timely basis as set forth in Article II, Section 2(b)(iii), and must update and supplement such written notice on a timely basis as set forth in Article II, Section 2(c). Such stockholder's notice shall set forth: (A) as to each matter such stockholder proposes to bring before the meeting, (1) a brief description of the business desired to be brought before the meeting and the reasons for conducting such business at such meeting, (2) the text of the proposal to be presented at the meeting, (3) a statement in support of the proposal, (4) a representation that such stockholder intends to appear in person, by remote communication, if applicable, or by proxy at the meeting to bring such business before the meeting, (5) the name and address, as they appear on the corporation's books, of the stockholder proposing such business, (6) the class, series and number of shares of the corporation which are owned of record and beneficially owned by the stockholder, and (7) any material interest (including any anticipated

benefit of such business to any Proponent (as defined below) other than solely as a result of its ownership of the corporation's capital stock, that is material to any Proponent individually, or to the Proponents in the aggregate) in such business of any Proponent; and (B) the information required by Article II, Section 2(b)(iv).

(iii) To be timely, the written notice required by Article II, Section 2(b)(i) or 2(b)(ii) of these Bylaws must be received by the Secretary at the principal executive offices of the corporation not later than the close of business on the one hundred twentieth (120th) day nor earlier than the close of business on the one hundred fiftieth (150th) day prior to the first anniversary of the date on which the corporation released its proxy materials to its stockholders for the prior year's annual meeting of stockholders or any longer period provided for by applicable law; *provided, however*, that in the event that the date of the annual meeting is advanced more than thirty (30) days prior to or delayed by more than thirty (30) days after the anniversary of the preceding year's annual meeting, for notice by the stockholder to be timely, such stockholder's written notice must be delivered to the Secretary not later than the close of business on the ninetieth (90th) day prior to such annual meeting or the tenth (10th) day following the day on which public announcement of the date of such meeting is first made, whichever is later. Notwithstanding the foregoing, in no event shall the public announcement of an adjournment or postponement of an annual meeting commence a new time period for the giving of a stockholder's notice as described above.

(iv) The written notice required by Article II, Section 2(b)(i) or 2(b)(ii) of these Bylaws shall also set forth, as of the date of the notice and as to the stockholder giving the notice and the beneficial owner, if any, on whose behalf the nomination or proposal is made (each, a "Proponent" and collectively, the "Proponents"): (A) the name and address of each Proponent, as they appear on the corporation's books; (B) the class, series and number of shares of the corporation that are owned beneficially and of record by each Proponent; (C) a description of any agreement, arrangement or understanding (whether oral or in writing) with respect to such nomination or proposal between or among any Proponent and any of its affiliates or associates, and any others (including their names) acting in concert, or otherwise under the agreement, arrangement or understanding, with any of the foregoing; (D) a representation that the Proponents are holders of record or beneficial owners, as the case may be, of shares of the corporation entitled to vote at the meeting and intend to appear in person or by proxy at the meeting to nominate the person or persons specified in the notice (with respect to a notice under Article II, Section 2(b)(i)) or to propose the business that is specified in the notice (with respect to a notice under Article II, Section 2(b)(ii)); (E) a representation as to whether the Proponents intend to deliver a proxy statement and form of proxy to holders of a sufficient number of holders of the corporation's voting shares to elect such nominee or nominees (with respect to a notice under Article II, Section 2(b)(i)) or to carry such proposal (with respect to a notice under Article II, Section 2(b)(ii)); (F) to the extent known by any Proponent, the name and address of any other stockholder supporting the proposal on the date of such stockholder's notice; and (G) a description of all Derivative Transactions (as defined below) by each Proponent during the previous twelve (12) month period, including the date of the transactions and the class, series and number of securities involved in, and the material economic terms of, such Derivative Transactions.

For purposes of Article II, Section 2, a "Derivative Transaction" means any agreement, arrangement, interest or understanding entered into by, or on behalf or for the benefit of, any Proponent or any of its affiliates or associates, whether record or beneficial:

(w) the value of which is derived in whole or in part from the value of any class or series of shares or other securities of the corporation,

(x) which otherwise provides any direct or indirect opportunity to gain or share in any gain derived from a change in the value of securities of the corporation,

(y) the effect or intent of which is to mitigate loss, manage risk or benefit of security value or price changes, or

(z) which provides the right to vote or increase or decrease the voting power of, such Proponent, or any of its affiliates or associates, with respect to any securities of the corporation,

which agreement, arrangement, interest or understanding may include, without limitation, any option, warrant, debt position, note, bond, convertible security, swap, stock appreciation right, short position, profit interest, hedge, right to dividends, voting agreement, performance-related fee or arrangement to borrow or lend shares (whether or not subject to payment, settlement, exercise or conversion in any such class or series), and any proportionate interest of such Proponent in the securities of the corporation held by any general or limited partnership, or any limited liability company, of which such Proponent is, directly or indirectly, a general partner or managing member.

(b) A stockholder providing written notice required by Article II, Section 2(b)(i) or (ii) of these Bylaws shall update and supplement such notice in writing, if necessary, so that the information provided or required to be provided in such notice is true and correct in all material respects as of (i) the record date for the meeting and (ii) as of the date that is five (5) business days prior to the meeting and, in the event of any adjournment or postponement thereof, five (5) business days prior to the revised meeting date that is publicly announced by the corporation. In the case of an update and supplement pursuant to clause (i) of this Article II, Section 2(c), such update and supplement shall be received by the Secretary at the principal executive offices of the corporation not later than five (5) business days after the record date for the meeting. In the case of an update and supplement pursuant to clause (ii) of this Article II, Section 2(c), such update and supplement shall be delivered to, or mailed and received by, the Secretary at the principal executive offices of the corporation not later than two (2) business days prior to the date for the meeting, and, in the event of any adjournment or postponement thereof, two (2) business days prior to the revised meeting date that is publicly announced by the corporation.

(c) Notwithstanding anything in Article II, Section 2(b)(iii) of these Bylaws to the contrary, in the event that the number of directors is increased and there is no public announcement of the appointment of a director to fill any vacancies created by such increase or if no appointment was made, of any vacancies created by such increase, by the corporation at least ten (10) days before the last day a stockholder may deliver a notice of nomination in accordance with Article II, Section 2(b)(iii), a stockholder's notice required by this Article II, Section 2 and which complies with the requirements in Article II, Section 2(b)(i), other than the timing requirements in Article II, Section 2(b)(iii), shall also be considered timely, but only with respect to nominees for any new positions, created by such increase, if it shall be received by the Secretary at the principal executive offices of the corporation not later than the close of business on the tenth (10th) day following the day on which such public announcement is first made by the corporation.

