ASML HOLDING NV
Form 20-F
February 06, 2019

United States
Securities and Exchange Commission
Washington, D.C. 20549
Form 20-F
ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d)
OF THE SECURITIES EXCHANGE ACT OF 1934
for the fiscal year ended December 31, 2018
Commission file number 001-33463
ASML HOLDING N.V.
(Exact Name of Registrant as Specified in Its Charter)
THE NETHERLANDS
(Jurisdiction of Incorporation or Organization)
DE RUN 6501
5504 DR VELDHOVEN
THE NETHERLANDS
(Address of Principal Executive Offices)
Skip Miller
Telephone: +1 480 235 0934
E-mail: skip.miller@asml.com
2650 W Geronimo Place
Chandler, AZ 85224, USA
(Name, Telephone, E-mail, and / or Facsimile number and Address of Company Contact Person)
Securities registered or to be registered pursuant to Section 12(b) of the Act:

Title of each class	Name of each exchange on which registered
Ordinary Shares (nominal value EUR 0.09 per share)	The NASDAQ Stock Market LLC

Securities registered or to be registered pursuant to Section 12(g) of the Act:
None
(Title of Class)
Securities for which there is a reporting obligation pursuant to Section 15(d) of the Act:
None
(Title of Class)
Indicate the number of outstanding shares of each of the issuer's classes of
capital or common stock as of the close of the period covered by the annual report.
421,097,729 Ordinary Shares
(nominal value EUR 0.09 per share)
Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act.
Yes (x) No ( )
If this report is an annual or transition report, indicate by check mark if the registrant
is not required to file reports pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934.
Yes ( ) No (x)
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 (x) No ( )
Indicate by check mark whether the registrant has submitted electronically

every Interactive
Data File required to be submitted pursuant to Rule
405 of Regulation S-T (§232.405 of this chapter) during the
preceding 12 months (or for such shorter period that the registrant was required to submit such files).
Yes (x) No ( )
Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, or an emerging growth company.
See definition of "large accelerated filer," “accelerated filer," and “emerging growth company" in Rule 12b-2 of the Exchange Act. (Check one):
Large accelerated filer (x) Accelerated filer ( ) Non-accelerated filer ( ) Emerging growth company ( )
If an emerging growth company that prepares its financial statements in accordance with U.S. GAAP, 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 which basis of accounting the registrant has used to prepare
the financial statements included in this filing:
U.S. GAAP (x) International Financial Reporting Standards as issued by the
International Accounting Standards Board ( ) Other ( )
If "Other" has been checked in response to the previous question, indicate by check mark
which financial statement item the registrant has elected to follow.
Item 17 ( ) Item 18 ( )
If this is an annual report, indicate by check mark whether the registrant is a
shell company (as defined in Rule 12b-2 of the Exchange Act)
Yes ( ) No (x)
Name and address of person authorized to receive notices and communications
from the Securities and Exchange Commission:
James A. McDonald
Skadden, Arps, Slate, Meagher & Flom (UK) LLP
40 Bank Street, Canary Wharf London E14 5DS England

ASML INTEGRATED REPORT 2018

Contents

A definition or explanation of abbreviations, technical terms and other terms used throughout this Integrated Report that require explanation can be found in the chapter Definitions. In some cases numbers have been rounded for readers' convenience.

This report comprises regulated information within the meaning of articles 1:1 and 5:25c of the Dutch Financial Markets Supervision Act (Wet op het Financieel Toezicht).

On November 22, 2016, we acquired 100 percent of the issued share capital of HMI. Financial information presented in our Integrated Report includes HMI from November 22, 2016 onwards.

On June 29, 2017, we completed the acquisition of a 24.9 percent interest in Carl Zeiss SMT Holding GmbH & Co. KG, which owns 100 percent of the shares in Carl Zeiss SMT GmbH. We record the results from the interest in Carl Zeiss SMT Holding GmbH & Co. KG using a one-quarter time lag as the results are not available in time to record them in our concurrent period.

In this report the name ‘ASML’ is sometimes used for convenience in contexts where reference is made to ASML Holding N.V. and / or any of its subsidiaries and / or any equity method investments, as the context may require. The name is also used where no useful purpose is served by identifying the particular company or companies.