(d) To be eligible to be a nominee for election or re-election as a director of the corporation pursuant to a nomination under clause (iii) of Article II, Section 2(a) of these Bylaws, such nominee or a person on his or her behalf must deliver (in accordance with the time periods prescribed for delivery of notice under Article II, Section 2(b)(iii) or Section 2(d), as applicable) to the Secretary at the principal executive offices of the corporation a written questionnaire with respect to the background and qualification of such nominee and the background of any other person or entity on whose behalf the nomination is being made (which questionnaire shall be provided by the Secretary upon written request) and a written representation and agreement (in the form provided by the Secretary upon written request) that such person (i) is not and will not become a party to (A) any agreement, arrangement or understanding with, and has not given any commitment or assurance to, any person or entity as to how such person, if elected as a director of the corporation, will act or vote on any issue or question (a "Voting Commitment") that has not been disclosed to the corporation in the questionnaire or (B) any Voting Commitment that could limit or interfere with such person's ability to comply, if elected as a director of the corporation, with such person's fiduciary duties under applicable law; (ii) is not and will not become a party to any agreement, arrangement or understanding with any person or entity other than the corporation with respect to any direct or indirect compensation, reimbursement or indemnification in connection with service or action as a director of the corporation that has not been disclosed therein; and (iii) in such person's individual capacity and on behalf of any person or entity on whose behalf the nomination is being made, would be in compliance, if elected as a director of the corporation, and will comply with, all applicable publicly disclosed corporate governance, conflict of interest, confidentiality and stock ownership and trading policies and guidelines of the corporation.

(e) A person shall not be eligible for election or re-election as a director unless the person is nominated either in accordance with clause (i), (ii) or (iii) of Article II, Section 2(a) of these Bylaws. Except as otherwise required by law, the chairman of the meeting shall have the power and duty to determine whether a nomination or any business proposed to be brought before the meeting was made, or proposed, as the case may be, in accordance with the procedures set forth in these Bylaws and, if any proposed nomination or business is not in compliance with these Bylaws, to declare that such defective proposal or nomination shall not be presented for stockholder action at the meeting and shall be disregarded. Notwithstanding anything in these Bylaws to the contrary, unless otherwise required by law, if a stockholder intending to make a nomination at a meeting pursuant to Article II, Section 2(b)(i) or to propose business at a meeting pursuant to Article II, Section 2(b)(ii) does not provide the information in the stockholder's notice required under Article II, Section 2(b)(i) or 2(b)(ii), as applicable, within the applicable time periods specified in this Article II, Section 2 (including any update and supplement required under Article II, Section 2(c)), or the stockholder (or a qualified representative of the stockholder) does not appear at the meeting to make such nomination or to propose such business, or the Proponents shall not have acted in accordance with the representations required under Article II, Section 2(b)(iv)(E), such nomination or proposal shall not be presented for stockholder action at the meeting and shall be disregarded, as determined by the chairman of the meeting as described above, notwithstanding that proxies in respect of such nominations or such business may have been solicited or received.

(f) In order to include information with respect to a stockholder proposal in the proxy statement and form of proxy for a stockholders' meeting, a stockholder must also comply with all applicable requirements of the Exchange Act and the rules and regulations thereunder. Nothing in these Bylaws shall be deemed to affect any rights of stockholders to request inclusion

of proposals in the corporation's proxy statement pursuant to Rule 14a-8 under the Exchange Act; *provided*, *however*, that any references in these Bylaws to the Exchange Act or the rules and regulations thereunder are not intended to and shall not limit the requirements applicable to proposals and/or nominations to be considered pursuant to clause (iii) of Article II, Section 2(a) of these Bylaws.

(g) For purposes of Article II, Section 2,

(i) "public announcement" shall mean disclosure in a press release reported by the Dow Jones News Service, Associated Press, Business Wire or comparable national news service or in a document publicly filed by the corporation with the Securities and Exchange Commission pursuant to Section 13, 14 or 15(d) of the Exchange Act; and

(ii) "affiliates" and "associates" shall have the meanings set forth in Rule 405 under the Securities Act of 1933, as amended.

Section 3. Written notice, or notice by electronic transmission as permitted by the DGCL, of the annual meeting stating the place, if any, date and hour of the meeting, and the means of remote communications, if any, by which stockholders and proxy holders may be deemed to be present in person and vote at such meeting, shall be given to each stockholder entitled to vote at such meeting not less than ten (10) nor more than sixty (60) days before the date of the meeting.

Section 4. The officer who has charge of the stock ledger of the corporation shall prepare and make, or cause a third party to prepare and make, at least ten (10) days before every meeting of stockholders, a complete list of the stockholders entitled to vote at the meeting, arranged in alphabetical order, and showing the address of each stockholder and the number of shares registered in the name of each stockholder. Such list shall be open to the examination of any stockholder, for any purpose germane to the meeting, during ordinary business hours, for a period of at least ten (10) days prior to the meeting, either at a place within the city where the meeting is to be held, which place shall be specified in the notice of the meeting, or, if not so specified, at the place where the meeting is to be held. The list shall also be produced and kept at the time and place of the meeting during the whole time thereof, and may be inspected by any stockholder who is present.

Section 5. (I) Special meetings of the stockholders, for any purpose or purposes as is a proper matter for stockholder action under the DGCL, unless otherwise prescribed by statute or by the certificate of incorporation, may be called by the Chairman, President or Chief Executive Officer and shall be called by the Chairman or President or Secretary at the request in writing of a majority of the Board. Such request shall state the purpose or purposes of the proposed meeting.

(a) Stockholders shall not be permitted to propose business to be brought before a special meeting of stockholders and the only matters that may be brought before a special meeting are the matters specified in the notice of meeting given by or at the direction of the person calling the meeting. The Board shall determine the time and place of such special meeting. Upon determination of the time and place of the meeting, the officer receiving the request shall cause notice to be given to the stockholders entitled to vote, in accordance with the provisions of Article II, Section 6 of these Bylaws. Nothing contained in this paragraph (b) shall be construed as limiting, fixing, or affecting the time when a meeting of stockholders called by action of the Board may be held.

(b) Nominations of persons for election to the Board may be made at a special meeting of stockholders at which directors are to be elected pursuant to the corporation's notice of meeting (i) by or at the direction of the Board or (ii) by any stockholder of the corporation who is a stockholder of record at the time of giving notice provided for in these Bylaws who shall be entitled to vote at the meeting and who delivers written notice to the Secretary of the corporation setting forth the information required by Article II, Section 2(b)(i) of these Bylaws; *provided*, that if such nominee(s) are proposed on behalf of a beneficial owner such nominations may only be properly brought before the meeting, if such beneficial owner was the beneficial owner of shares of the corporation at the time of the giving of the stockholder's notice set forth in this paragraph. In the event the corporation calls a special meeting of stockholders for the purpose of electing one or more directors to the Board of Directors, any such stockholder of record may nominate a person or persons (as the case may be), for election to such position(s) as specified in the corporation's notice of meeting, if the stockholder's notice required by Article II, Section 2(b)(i) of these Bylaws (including the information required by Section 2(b)(iv)) shall be delivered to the Secretary at the principal executive offices of the corporation not earlier than the close of business on the one hundred twentieth (120th) day prior to such special meeting and not later than the close of business on the later of the ninetieth (90th) day prior to such meeting or the tenth (10th) day following the day on which public announcement is first made of the date of the special meeting and of the nominees proposed by the Board to be elected at such meeting. The stockholder shall also update and supplement such information as required under Article II, Section 2(c). In no event shall the public announcement of an adjournment or postponement of a special meeting commence a new time period for the giving of a stockholder's notice as described above.

(c) A stockholder must also comply with all applicable requirements of the Exchange Act and the rules and regulations thereunder with respect to matters set forth in this Article II, Section 5. Nothing in these Bylaws shall be deemed to affect any rights of stockholders to request inclusion of proposals in the corporation's proxy statement pursuant to Rule 14a-8 under the Exchange Act; *provided, however*, that any references in these Bylaws to the Exchange Act or the rules and regulations thereunder are not intended to and shall not limit the requirements applicable to nominations for the election to the Board to be considered pursuant to Article II, Section 5(c) of these Bylaws.

Section 6. Written notice, or notice by electronic transmission as permitted by the DGCL, of a special meeting stating the place, if any, date and hour of the meeting, the means of remote communications, if any, by which stockholders and proxy holders may be deemed to be present in person and vote at such meeting, and the purpose or purposes for which the meeting is called, shall be given not less than ten (10) nor more than sixty (60) days before the date of the meeting, to each stockholder entitled to vote at such meeting, such notice to specify the place, if any, date and hour, in the case of special meetings, the purpose or purposes of the meeting, and the means of remote communications, if any, by which stockholders and proxy holders may be deemed to be present in person and vote at any such meeting. If mailed, notice is given when deposited in the United States mail, postage prepaid, directed to the stockholder at such stockholder's address as it appears on the records of the corporation. Notice of the time, place, if any, and purpose of any meeting of stockholders may be waived in writing, signed by the person entitled to notice thereof, or by electronic transmission by such person, either before or after such meeting, and will be waived by any stockholder by his attendance thereat in person, by remote communication, if applicable, or by proxy, except when the stockholder attends a meeting for the express purpose of objecting, at

the beginning of the meeting, to the transaction of any business because the meeting is not lawfully called or convened. Any stockholder so waiving notice of such meeting shall be bound by the proceedings of any such meeting in all respects as if due notice thereof had been given.

Section 7. The holders of a majority of the stock issued and outstanding and entitled to vote thereat, present in person or represented by proxy, shall constitute a quorum at all meetings of the stockholders for the transaction of business, except as otherwise provided by statute or by the certificate of incorporation. If, however, such quorum shall not be present or represented at any meeting of the stockholders, the stockholders entitled to vote thereat, present in person or represented by proxy, shall have power to adjourn the meeting from time to time by a vote of the holders of a majority of the shares present in person, without notice other than announcement at the meeting, until a quorum shall be present or represented, but no other business shall be transacted at such meeting. At such adjourned meeting at which a quorum shall be present or represented, any business may be transacted which might have been transacted at the meeting as originally notified. If the adjournment is for more than thirty (30) days, or if after the adjournment a new record date is fixed for the adjourned meeting, a notice of the adjourned meeting shall be given to each stockholder of record entitled to vote at the meeting. In no event shall the public announcement of an adjournment of an annual meeting commence a new time period for the giving of a stockholder's notice as described above.

Section 8. When a quorum is present at any meeting, the vote of the holders of a majority of the stock having voting power present in person or represented by proxy and voting on that particular matter shall decide any question brought before such meeting, unless the question is one upon which by express provision of the statutes or of the certificate of incorporation, a different vote is required, in which case such express provision shall govern and control the decision of such question.

Section 9. Unless otherwise provided in the certificate of incorporation, each stockholder shall, at every meeting of the stockholders, be entitled to one (1) vote in person or by proxy for each share of the capital stock having voting power held by such stockholder, but no proxy shall be voted on after three (3) years from its date, unless the proxy provides for a longer period.

Section 10. (I) At every meeting of stockholders, the Chairman of the Board of Directors, or, if a Chairman has not been appointed or is absent, the Chief Executive Officer, or, if the Chief Executive Officer has not been appointed or is absent, the President, or, if the President is absent, a Director or Officer designated by the Chairman of the Board, shall act as chairman. The Secretary, or, in his or her absence, an Assistant Secretary or other person directed to do so by the President, shall act as secretary of the meeting.

(a) The Board of Directors of the corporation shall be entitled to make such rules or regulations for the conduct of meetings of stockholders as it shall deem necessary, appropriate or convenient. Subject to such rules and regulations of the Board of Directors, if any, the chairman of the meeting shall have the right and authority to prescribe such rules, regulations and procedures and to do all such acts as, in the judgment of such chairman, are necessary, appropriate or convenient for the proper conduct of the meeting, including, without limitation, establishing an agenda or order of business for the meeting, making a determination concerning whether business is properly brought

before the meeting, rules and procedures for maintaining order at the meeting and the safety of those present, limitations on participation in such meeting to stockholders of record of the corporation and their duly authorized and constituted proxies and such other persons as the chairman shall permit, restrictions on entry to the meeting after the time fixed for the commencement thereof, limitations on the time allotted to questions or comments by participants and regulation of the opening and closing of the polls for balloting on matters which are to be voted on by ballot. The date and time for the opening and closing of the polls for each matter upon which the stockholders will vote at the meeting shall be announced at the meeting. Unless and to the extent determined by the Board of Directors of the chairman of the meeting, meetings of stockholders shall not be required to be held in accordance with rules of parliamentary procedure.