Special Note Regarding Forward-Looking Statements

In addition to historical information, this Integrated Report contains statements relating to our future business and / or results. These statements include certain projections, business trends and other matters that are "forward-looking" within the meaning of the Private Securities Litigation Reform Act of 1995. You can generally identify these statements by the use of words like "may", "will", "could", "should", "project", "believe", "anticipate", "expect", "plan", "estimate", "forecast", "potential", "intend", "continue" and variations of these words or comparable words. They appear in a number of places throughout this Integrated Report and include statements with respect to our expected trends and outlook, corporate priorities and strategy, including the potential pursuit of merger and acquisition activities in the future bookings, expected financial results and expected semiconductor industry trends and opportunities, including expected sales, EUV revenue, gross margin, capital expenditures, R&D and SG&A expenses, cash conversion cycle, target effective annualized tax rate, opportunity, the new wave of semiconductor devices and the expected introduction of the first set of such devices in 2019 and expected customer demand in specified market segments including memory, logic and foundry, expected annual revenue opportunity and potential in 2020 and for 2025, the expected impact of the fire experienced by one of our suppliers including the expected timing of recovery of financial impact, expected trends in the lithography system market, trends in DUV systems revenue and expected future DUV sales and Holistic Lithography and installed based management revenues, expected semiconductor market growth and growth in worldwide factory capacity, statements with respect to customer demand and the commitment of customers to High NA machines and to insert EUV into volume manufacturing by ordering systems and investing in preparation for high-volume production, statements with respect to Holistic Lithography roadmaps and roadmap acceleration, including the expected introduction of higher productivity systems in 2019 (including the expected shipment of NXE:3400C and expected timing thereof) and the expected benefits, statements with respect to commitments for systems sales orders, including expected timing of recognition of anticipated revenues and expected timing of shipment of first High NA systems, ASML’s commitment to secure system performance, shipments, and support for volume manufacturing, including availability, timing of and progress supporting EUV ramp and improving consistency, statements with respect to the expected benefits of EUV, including year-on-year cost reduction and system performance, and of the introduction of the new DUV system and expected demand for such system, the expected benefits of HMI’s e-beam metrology capabilities, including the expansion of ASML’s integrated Holistic Lithography solutions through the introduction of a new class of pattern fidelity control, the expected enhancement of pattern fidelity metrology, statements with respect to the expected benefits of the imec collaboration, including roadmap acceleration and potential for printing of even smaller nanoscale devices, statements with respect to ASML’s applications business, expected lower attrition rate in the near future, customer, partner and industry roadmaps, including shrink roadmaps and continued semiconductor process scaling, the development of High NA and its benefits, including offering at least 10 more years of development opportunity, the expected benefits of the indirect interest in Carl Zeiss SMT GmbH, statements with respect to DUV competitiveness, strategy alignment with international standards such as United Nations Sustainable Development Goals, statements with respect to the intention to keep driving innovation into the next decade and beyond, expected growth of our service business, expected shipments of systems, planned shipments of EUV tools, productivity of our tools and systems, including EUV productivity targets and goals, and system performance, expected industry adoption of EUV, supply chain and service capabilities, expected integration of use of supplier information in sourcing decisions, the development of EUV technology and EUV industrialization, the number and timing of EUV systems expected to be shipped, expected use of EUV systems in high-volume manufacturing and revenue recognition, enabling of high-volume manufacturing of next generation chips and higher performance chips at lower cost, shrink being a key driver supporting innovation and providing long-term industry growth, lithography enabling affordable shrink and delivering value to customers, expected industry trends and expected trends and opportunities in the business environment, including the expectation that semiconductor end-market growth will be fueled by innovation drivers such as 5G connectivity, artificial intelligence, autonomous driving and big data, the continuation of Moore’s law and the expectation that EUV will continue to enable Moore’s law and drive long term value for ASML beyond the next decade, dividend policy, our proposed dividend and intention to repurchase and cancel shares, including statements with respect to the share repurchase plan for 2018-2019, our expectation to continue to return cash to our shareholders through share buybacks

and dividends and statements with respect to the expected impact of accounting standards, and statements with respect to the memorandum of understanding (MOU) executed with Nikon to settle litigation proceedings, including the expectation to enter into a definitive cross-license and settlement agreement and the terms of such agreements. These forward-looking statements are not historical facts, but rather are based on current expectations, estimates, assumptions and projections about the business and our future financial results and readers should not place undue reliance on them. Forward-looking statements do not guarantee future performance, and actual results may differ materially from projected results as a result of certain risks, and uncertainties. These risks and uncertainties include, without limitation, those described under Management Board Report - Risk Factors. These forward-looking statements are made only as of the date of this Integrated Report. We do not undertake to update or revise the forward-looking statements, whether as a result of new information, future events or otherwise.

Message from our CEO

Dear stakeholders,

This has truly been a milestone year for ASML: 2018 has seen extraordinary growth, building on the heights of recent years. Our technology breakthroughs have helped us increase the performance of our newest generation of chip-making systems, which will allow customers to start high-volume production of next-generation chips. This will create huge value, helping technologies such as artificial intelligence, 5G connectivity, the Internet of Things and augmented reality to become part of everyday life and to solve some of society's major challenges.

Our record net income of EUR 2.6 billion in 2018 underscores our growth path. With net sales of EUR 10.9 billion, we have nearly reached our initial sales target for 2020. Overall, we have a solid foundation to take us into the next decade, allowing us to update our target for 2020 to net sales of EUR 13 billion, based on a moderate market scenario.

ASML’s entire suite of products and services performed well in 2018, advancing the execution of our roadmap of our Holistic Lithography solutions. In line with our projections, we made progress in EUV profitability and continued to strengthen our DUV and Applications businesses. With EUV, all systems sold and shipped to customers meet the specifications that are able to support high-volume manufacturing.

Highlights in the DUV business include significant progress in the introduction of the TWINSCAN NXT:2000i, while in Applications, we adopted YieldStar 375 in 3D NAND manufacturing. We also made breakthroughs in implementing multi-beam technology, as part of our inspection and metrology product offering, which is a result of the synergy of pattern verification improvements in stage hardware and computational lithography software for the identification of critical inspection areas.

To support the industry driver of shrink well into the next decade, we accelerated our 0.33 NA EUV and are on track with our High NA EUV program, with major customers already committing themselves commercially to this technology. This is an indication that our strategy resonates with our customers and other stakeholders.

While helping the semiconductor industry to continue to realize Moore’s Law, we seek to contribute to realizing the United Nations Sustainability Development Goals that aim to protect the planet and end poverty, and will further align our 2019-2025 strategy with these goals. Our technological breakthroughs in 2018 enhance the energy efficiency of our products, as well as address challenges related to aging populations, healthcare and the energy transition, among others. Advanced chips use significantly less power than older-generation chips. Reuse of parts was also a critical focus area for us in 2018, and we are continually improving ways to reduce waste and extend the lifespan of our lithography systems.