ARTICLE III

DIRECTORS

Section 1. The number of Directors which shall constitute the whole Board of Directors shall be determined by resolution of the Board of Directors. The Directors shall be elected at the annual meeting of the stockholders for a term of one year, except as provided in Section 2 of this Article III, and each Director elected shall hold office until his or her successor is elected and qualified or until his or her death, resignation or removal. Directors need not be stockholders.

Section 2. Vacancies and newly-created directorships may be filled only by vote of at least two-thirds (2/3rds) of the Directors then in office, though less than a quorum, or by a sole remaining Director, except that in the event a Director is removed by the stockholders for cause, the stockholders shall be entitled to fill the vacancy created as a result of such removal. The Directors so chosen shall serve for the remainder of the term of the vacated directorships being filled and until their successors are duly elected and shall qualify, unless sooner displaced. If there are no Directors in office, then an election of Directors may be held in the manner provided by statute.

Section 3. The business of the corporation shall be managed by, or under the direction of, its Board of Directors, which may exercise all such powers of the corporation and do all such lawful acts and things as are not by statute or by the certificate of incorporation or by these bylaws directed or required to be exercised or done by the stockholders.

MEETINGS OF THE BOARD OF DIRECTORS

Section 4. The Board of Directors of the corporation may hold meetings, both regular and special, either within or without the state of Delaware.

Section 5. Intentionally omitted.

Section 6. Regular meetings of the Board of Directors may be held without notice (as defined in Article IV, Section 1) at such time and at such place as shall from time to time be determined by the Board, *provided* that such time and such place has been designated previously by the Board of Directors and publicized among all Directors, either orally or in writing, by telephone, including a voice-messaging system or other system designed to record and communicate messages, facsimile, electronic mail or other electronic means.

Section 7. Special meetings of the Board may be called by the Chairman or President on four (4) days' notice to each Director by mail or twenty-four (24) hours' notice to each Director either personally or by telephone, telegram, electronic transmission or facsimile; special meetings shall be called by the Chairman or President or Secretary in like manner and on like notice on the request in writing or by electronic transmission of two (2) Directors unless the Board consists of only one (1) Director, in which case special meetings shall be called by the Chairman or President or Secretary in like manner and on like notice on the request in writing or by electronic transmission of the sole Director. A written waiver of notice, signed by the person entitled thereto, or waiver of notice by electronic transmission sent by such person, whether before or after the time of the meeting stated therein, shall be deemed equivalent to notice.

Section 8. At all meetings of the Board of Directors a majority of the Directors then in office shall constitute a quorum for the transaction of business, and the act of a majority of the Directors present at any meeting at which there is a quorum shall be the act of the Board of Directors, except as may be otherwise specifically provided by statute or by the certificate of incorporation. If a quorum shall not be present at any meeting of the Board of Directors, the Directors present thereat may adjourn the meeting from time to time, without notice other than announcement at the meeting, until a quorum shall be present.

Section 9. Unless otherwise restricted by the certificate of incorporation or these bylaws, any action required or permitted to be taken at any meeting of the Board of Directors or of any committee thereof may be taken without a meeting, if all members of the Board or committee, as the case may be, consent thereto in writing or by electronic transmission, and the writing or writings or transmission or transmissions are filed with the minutes of proceedings of the Board or committee. Such filing shall be in paper form if the minutes are maintained in paper form and shall be in electronic form or paper form if the minutes are maintained in electronic form.

Section 10. Unless otherwise restricted by the certificate of incorporation or these bylaws, members of the Board of Directors, or any committee designated by the Board of Directors, may participate in a meeting of the Board of Directors, or any committee, by means of conference telephone or similar communications equipment by means of which all persons participating in the meeting can hear each other, and such participation in a meeting shall constitute presence in person at the meeting.

LEAD INDEPENDENT DIRECTOR

Section 11. The Chairman of the Board of Directors, or if the Chairman is not an independent Director, one of the independent Directors, may be designated by the Board of Directors as lead independent Director to serve until replaced by the Board of Directors ("Lead Independent Director"). The Lead Independent Director will, with the Chairman of the Board of Directors, establish the agenda for regular Board meetings and serve as chairman of Board of Directors meetings in the absence of the Chairman of the Board of Directors; establish the agenda for meetings of the independent Directors; and coordinate the activities of the other independent Directors and perform such other duties as may be established or delegated by the Board of Directors.

COMMITTEES OF DIRECTORS

Section 12. The Board of Directors may, by resolution passed by a majority of the whole Board, designate one or more committees, each committee to consist of one or more of the Directors of the corporation. The Board may designate one or more Directors as alternate members of any committee, who may replace any absent or disqualified member at any meeting of the committee.

In the absence of disqualification of a member of a committee, the member or members thereof present at any meeting and not disqualified from voting, whether or not he, she or they constitute a quorum, may unanimously appoint another member of the Board of Directors to act at the meeting in the place of any such absent or disqualified member.

Any such committee, to the extent provided in the resolution of the Board of Directors, shall have and may exercise all the powers and authority of the Board of Directors in the management of the business and affairs of the corporation, and may authorize the seal of the corporation to be affixed to all papers which may require it; but no such committee shall have the power or authority in reference to amending the certificate of incorporation, adopting an agreement of merger or consolidation, recommending to the stockholders the sale, lease or exchange of all or substantially all of the corporation's property and assets, recommending to the stockholders a dissolution of the corporation or a revocation of a dissolution, or amending the bylaws of the corporation; and, unless the resolution or the certificate of incorporation expressly so provide, no such committee shall have the power or authority to declare a dividend or to authorize the issuance of stock. Such committee or committees shall have such name or names as may be determined from time to time by resolution adopted by the Board of Directors. The provisions relating to the holding of Board of Directors meetings, including the provisions regarding the time, place, notice, waiver, quorum, action by written consent in lieu of meetings, and telephonic attendance, shall apply equally to committee meetings.