We believe we are an integral part of the communities in which we operate, and this is key to our sustainable business model. We invest in these communities not only to make them more attractive for people to live and work in, but also to create strong ecosystems. ASML volunteers help local schools improve their technology and science education, to prepare the younger generations for a digitalized world. We support universities, research institutes and startups, as well as the ASML Foundation’s global education projects.

Of course, 2018 was not without its challenges. Geopolitical shifts are taking place, new global trade blocs are forming, and we are seeing signs of protectionism. We can only keep progressing through an open and global innovation model, and protectionism will hinder innovation. We strongly favor the free flow of people, trade and knowledge, while at the same time respecting ownership of that knowledge.

As we expand around the globe, recruiting and onboarding the right people, and seamlessly integrating them into our culture, also presents a challenge. We achieved successes here in 2018, creating 4,000 jobs and filling them with the best and brightest people, as well as providing a dynamic, nurturing workspace where our talent pool can learn and grow.

We are very pleased Roger Dassen joined us as our CFO. He brings to the position deep financial expertise and broad managerial experience. Roger succeeded Wolfgang Nickl, who left ASML at the end of April. Additionally, we are delighted to welcome Christophe Fouquet to the Board of Management, where he will lead business line EUV utilizing his extensive technology and business experience.

Looking ahead, we see yet more growth, with potential for net sales of EUR 15 billion in a low market scenario and net sales of EUR 24 billion in a high market scenario for 2025. The path is clear: we have the technology, people, customers, suppliers and partners. We will keep driving innovation for the good of all our stakeholders, and to help

solve society’s challenges into the next decade and beyond.
Peter Wennink
President and Chief Executive Officer
Dated: February 5, 2019

All information disclosed in this Management Board Report is provided as a supplement to, and should be read in conjunction with, our Corporate Governance and Consolidated Financial Statements.

Board of Management

Peter T.F.M. Wennink (1957)
Term expires 2022

President, Chief Executive Officer and Chairman of the Board of Management

- Mr. Wennink joined ASML in 1999 and was appointed as Executive Vice President, CFO and member of our BoM at the 1999 AGM. Mr. Wennink was appointed as President and CEO in 2013.
- Mr. Wennink has an extensive background in finance and accounting. Prior to his employment with ASML, Mr. Wennink worked as a partner at Deloitte Accountants B.V., specializing in the high-technology industry with an emphasis on the semiconductor equipment industry.
- Mr. Wennink is a member of the Dutch Institute of Registered Accountants, a member of the supervisory board of the Eindhoven University of Technology, and a member of the Advisory Board of the Investment Committee of Stichting Pensioenfonds ABP (Dutch pension fund for government employees). Mr. Wennink further serves on the board of the FME-CWM (the employers' organization for the technology industry in the Netherlands).

Martin A. van den Brink (1957)
Term expires 2022

President, Chief Technology Officer and Vice Chairman of the Board of Management

- Mr. Van den Brink joined ASML when the company was founded in 1984. Mr. Van den Brink held several positions in engineering and from 1995 he served as Vice President Technology. Mr. Van den Brink was appointed as Executive Vice President Product & Technology and member of the BoM at the 1999 AGM. Mr. Van den Brink was appointed as President and CTO in 2013.
- Mr. Van den Brink earned a degree in Electrical Engineering from HTS Arnhem (HAN University), and a degree in Physics (1984) from the University of Twente, the Netherlands.
- Mr. Van den Brink was awarded an honorary doctorate in physics by the University of Amsterdam, the Netherlands, in 2012.

Roger J.M. Dassen (1965)
Term expires 2022

Executive Vice President and Chief Financial Officer

- Mr. Dassen joined ASML in June, 2018 and was appointed as Executive Vice President and CFO and member of our BoM at the 2018 AGM.
- Prior to joining ASML, Mr. Dassen was the Global Vice Chairman and member of the Executive Board of Deloitte Touche Tohmatsu Limited. Before that Mr. Dassen was the CEO of Deloitte Holding B.V.
- Mr. Dassen earned a Master's degree in Economics and Business Administration (1988), University of Maastricht; a post-master in Auditing (1990), University of Maastricht; and a PhD in Business Administration (1995).
- Mr. Dassen is a professor of auditing at the Free University of Amsterdam and serves as a member of the supervisory board of The Dutch National Bank.

Frits J. van Hout (1960)
Term expires 2021

Executive Vice President and Chief Strategy Officer

- Mr. Van Hout joined ASML in 1984 and rejoined ASML in 2001, after an eight-year absence. He was appointed as Executive Vice President and Chief Marketing Officer and became a member of our BoM at the 2009 AGM. Mr. Van Hout served as Executive Vice President and Chief Program Officer from July 1, 2013 and was appointed Executive Vice President and Chief Strategy Officer effective April 1, 2018. Prior to his BoM membership, Mr. Van Hout served as ASML's Executive Vice President Integral Efficiency, Senior Vice President Customer Support and held various other positions.
- Mr. Van Hout served as CEO of the Beyeler Group and held various management positions at Datacolor International from 1992 until 2001.
- Mr. Van Hout earned a Master's degree in Theoretical Physics (1981), University of Oxford; and a Master's degree in Applied Physics (1984), Eidgenössische Technische Hochschule, Zürich.
- Mr. Van Hout is a member of the Board of the Stichting Brainport, the Eindhoven Region Economic Development Board.