Section 13. Each committee shall keep regular minutes of its meetings and report the same to the Board of Directors when required.

COMPENSATION OF DIRECTORS

Section 14. Unless otherwise restricted by the certificate of incorporation or these bylaws, the Board of Directors shall have the authority to fix the compensation of Directors. Director compensation may include, among other things, payment of his or her expenses, if any, of attendance at each meeting of the Board of Directors, payment of a fixed sum for attendance at each meeting of the Board of Directors or payment of a stated salary as Director. No such payment shall preclude any Director from serving the corporation in any other capacity and receiving compensation therefor. Members of special or standing committees may be allowed like compensation for attending committee meetings.

RESIGNATION OF DIRECTORS

Section 15. Any Director may resign at any time by delivering his or her notice in writing or by electronic transmission to the Secretary, such resignation to specify whether it will be effective at a particular time, upon receipt by the Secretary or at the pleasure of the Board of Directors. If no such specification is made, it shall be deemed effective at the pleasure of the Board of Directors.

REMOVAL OF DIRECTORS

Section 16. Unless otherwise restricted by the certificate of incorporation or by law, any Director or the entire Board of Directors may be removed, with or without cause, by the holders of a majority of shares entitled to vote at an election of Directors.

ARTICLE IV

NOTICES

Section 1. Whenever, under the provisions of the statutes or of the certificate of incorporation or of these bylaws, notice is required to be given to any Director or stockholder, it shall not be construed to mean personal notice (except as provided in Section 7 of Article III of these bylaws), but such notice may be given in writing, by mail, addressed to such Director or stockholder, at his or her address as it appears on the records of the corporation, with postage thereon prepaid, or by electronic transmission as permitted by the DGCL, and such notice shall be deemed to be given at the time when the same shall be deposited in the United States mail or transmitted electronically. Notice to Directors may also be given by telephone, telegram or facsimile.

Section 2. Whenever any notice is required to be given under the provisions of the statutes or of the certificate of incorporation or of these bylaws, a waiver thereof in writing, signed by the person or persons entitled to said notice, or waiver of notice by electronic transmission sent by such person or persons, whether before or after the time stated therein, shall be deemed equivalent thereto.

Section 3. Except as otherwise prohibited under DGCL, any notice given under the provisions of DGCL, the Certificate of Incorporation or the Bylaws shall be effective if given by a single written notice to stockholders who share an address if consented to by the stockholders at that address to whom such notice is given. Such consent shall have been deemed to have been given if such stockholder fails to object in writing to the corporation within sixty (60) days of having been given notice by the corporation of its intention to send the single notice. Any consent shall be revocable by the stockholder by written notice to the corporation.

Section 4. Whenever notice is required to be given, under any provision of law or of the Certificate of Incorporation or Bylaws of the corporation, to any person with whom communication is unlawful, the giving of such notice to such person shall not be required and there shall be no duty to apply to any governmental authority or agency for a license or permit to give such notice to such person. Any action or meeting which shall be taken or held without notice to any such person with whom communication is unlawful shall have the same force and effect as if such notice had been duly given. In the event that the action taken by the corporation is such as to require the filing of a certificate under any provision of the DGCL, the certificate shall state, if such is the fact and if notice is required, that notice was given to all persons entitled to receive notice except such persons with whom communication is unlawful.

ARTICLE V

OFFICERS

Section 1. The officers of the corporation shall be chosen by the Board of Directors and shall be a Chief Executive Officer (or one or more Co-Chief Executive Officers), a President, a

Chief Financial Officer, a Secretary and a Treasurer. The Board of Directors may elect from among its members a Chairman of the Board, a Vice Chairman of the Board and a Lead Independent Director (provided that notwithstanding anything to the contrary contained in these Bylaws, neither the Chairman of the Board, the Vice Chairman of the Board nor the Lead Independent Director shall be deemed an officer of the corporation unless so designated by the Board of Directors). The Board of Directors may also choose one or more Vice Presidents, Assistant Secretaries and Assistant Treasurers. Any number of offices may be held by the same person, unless the certificate of incorporation or these bylaws otherwise provide.

Section 2. All officers shall hold office at the pleasure of the Board of Directors and until their successors shall have been duly elected and qualified, or until such officer's earlier resignation or removal. An officer may resign at any time upon written notice to the corporation.

Section 3. The Board of Directors may appoint such other officers and agents as it shall deem necessary who shall hold their offices for such terms and shall exercise such powers and perform such duties as shall be determined from time to time by the Board.

Section 4. The salaries of all officers of the corporation shall be fixed by the Board of Directors. The salaries of agents of the corporation shall, unless fixed by the Board of Directors, be fixed by the President or any Vice President of the corporation.

Section 5. The officers of the corporation shall hold office until their successors are chosen and qualify. Any officer elected or appointed by the Board of Directors may be removed at any time, with or without cause, by the affirmative vote of a majority of the Board of Directors or by the unanimous written consent of the Board of Directors. Any vacancy occurring in any office of the corporation shall be filled by the Board of Directors.

CHAIRMAN OF THE BOARD

Section 6. The Chairman of the Board shall preside at all meetings of the Board of Directors and of the stockholders at which he or she shall be present. He or she shall perform other duties commonly incident to the office and shall also perform such other duties and have such other powers as the Board of Directors shall designate from time to time.

Section 7. In the absence of the Chairman of the Board or the Vice Chairman of the Board, if any, the Lead Independent Director shall preside at all meetings of the Board of Directors and of the stockholders at which he or she shall be present. He or she shall have and may exercise such powers as are, from time to time, assigned to him or her by the Board and as may be provided by law.

CHIEF EXECUTIVE OFFICER

Section 8. The Board of Directors may appoint a Chief Executive Officer or one or more Co-Chief Executive Officers. For all purposes of the Bylaws, the term "Chief Executive Officer" shall mean "Chief Executive Officer or Co-Chief Executive Officer(s)", as the case may be. The Chief Executive Officer shall perform duties commonly incident to the office and shall also perform such other duties and have such other powers, as the Board of Directors shall designate from time to time. If the Chairman of the Board of Directors has not been appointed or is not

present and if the Lead Independent Director has not been appointed or is not present, the Chief Executive Officer shall preside at all meetings of the Board of Directors. The Chief Executive Officer shall preside at any meeting of the stockholders under the circumstances described in Article II, Section 10(a). .