Christophe D. Fouquet (1973)
Term expires 2022

Executive Vice President EUV

- Mr. Fouquet joined ASML in 2008 and was appointed as Executive Vice President EUV and became a member of our BoM at the 2018 AGM.
- Mr. Fouquet has held several positions at ASML, including Executive Vice President Applications, which he has held from 2013 until 2018. Prior to joining ASML, Mr. Fouquet worked at semiconductor equipment peers KLA Tencor and Applied Materials.
- Mr. Fouquet earned a degree in Physics at the Institut Polytechnique de Grenoble.

Frédéric J.M. Schneider-Maunoury (1961)
Term expires 2022

Executive Vice President and Chief Operations Officer

- Mr. Schneider-Maunoury joined ASML in December, 2009, as Executive Vice President and COO and was appointed to our BoM at the 2010 AGM.
- Prior to joining ASML, Mr. Schneider-Maunoury served as Vice President Thermal Products Manufacturing of the power generation and rail transport equipment group ALSTOM. Previously, Mr. Schneider-Maunoury was general manager of the worldwide Hydro Business of ALSTOM.
- Mr. Schneider-Maunoury also held various positions at the French Ministry of Trade and Industry.
- Mr. Schneider-Maunoury is a graduate of Ecole Polytechnique (1985) and Ecole Nationale Supérieure des Mines (1988) in Paris.

The Role of Lithography Lithography is the critical process step in the production of microchips. Our systems are essentially projection systems, comparable to a slide projector, using laser light to lay out the transistors - the ‘brain cells’ of a microchip. The light is projected using a so-called mask (also known as a reticle), containing the blueprint of the pattern that will be printed. A lens or mirror focuses the pattern onto the wafer - a thin, round slice of semiconductor material - which is coated with a light-sensitive material. When the unexposed parts are etched away, the pattern is revealed. Because lithography patterns the structures on a microchip, lithography plays an important role in determining how small the features on the chip can be and how densely chip makers can pack transistors together.

Faster, smaller, greener

Our guiding principle is continuing Moore's Law towards ever-smaller, cheaper, more powerful and energy-efficient semiconductors. The long-term growth of the semiconductor industry is based on the principle that the power, cost and time required for every computation on a digital electronic device can be reduced by shrinking the size of transistors on chips. One of the main drivers of shrink is the resolution that our systems can achieve. This, in turn, is mainly determined by the wavelength of the light that is used and the numerical aperture of the optics. A shorter wavelength - like a finer brush used for painting - can resolve smaller features. A larger numerical aperture can focus the light more tightly, which also leads to smaller resolution. The industry has gone through a series of technology transitions where it shortened the wavelength of the light from 365 nm (i-line) to 193 nm (ArF) in the DUV part of the spectrum. Currently ASML is helping customers to transition to 13.5 nm (EUV), which again allows lithography systems to resolve smaller features.

Leading-edge chip makers have routinely produced chip features with geometries of between 20 nm and 10 nm, compared to typical geometries of 10,000 nm in the early 1970s. The number of transistors on the most advanced microchips has increased from several thousand to over 6 billion.

This trend was first observed by Intel co-founder Gordon Moore in 1965. Moore stated that chip makers could double the number of transistors in - and boost the performance of - a typical microprocessor every year, while maintaining the same cost. He later adjusted this to every 2 years. The trend has held for more than 50 years. The semiconductor industry continues to realize Moore's Law, and our customers' roadmaps require lithography-enabled shrink beyond the next decade, which is the time frame the industry has always used to plan its roadmap. In 2018, major chip makers were investing in and preparing for high volume-production with EUV. We expect the first commercial chips with EUV layers to be on the market in 2019.

Our Company

It is hard to imagine the world without microchips. They are at the heart of the devices that we use to work, travel, stay healthy and be entertained - from smartphones to cars, from MRI scanners to industrial robots. Delivering new functionalities, better performance and lower cost with each generation, advances in chips have spawned new products and transformed industries. New technologies and trends, such as artificial intelligence, 5G connectivity, augmented reality and the Internet of Things, result in additional demand for semiconductor chips to generate, transfer, store, analyze and apply vast amounts of data.

As one of the world's leading manufacturers of chip-making equipment, ASML provides its customers with tools - hardware, software and services - to create the patterns that define the electronic circuits on a chip. As we improve our products, our customers can increase the value and reduce the cost of chips for their customers.

We are a global company with 23,247 employees and achieved total net sales of EUR 10.9 billion during 2018, resulting in a net income of EUR 2.6 billion. Our thousands of engineers work in multi-disciplinary teams and with a network of suppliers and technology partners, innovating to maintain our technology leadership. We set ourselves ambitious goals and take pride in the impact we have on the world around us.

A short company history

Our company was founded in 1984 in Eindhoven under the name of ASM Lithography. By 1985 we had grown into a company of more than 200 employees and moved to Veldhoven, where we have been headquartered ever since. In 1991, we launched our PAS 5500, which became a major success for ASML and continues to be in use today. After we incorporated as 'ASM Lithography Holding N.V.' in the Netherlands on October 3, 1994, we became a public company in 1995 with listings on NASDAQ and Euronext Amsterdam.

We continued our growth and technological advancement by acquiring the Silicon Valley Group in 2001, whose site in Wilton, Connecticut, in the US, is now a major R&D and manufacturing center. That same year we introduced our TWINSCAN system which, using 'dual-stage' technology, exposes one wafer while the next wafer is already being measured, maximizing performance and productivity. In 2001, we changed our name to ASML Holding N.V.

In 2007, we acquired Brion, a US company specialized in computational lithography for ICs, which became a cornerstone of our Holistic Lithography product strategy. In 2013, we acquired Cymer, a manufacturer of light sources in the US, to accelerate the development of the next-generation lithography technology, EUV. In 2016, we acquired HMI in Taiwan to further enhance our Holistic Lithography product portfolio. In 2017, we acquired a 24.9 percent indirect interest in Carl Zeiss SMT GmbH in Germany, to facilitate the further development of our EUV systems.

Industry Trends and Opportunities

The exponential increase in data generation, transfer and storage is being complemented by new data analysis techniques and applications, which together are fueling industry growth and a new wave of semiconductor devices. These new drivers include technologies and applications such as 5G connectivity, Internet of Things (IoT), virtual assistants, autonomous driving, augmented and virtual reality, big data and artificial intelligence.[1] 5G connectivity enables speeds up to 1,000 times faster than 4G mobile networks, supporting several of these new applications. We expect the first of these semiconductor devices will be introduced in 2019. Artificial intelligence is being enabled by the increasing processing capability of advanced semiconductors, reinforced by new classes of devices that are designed to support these applications, both at the edge in mobile devices, such as Neural Processing Units (NPUs), and in the cloud, with devices such as Google's Tensor Processing Unit (TPU).

The importance of semiconductors in enabling these new applications is reflected in the move by leading technology companies like Google, Amazon and Microsoft to join companies like Apple, Samsung and Huawei in designing their own advanced ICs. These new growth engines complement the maturing smartphone, PC, laptop and tablet semiconductor market segments, which continue to refresh product offerings with more advanced ICs, to process and store more data and offer these new applications. This is expected to translate into semiconductor end-market growth, which in turn drives investments in technology upgrades and growth in worldwide factory capacity in all segments, especially at the leading-edge nodes.

To address these market requirements, our customers continue to invest in developing more advanced semiconductor processes to enable more powerful, energy-efficient, cost-effective logic and memory ICs. For further information on these markets, see Management Board Report - Business Strategy - Our markets. Industry and customers' roadmaps indicate a path for continued semiconductor process scaling beyond the next decade. We are addressing this trend by extending the accuracy and productivity of our TWINSCAN XT and NXT lithography systems while in parallel maturing TWINSCAN NXE lithography to the point where it can be used for high-volume IC manufacturing. To secure the tighter accuracy requirements for the more advanced processes we continue to develop enhancements to our YieldStar optical metrology systems and associated feedback and control software. This has been further strengthened with the acquisition of HMI in 2016 to provide higher resolution e-beam metrology and inspection capability.

Beyond technology and productivity our customers continue to focus on cost and quality of our products and services. To address this, we are investing in programs to enhance quality and drive lean processes in our development, manufacturing, field service and supply chain operations. See Management Board Report - Operations - Operational excellence and Management Board Report - Operations - Quality.

We believe these industry trends offer continued strong business opportunities for ASML for the coming 10 years and beyond. For a broader overview of trends, risks and opportunities in our industry and global environment, see Management Board Report - Materiality Assessment.

We also follow developments regarding international guidelines, such as the United Nations Sustainable Development Goals, which aim to end poverty, protect the planet and ensure prosperity for all. We support this ambition and aligned our strategy with certain United Nations Sustainable Development Goals. See also Management Board Report - Materiality Assessment - Sustainable Development Goals.

1. Source: BI Intelligence, CCS Insights, Gartner.

Business Strategy

How we create value

ASML creates economic value with strong financial performance; social value by enhancing the welfare of our employees, suppliers, customers and the communities we operate in; and environmental value by improving the energy efficiency of chips.

Our value chain

Geared towards providing long-term value to our customers and other stakeholders, our value chain consists of our R&D partners, our supply chain and our manufacturing and service activities, as shown below:

Creating value

We use input from stakeholders and trends in our industry and society to develop our strategy, our products and services. As such, we aim to create long-term value for our customers and other stakeholders.

For details on the value we created in the past year, see Management Board Report - Products and Technology, People, Partners and Operations for our social and environmental impact and Management Board Report - Financial Performance for our economic impact. For the topics most relevant to our stakeholders see Management Board Report - Materiality Assessment and Non-Financial Statements - Stakeholder Engagement. For details on our value creation over the past five years see Highlights.

Our vision and mission

We see a world in which semiconductor technology is everywhere and helps to tackle society’s toughest challenges. We contribute to this goal by creating products and services that let our customers define the patterns that ICs are made of. We continuously raise our products' capabilities, which allows our customers to increase the value and reduce the cost of chips. By helping to make chips cheaper and more powerful, we make semiconductor technology more attractive for a larger range of products and services. This enables progress in fields such as healthcare, energy, mobility and entertainment.

Our strategy

We are a focused supplier of Holistic Lithography solutions, including patterning, metrology & inspection products and services, to IC manufacturers, providing high-performance hardware and software. This allows our customers to increase the value and capability of their microchips, while reducing their cost. We work with long-term partners to share the risk and reward of inventing, designing and manufacturing our high-end, market-leading technology. We set targets to get our innovations into the hands of our customers faster, while enhancing the value and reliability of our products with well-integrated software and services.

In determining our strategy, we carefully consider the input and interests of all of our stakeholders. See Management Board Report - Materiality Assessment. We also analyze the risk and opportunities based on the industry and global trends, and set strategic and corporate priorities, which aim to create value for all of our stakeholders. Our strategic priorities remain unchanged for 2019 and focus on the successful industrialization of EUV, securing our DUV competitiveness, building a leadership position in Holistic Lithography extension, and aligning the plan for the introduction of High NA with our customers and key technology providers.