PRESIDENT AND VICE PRESIDENTS

Section 9. The President shall be the Chief Executive Officer of the corporation in the event that there is not another person designated as the Chief Executive Officer by the Board of Directors, and shall, subject to the control of the Board of Directors, have general supervision, direction and control of the business and affairs of the corporation. The President shall perform other duties commonly incident to the office and shall also perform such other duties and have such other powers as the Board of Directors shall designate from time to time.

Section 10. The Chairman, the Chief Executive Officer, the President, the Chief Financial Officer, any Vice President or the Secretary shall execute bonds, mortgages and other contracts requiring a seal, under the seal of the corporation, except where required or permitted by law to be otherwise signed and executed and except where the signing and execution thereof shall be expressly delegated by the Board of Directors to some other officer or agent of the corporation.

Section 11. In the absence of the Chairman, Chief Executive Officer or the President or in the event of their inability or refusal to act, the Vice President, if any, (or in the event there be more than one Vice President, the Vice Presidents in the order designated by the Directors, or in the absence of any designation, then in the order of their election) shall perform the duties of the President, and when so acting, shall have all the powers of, and be subject to all the restrictions upon, the President.

CHIEF FINANCIAL OFFICER

Section 12. The Chief Financial Officer shall keep or cause to be kept the books of account of the corporation in a thorough and proper manner and shall render statements of the financial affairs of the corporation in such form and as often as required by the Board of Directors or the Chief Executive Officer. The Chief Financial Officer, subject to the order of the Board of Directors, shall have the custody of all funds and securities of the corporation. The Chief Financial Officer shall perform other duties commonly incident to the office and shall also perform such other duties and have such other powers as the Board of Directors or the Chief Executive Officer shall designate from time to time. The Chief Executive Officer may direct the Vice President and Controller, Treasurer or any Assistant Treasurer or Assistant Controller, to assume and perform the duties of the Chief Financial Officer in the absence or disability of the Chief Financial Officer and, in the absence or disability of the Chief Financial Officer, each such officer shall perform other duties commonly incident to the office and shall also perform such other duties and have such other powers as the Board of Directors or the Chief Executive Officer shall designate from time to time.

SECRETARY AND ASSISTANT SECRETARY

Section 13. The Secretary shall attend all meetings of the Board of Directors and all meetings of the stockholders and record all the proceedings of the meetings of the corporation and of the Board of Directors in a book to be kept for that purpose and shall perform like duties for the

standing committees when required. He or she shall give, or cause to be given, notice of all meetings of the stockholders and special meetings of the Board of Directors, and shall perform such other duties as may be prescribed by the Board of Directors or Chairman, under whose supervision he or she shall be. He or she shall have custody of the corporate seal of the corporation and he or she, or an assistant secretary, shall have authority to affix the same to any instrument requiring it and when so affixed, it may be attested by his or her signature or by the signature of such Assistant Secretary. The Board of Directors may give general authority to any other officer to affix the seal of the corporation and to attest the affixing by his or her signature.

Section 14. The Assistant Secretary, or if there be more than one, the Assistant Secretaries in the order determined by the Board of Directors (or if there be no such determination, then in the order of their election) shall, in the absence of the Secretary or in the event of his or her inability or refusal to act, perform the duties and exercise the powers of the Secretary and shall perform such other duties and have such other powers as the Board of Directors may from time to time prescribe.

TREASURER AND ASSISTANT TREASURERS

Section 15. The Treasurer shall be the Chief Financial Officer of the corporation in the event that there is not another person designated as the Chief Financial Officer by the Board of Directors, and shall have the custody of the corporate funds and securities and shall keep full and accurate accounts of receipts and disbursements in books belonging to the corporation and shall deposit all moneys and other valuable effects in the name and to the credit of the corporation in such depositories as may be designated by the Board of Directors.

Section 16. The Treasurer shall disburse the funds of the corporation as may be ordered by the Board of Directors, taking proper vouchers for such disbursements, and shall render to the President and the Board of Directors, at its regular meetings, or when the Board of Directors so requires, an account of all his or her transactions as Treasurer and of the financial condition of the corporation.

Section 17. If required by the Board of Directors, the Treasurer shall give the corporation a bond (which shall be renewed every six (6) years) in such sum and with such surety or sureties as shall be satisfactory to the Board of Directors for the faithful performance of the duties of his or her office and for the restoration to the corporation, in case of his or her death, resignation, retirement or removal from office, of all books, papers, vouchers, money and other property of whatever kind in his or her possession or under his or her control belonging to the corporation.

Section 18. The Assistant Treasurer, or if there shall be more than one, the Assistant Treasurers in the order determined by the Board of Directors (or if there be no such determination, then in the order of their election) shall, in the absence of the Treasurer or in the event of his or her inability or refusal to act, perform the duties and exercise the powers of the Treasurer and shall perform such other duties and have such other powers as the Board of Directors may from time to time prescribe.

ARTICLE VI

CERTIFICATE OF STOCK

Section 1. The shares of the corporation shall be represented by certificates, or shall be uncertificated. Every holder of stock in the corporation shall be entitled to have a certificate, signed by, or in the name of the corporation by, the Chairman or Vice Chairman of the Board of Directors, or the President or a Vice President and the Treasurer or an Assistant Treasurer, or the Secretary or an Assistant Secretary of the corporation, certifying the number of shares owned by him or her in the corporation.

If the corporation shall be authorized to issue more than one class of stock or more than one series of any class, then in the case of shares represented by certificates, the powers, designations, preferences and relative, participating, optional or other special rights of each class of stock or series thereof and the qualification, limitations or restrictions of such preferences and/or rights shall be set forth in full or summarized on the face or back of the certificate, provided that, except as otherwise provided in Section 202 of the General Corporation Law of Delaware, in lieu of the foregoing requirements, there may be set forth on the face or back of the certificate, a statement that the corporation will furnish without charge to each stockholder who so requests the powers, designations, preferences and relative, participating, optional or other special rights of each class of stock or series thereof and the qualifications, limitations or restrictions of such preferences and/or rights.

Section 2. Any or all of the signatures on the certificate may be facsimile. In case any officer, transfer agent or registrar who has signed or whose facsimile signature has been placed upon a certificate shall have ceased to be such officer, transfer agent or registrar before such certificate is issued, it may be issued by the corporation with the same effect as if he or she were such officer, transfer agent or registrar at the date of issue.