The strategic priorities are translated into Corporate Priorities that guide our entire company.

The following table demonstrates how the execution of Corporate Priorities addresses our key risk areas and supports the themes material to our stakeholders in creating value for them.

	Corporate Priority 1:	Corporate Priority 2:	Corporate Priority 3:	Corporate Priority 4:	Corporate Priority 5:
Corporate Priorities	Execute the product and installed base services roadmap in Holistic Lithography	Deliver quality products and services that consistently meet or exceed the expectations as agreed with customers, reinforced by an ASML quality culture	Drive the patterning ecosystem with customers, suppliers and peers in target market segments	Improve return on investments for ASML and its stakeholders, with a focus on cost of ownership and cost awareness	Develop our people and processes to support the growth of the organization towards a EUR 13 billion revenue company by 2020
Related material themes [1]	• Innovation • Knowledge management	• Sustainable relationships with customers • Operational excellence	• Sustainable relationships with suppliers • Sustainable relationships with customers • Innovation	• Financial performance	Employee safety • Business ethics & compliance Talent • management • Sustainable relationships with our people • Business risk & continuity
Key related risks [2]	• Rapid and complex technological changes • Ability to execute our R&D programs	• Product industrialization	• Supplier dependency Rapid and complex • technological changes Product • industrialization	• Success of new product introductions • High cyclicality of the semiconductor industry • Competition • High % of net sales derived from few customers • Revenues derived from a small number of products • Global trade issues	• Attraction and retention of adequately skilled people • The growth of our organization • Use of hazardous substances
Related KPIs	• R&D expenses • Technology Leadership Index • Technical Competence and Functional	• Customer Loyalty Survey Score	• Supplier Relationship Satisfaction Survey Score • VLSI Survey Results	• Total net sales • Gross margin • EPS • Cash flow • ROAIC	• Employee engagement • Employee attrition rate (overall, high performers) •

	• Ownership maturity • Number of technical training hours				• Promotion rate of high performers • Recordable incident rate
Related impact areas [3]	• Affordable technology • Knowledge creation & sharing • Resource efficient chips • Financial performance	• Affordable technology • Financial performance	• Employment creation • Affordable technology • Knowledge creation & sharing • Resource efficient chips • Financial performance	• Financial performance	• Employment creation • Employee welfare • Financial performance

1. See Management Board Report - Materiality Assessment.
2. See Management Board Report - Risk Factors.
3. See Management Board Report - Business Strategy - How we create value.

In terms of our sustainability focus, we began a refresh of our Corporate Responsibility Strategy in 2018, covering the period 2019-2025. We revised our corporate responsibility priorities, identifying five main priority areas: People, the Circular Economy, Climate & Energy, Responsible Supply Chain, and the Innovation Ecosystem. This strategy contributes to a number of the United Nations Sustainable Development Goals. The Industry, Innovation and Infrastructure (SDG 9) goal is connected to the core of our company, as innovation is our lifeblood and the engine that drives our business. We also contribute towards the Quality Education (SDG 4), Decent Work and Economic Growth (SDG 8), Responsible Production and Consumption (SDG 12) and Climate Action (SDG 13) goals.

We are in the process of finalizing how this new strategy will be implemented (including performance indicators and quantitative 2025 targets), and will begin reporting on the new strategy in 2019.

Our markets

Our main customer groups are memory and logic chip makers. Memory chips can store a large amount of data in a very small area. They are used in an increasing variety of electronic products like smartphones, high-performance computing, automotive or personal computers, and other communication devices. There are two main classes of memory: NAND and DRAM. With NAND chips, information can be stored even when the device is powered off. DRAM memory is used to improve the performance of the electronic product. These DRAM and NAND chips are made in dedicated memory-chip factories.

Logic chips process information in electronic devices. They are produced by two groups of manufacturers. The first group designs and manufactures logic chips and is referred to as Integrated Device Manufacturers (IDM). The second group is made up of contract manufacturers known as foundries. Foundry manufacturers do not design chips, but produce chips for other companies.

Over the past 20 years, the chip market has grown at an average of five percent per year, however the growth drivers have changed over time. In the 1990s, the introduction and adoption of Personal Computers (PCs), both “desktops” and later “laptops” fueled chip demand. In the first decade of this century, the market driver transitioned from PCs to smartphones. PCs and smartphones have in turn fueled a new market driver, data-centers, where data from PCs and smartphones is routed, stored, and processed with extensive use of DRAM, NAND and specialized logic chips. A new category of end-point devices, beyond PCs and smartphones, has emerged over the last five years classified as the Internet of Things (IoT), which includes devices such as security cameras, home and industrial devices, and autonomous vehicles, that are exponentially adding to the growth in data being transmitted, processed and stored. The combination of increasing data together with more powerful processing capability from more advanced logic chips is enabling the application of artificial intelligence techniques, such as machine-learning and deep-learning, leading to whole new set of applications and services. These new applications in-turn are fueling new growth drivers at the edge, such as smart assistants, and in data centers, such as real-time language translation.

Long-term growth opportunity

On November 8, 2018, we presented our view of long-term growth opportunity, updated our outlook for 2020, and extended our outlook to 2025. We also updated our long-term business and financial analysis, reflecting an annual revenue opportunity of around EUR 13 billion in 2020, based on a moderate market scenario.

For 2025, we have modeled our potential revenue scenarios within the context of different business sensitivities. We recognize our potential growth opportunity is sensitive to market growth, and potential annual revenue for 2025 between EUR 15 billion in a low market scenario and EUR 24 billion in a high market scenario.

Our revenue potential is primarily based on organic growth. We continuously review our product roadmap and have, from time to time, made focused acquisitions / equity method investments to enhance the industrial value of our product offering. Based on such reviews and the assessment of clear potential product and value synergies, we may also evaluate and pursue focused merger and acquisition activities in the future. Within this growth ambition, we expect to continue to return significant amounts of cash to our shareholders through a combination of share buybacks and growing dividends.

Our products

We sell Holistic Lithography solutions which integrate our three categories of products: DUV lithography, EUV lithography, and Applications. We believe that our customers get the best-possible performance from their chip-making systems by considering the whole chip-creation process, from design to volume manufacturing. We provide services that make sure our systems are installed effectively and efficiently, and there is superior support and training to create the best-possible manufacturing processes for our customers. We also have services to upgrade and refurbish our systems, helping our customers extend their systems' lifespan and enhance our customers' capital efficiency.

We offer TWINSCAN (N)XT (DUV) systems for imaging wafers. The DUV range consists of systems that operate at a specific wavelength of the light source, varying from the so-called i-line (365 nm) to KrF (248 nm) and ArF (193 nm). Although these systems are usually referred to as dry systems, the DUV range is completed with ArF immersion lithography systems that provide imaging capability down to a resolution of 38 nm. In these systems, a film of water is placed between the wafer and the projection lens. This film acts as an extra lens, which results in smaller features compared with the previous generation of dry systems. We pioneered this technology and have extended it over multiple generations to enhance the precision of the feature placement to enable so-called multiple patterning technology. This technique has enabled our customers to produce integrated circuits down to the 7nm logic node and 10 nm class DRAM nodes.

Our next-generation lithography systems, TWINSCAN NXE (EUV), are equipped with an entirely new EUV light-source technology and a new optical technology that uses reflective mirrors rather than traditional lenses. The shorter wavelength of this light (13.5 nm) results in a higher resolution for the manufacturing of denser and faster chips. The EUV platform can produce ICs of 13 nm resolution and smaller. We are developing the future generation of EUV lithography systems due early in the next decade, using High NA technology. Customers are already committing to this technology. In April 2018, ASML received its first orders for these future-generation systems. Three customers placed initial orders for the research-level High NA systems, for an aggregate four tools initially, plus options for another eight volume systems. The initial research-level systems are targeted to start shipping in 2021. With this technology, the semiconductor industry will be able to produce higher-performance microchips at lower costs. The higher numerical aperture optics will make it possible to further reduce critical dimensions in the lithography process. The current EUV systems have an optical system with a numerical aperture of 0.33, whereas the new optics will have a numerical aperture of 0.55, enabling several generations of geometric chip scaling.

We have complemented our scanner products with a rapidly expanding Applications portfolio of software and metrology & inspection products. This portfolio helps our customers get optimal use from and control over semiconductor scanner performance, which provides faster start-to-chip production. This results in better patterning at higher resolutions, and higher product yields. Our solutions offer cost-saving opportunities for our customers. The addition of HMI's e-beam technology to our existing portfolio extends our control scope. New process control opportunities, built on the same unique and proven approach, will give our customers additional value. This approach - pattern fidelity metrology - allows us to guide the e-beam inspection system to the most critical areas, based on the predictive model, on the wafer to increase the effective productivity. We are extending this technology even further with a multi-beam design. In 2018, we demonstrated the first proof of concept of multiple e-beams to further improve productivity of e-beam metrology, and expand the application opportunity in high-volume production. The biggest new opportunity is in the extension of overlay control to a comprehensive control of pattern fidelity.

See our lithography systems overview below.

Managing our installed base systems

We develop and sell product options and enhancements designed to increase throughput, and improve patterning and overlay. This allows for optimal cost of ownership over the lifespan of our systems. We have developed field upgrade packages, which allow our DUV and EUV scanners to be upgraded from one model to another in the field. Customers are able to migrate these systems in production from one process technology node to another. This lets them meet tighter lithography requirements for increasingly advanced processes. In addition, our Mature Products and Services business refurbishes used lithography equipment, and offers associated services. Upgrades and refurbishments help our customers extend their systems' lifespan and get the best value from their capital. They also support our circular economy approach.

We support our customers with a broad range of applications, services, and technical support products to maintain and enhance our systems' performance. We also offer our customers OnPulse contracts on DUV sources, providing on-site support from certified service engineers and continuous real-time light-source monitoring.

We expect our service business, which is critical to our overall success, to continue to grow. We aim to deliver a complete and cohesive service product offering designed to keep our customers' systems operating continuously and competitively. Our service business strategy makes customer value and satisfaction a priority, while seeking to optimize our total net sales and gross margin. Our Installed Base Management product portfolio, and its wide range of service and upgrade product offerings, is structured in line with the life cycle of our customers' technology nodes and is intended to offer the best-possible value proposition for customers.

Innovation drives our business

Innovation is ASML's lifeblood and the engine that drives our business. As the markets of artificial intelligence, 5G connectivity, augmented reality and the Internet of Things expand, consumers across the world are using ever-more powerful and sophisticated devices that are increasingly interconnected. These developments drive demand for microchips, which in turn drive demand for the chip-making systems that produce smaller, faster, cheaper, more powerful and energy-efficient microchips. We can only meet this demand by consistently and continuously advancing our technology.