LOST CERTIFICATES

Section 3. The Board of Directors may direct a new certificate or certificates to be issued in place of any certificate or certificates theretofore issued by the corporation alleged to have been lost, stolen or destroyed, upon the making of an affidavit of that fact by the person claiming the certificate of stock to be lost, stolen or destroyed. When authorizing such issue of a new certificate or certificates, the Board of Directors may, in its discretion and as a condition precedent to the issuance thereof, require the owner of such lost, stolen or destroyed certificate or certificates, or his or her legal representative, to advertise the same in such manner as it shall require and/or to give the corporation a bond in such sum as it may direct as indemnity against any claim that may be made against the corporation with respect to the certificate alleged to have been lost, stolen or destroyed.

TRANSFER OF STOCK

Section 4. (I) Upon surrender to the corporation or the transfer agent of the corporation of a certificate for shares duly endorsed or accompanied by proper evidence of succession, assignation or authority to transfer, it shall be the duty of the corporation to cancel the old certificate and record the transaction upon its books and, if the shares are to continue to be represented by certificate, issue a new certificate to the person entitled thereto.

(a) The corporation shall have power to enter into and perform any agreement with any number of stockholders of any one or more classes of stock of the corporation to restrict

the transfer of shares of stock of the corporation of any one or more classes owned by such stockholders in any manner not prohibited by the DGCL.

FIXING RECORD DATE

Section 5. In order that the corporation may determine the stockholders entitled to notice of, or to vote at, any meeting of stockholders or any adjournment thereof, or to express consent to corporate action in writing without a meeting, or entitled to receive payment of any dividend or other distribution or allotment of any rights, or entitled to exercise any rights in respect of any change, conversion or exchange of stock or for the purpose of any other lawful action, the Board of Directors may fix, in advance, a record date, which shall not be more than sixty (60) nor less than ten (10) days before the date of such meeting, nor more than sixty (60) days prior to any other action. A determination of stockholders of record entitled to notice of, or to vote at, a meeting of stockholders shall apply to any adjournment of the meeting; provided, however, that the Board of Directors may fix a new record date for the adjourned meeting. If no record date is fixed by the Board of Directors, the record date for determining stockholders entitled to notice of or to vote at a meeting of stockholders shall be at the close of business on the day immediately preceding the day on which notice is given, or if notice is waived, at the close of business on the day immediately preceding the day on which the meeting is held. A determination of stockholders of record entitled to notice of or to vote at a meeting of stockholders shall apply to any adjournment of the meeting; *provided, however,* that the Board of Directors may fix a new record date for the adjourned meeting.

REGISTERED STOCKHOLDERS

Section 6. The corporation shall be entitled to recognize the exclusive right of a person registered on its books as the owner of shares to receive dividends, and to vote as such owner, and to hold liable for calls and assessments a person registered on its books as the owner of shares and shall not be bound to recognize any equitable or other claim to or interest in such share or shares on the part of any other person, whether or not it shall have express or other notice thereof, except as otherwise provided by the laws of the state of Delaware.

ARTICLE VII

GENERAL PROVISIONS

DIVIDENDS

Section 1. Dividends upon the capital stock of the corporation, subject to the provisions of the certificate of incorporation, if any, may be declared by the Board of Directors at any regular or special meeting, pursuant to law. Dividends may be paid in cash, in property, or in shares of the capital stock, subject to the provisions of the certificate of incorporation.

Section 2. Before payment of any dividend, there may be set aside out of any funds of the corporation available for dividends such sum or sums as the Directors from time to time, in their absolute discretion, think proper as a reserve or reserves to meet contingencies, or for equalizing dividends, or for repairing or maintaining any property of the corporation, or for such other purposes as the Directors shall think conducive to the interest of the corporation, and the Directors may modify or abolish any such reserve in the manner in which it was created.

CHECKS

Section 3. All checks or demands for money and notes of the corporation shall be signed by such officer or officers or such other person or persons as the Board of Directors may from time to time designate.

FISCAL YEAR

Section 4. The fiscal year of the corporation shall be fixed by resolution of the Board of Directors.

SEAL

Section 5. The Board of Directors may adopt a corporate seal having inscribed thereon the name of the corporation, the year of its organization and the words "Corporate Seal, Delaware." The seal may be used by causing it or a facsimile thereof to be impressed or affixed or reproduced or otherwise.

INDEMNIFICATION

Section 6. The corporation shall indemnify its officers and Directors to the full extent permitted by the General Corporation Law of Delaware; *provided, however*, that the corporation may modify the extent of such indemnification by individual contracts with its Directors and officers. Without limiting the generality of the preceding sentence, the corporation shall indemnify to the full extent permitted by, and in the manner permissible under, the laws of the state of Delaware any person made, or threatened to be made, a party to an action or proceeding, whether criminal, civil, administrative or investigative, by reason of the fact that he or she, his or her testator or intestate is or was a Director or officer of the corporation or any predecessor of the corporation, or served any other enterprise as a Director or officer at the request of the corporation or any predecessor of the corporation.

Expenses incurred by a Director or officer of the corporation in defending a civil or criminal action, suit or proceeding by reason of the fact that he or she is or was a Director or officer of the corporation (or was serving at the corporation's request as a Director or officer of another enterprise or corporation) shall be paid by the corporation in advance of the final disposition of such action, suit or proceeding upon receipt of an undertaking by or on behalf of such Director or officer to repay such amount if it shall ultimately be determined that he or she is not entitled to be indemnified by the corporation as authorized by relevant sections of the General Corporation Law of Delaware.

The foregoing provisions of this Article VII shall be deemed to be a contract between the corporation and each Director and officer who serves in such capacity at any time while this bylaw is in effect, and any repeal or modification thereof shall not affect any rights or obligations then existing with respect to any state of facts then or theretofore existing or any action, suit or proceeding theretofore or thereafter brought based in whole or in part upon any such state of facts.

The Board of Directors in its discretion shall have power on behalf of the corporation to indemnify any person, other than a Director or officer, made a party to any action, suit or proceeding by reason of the fact that he or she, his or her testator or intestate, is or was an employee or agent

of the corporation and to pay the expenses incurred by any such person in defending such action, suit or proceeding.

The foregoing rights of indemnification shall not be deemed exclusive of any other rights to which any Director or officer may be entitled apart from the provisions of this Article VII.

ARTICLE VIII

AMENDMENTS

Any bylaw (including these bylaws) may be adopted, amended or repealed by the vote of the holders of a majority of the shares then entitled to vote at an election of Directors, or by vote of the Board or by the Directors' written consent pursuant to Section 9 of Article III.

ARTICLE IX

EXCLUSIVE JURISDICTION OF DELAWARE COURTS

Unless the corporation consents in writing to the selection of an alternative forum, the Court of Chancery of the State of Delaware shall be the sole and exclusive forum for (a) any derivative action or proceeding brought on behalf of the corporation, (b) any action asserting a claim of breach of a fiduciary duty owed by any director, officer, employee or agent of the corporation to the corporation or the corporation's stockholders, (c) any action asserting a claim arising pursuant to any provision of the DGCL, the certificate of incorporation or these bylaws, or (d) any action asserting a claim governed by the internal affairs doctrine.

EXHIBIT 21.1

SUBSIDIARIES OF SYNOPSYS, INC.*

Name	Jurisdiction of Incorporation
Black Duck Software, Inc.	Delaware
Coverity LLC	Delaware
Nihon Synopsys G.K.	Japan
Synopsys Emulation and Verification S.A.S.	France
Synopsys International Limited	Ireland
Synopsys International Old Unlimited Company	Ireland
Synopsys Ireland New Limited	Ireland
Synopsys Ireland Unlimited Company	Ireland
Synopsys Netherlands B.V.	Netherlands
Synopsys Taiwan Co., Ltd.	Taiwan
Synopsys Global Kft.	Hungary

*Pursuant to Item 601(b)(21)(ii) of Regulation S-K, the names of other subsidiaries of Synopsys, Inc. are omitted because, considered in the aggregate, they would not constitute a significant subsidiary as of the end of the year covered by this report.

EXHIBIT 23.1

Consent of Independent Registered Public Accounting Firm

The Board of Directors
Synopsys, Inc.:

We consent to the incorporation by reference in the registration statements (Nos. 333-84517 and 333-68011) on Form S-3 and (Nos. 333-225237, 333-221990, 333-217177, 333-215526, 333-213246, 333-206458, 333-196428, 333-195167, 333-189019, 333-185600, 333-181875, 333-179940, 333-174587, 333-169275, 333-166274, 333-157791, 333-151070, 333-151067, 333-134899, 333-125225, 333-125224, 333-116222, 333-108507, 333-106149, 333-103636, 333-103635, 333-103418, 333-100155, 333-99651, 333-97319, 333-97317, 333-75638, 333-77000, 333-71056, 333-63216, 333-56170, 333-45056, 333-38810, 333-32130, 333-90643, 333-84279, 333-77597, 333-77127, 333-68883, 333-60783, 333-50947, 333-45181, 333-42069, and 333-22663) on Form S-8 of Synopsys, Inc. of our report dated December 14, 2018, with respect to the consolidated balance sheets of Synopsys, Inc. and its subsidiaries as of November 3, 2018 and October 28, 2017, and the related consolidated statements of operations, comprehensive income, stockholders' equity, and cash flows for each of the years in the three-year period ended November 3, 2018, and the related notes (collectively, "the consolidated financial statements"), and the effectiveness of internal control over financial reporting as of November 3, 2018, which report appears in the November 3, 2018 annual report on Form 10-K of Synopsys, Inc.

/s/ KPMG LLP

Santa Clara, California
December 14, 2018

EXHIBIT 31.1

CERTIFICATION

I, Aart J. de Geus, certify that:

1. I have reviewed this Annual Report on Form 10-K of Synopsys, 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 officers 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 officers and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

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

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

Date: December 14, 2018

/s/ Aart J. de Geus

Aart J. de Geus
Co-Chief Executive Officer and Chairman
(Co-Principal Executive Officer)

EXHIBIT 31.2

CERTIFICATION

I, Chi-Foon Chan, certify that:

1. I have reviewed this Annual Report on Form 10-K of Synopsys, 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 officers 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 officers and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

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

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

Date: December 14, 2018

/s/ Chi-Foon Chan

Chi-Foon Chan

Co-Chief Executive Officer and President
(Co-Principal Executive Officer)

EXHIBIT 31.3

CERTIFICATION

I, Trac Pham, certify that:

1. I have reviewed this Annual Report on Form 10-K of Synopsys, 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 officers 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 officers and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

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

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

Date: December 14, 2018

/s/ Trac Pham

Trac Pham

Chief Financial Officer
(Principal Financial Officer)

EXHIBIT 32.1

Certification Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002 (Subsections (a) and (b) of Section 1350, Chapter 63 of Title 18, United States Code)

Pursuant to the requirement set forth in Rule 13a-14(b) of the Securities Exchange Act of 1934, as amended (the "Exchange Act") and Section 1350, Chapter 63 of Title 18 of the United States Code (18 U.S.C-§1350), each of Aart J. de Geus, Co-Chief Executive Officer and Chairman of Synopsys, Inc., a Delaware corporation (the "Company"), Chi-Foon Chan, Co-Chief Executive Officer and President of the Company, and Trac Pham, Chief Financial Officer of the Company, does hereby certify, to such officer's knowledge that:

The Annual Report on Form 10-K for the fiscal year ended October 31, 2018 (the "Form 10-K") to which this Certification is attached as Exhibit 32.1 fully complies with the requirements of Section 13(a) or 15(d) of the Exchange Act. The information contained in the Form 10-K fairly presents, in all material respects, the financial condition and results of operations of the Company.

IN WITNESS WHEREOF, the undersigned have set their hands hereto as of December 14, 2018.

/s/ Aart J. de Geus

Aart J. de Geus
Co-Chief Executive Officer and Chairman

/s/ Chi-Foon Chan

Chi-Foon Chan
Co-Chief Executive Officer and President

/s/ Trac Pham

Trac Pham
Chief Financial Officer

The foregoing certification is being furnished solely pursuant to Section 906 of the Sarbanes-Oxley Act of 2002 (subsections (a) and (b) of Section 1350, Chapter 63 of Title 18, United States Code) and is not deemed filed with the Securities and Exchange Commission as part of the Form 10-K or as a separate disclosure document and is not to be incorporated by reference into any filing of the Company under the Securities Act of 1933, as amended, or the Securities Exchange Act of 1934, as amended (whether made before or after the date of the Form 10-K), irrespective of any general incorporation language contained in such filing.