Our innovations in 2018 helped us improve our DUV technology. This allowed us to meet our goal of continuing to offer competitive chip-making systems using 'dry' and 'immersion' lithography technology. Due to improvements and innovations, we succeeded in further increasing the number of wafers processed per day for most of our DUV systems. We shipped 206 TWINSCAN DUV systems in 2018. We also shipped 17 of our latest TWINSCAN NXT:2000i immersion systems, which are used on the most advanced nodes. While bringing new technology to the field, we also managed to ramp time-to-yield, hitting a performance level of >150 hours Mean Time Between Interruption (MTBI) in 15 weeks. This is almost 40 percent faster than the previous model, NXT1980i, and is enabled by a more mature platform achieved through continuous improvements.

Continuous improvements helped us move our EUV technology to the high-volume production stage in 2018. We demonstrated production capability of >145 wafers per hour, up from 125 wafers per hour in 2017, and are working towards 92 percent production time (availability) with consistent performance. We shipped 18 EUV systems in 2018 of which 17 were NXE:3400B EUV systems. The NXE:3400B showed improved performance on a customer site, where the customer ran over 1,000 wafers per day over a period of more than six weeks. On some days, more than 1,500 wafers were produced. At another customer site, we saw a peak performance of more than 2,000 wafers per day. These performances were representative of a significant number of successes for our NXE:3400Bs. Through innovations and improvements, we are committed to accelerating our roadmap, providing our customers with a system with more than 35 percent higher productivity, the NXE:3400C, which is capable of producing 170 wafers per hour. This has a planned delivery date for the second half of 2019.

Since the acquisition of HMI, we shipped multiple ePfm5 systems, a pattern fidelity metrology tool that offers our customers enhanced capabilities for detecting patterning defects. We enabled customers to substantially improve accuracy in chip patterning by implementing HMI's metrology technology and Brion's metrology software and machine-learning technology. The ePfm5 device is based on single-beam technology, which will be guided to the critical areas (known as areas of interest) based on our computational lithography model. In 2018, we also achieved significant breakthroughs in multi-beam technology, showing our first 3x3 image on a proof of concept system. This

will further enhance pattern fidelity metrology.
There was large-scale adoption of YieldStar 375 among all major memory makers in 2018. The unique, large spot multi-wavelength measurement mode has proven to be accurate and robust compared to alternative methods. Memory makers have seen significant overlay performance improvements after adopting YieldStar.
We continued efforts to develop High NA, the next generation of EUV optics. We are confident we have the ability to apply this technology at a scalable model in coming years. High NA will offer a higher numerical aperture, making it possible to further reduce critical dimensions in the lithography process. We have received the first four orders for High NA systems from three customers and we also sold options to buy eight more systems.
We measure innovation based on an internal KPI we call the Technology Leadership Index. This index comprises three objectives: a) DUV performance enabling memory 1x and 7/5 nm logic nodes, b) Enable on product performance, and c) Drive economics and extendibility of EUV. See Products and technology objectives in the table towards the end of this chapter.

Another important indicator of our focus on innovation is the amount we spend on R&D. In 2018, we spent EUR 1,575.9 million or 14 percent of total net sales on R&D, compared to EUR 1,259.7 million or 14 percent of total net sales in 2017, and EUR 1,105.8 million or 16 percent of total net sales in 2016, which underscores our commitment to investing in R&D.

How we manage innovation

We manage innovation based on ‘roadmaps’ - the semiconductor industry’s standard term for product-development planning. Our marketing organization first assesses our customers’ needs, the required functionality of our systems, and the deadline for these requirements. This ‘marketing roadmap’ of customer requirements includes detailed system specifications and functionalities. Our product organization then puts together a ‘product roadmap’. This outlines the specifications and functionalities of the new types of system that are feasible to produce and that meet our customers’ demands.

At the same time, we draw up a ‘technology roadmap’, identifying what technology we need to build in the system as described in the product roadmap. From our integrated roadmap we create further detailed roadmaps for each of our main product groups: DUV, EUV and Applications. Roadmaps typically look five years ahead. We adjust them when required, depending on changing customer needs or unexpected technological breakthroughs or challenges.

We also invest in innovation by conducting research with a longer-term view. Run by our Research department, this research aims to create technological solutions our D&E experts can tap into when they develop new systems or improve existing models. Our research teams collaborate with a wide network of technology partners, such as universities and other research institutions.

We manage our innovation efforts through our Product Generation Process. Our CTO is responsible for R&D at board level. Our Executive Vice-President Development and Engineering and our Senior Vice-President Technology report to the CTO.

ASML’s ‘open innovation’ concept

The concept of ‘open innovation’ helps us sustain our pace of invention. This means we develop our technology in close collaboration with partners inside and outside our company, sharing the rewards and the risks. This way of working gives us easy access to leading-edge knowledge and skills across a wide range of technologies. Our partners can also use these in other markets.

Researchers from ASML, the Advanced Research Center for Nanolithography, Tata Steel and Vrije Universiteit Amsterdam cooperate to develop new techniques for imaging surfaces based on lensless microscopy. To support our lithography business, we also have a close and long-standing partnership with Carl Zeiss AG, and with Cadence Design Systems, as part of our holistic patterning strategy.

ASML and world-famous research and innovation hub, imec, announced the next step in their extensive collaboration. Together, we expect to accelerate the adoption of EUV lithography for high-volume production, including the latest available equipment for EUV. Additionally, we will explore the potential of the next-generation High NA EUV lithography to enable printing of even smaller nanoscale devices.

In 2018, our annual ASML Technology Conference was one of the largest of its kind with delegates spread across four locations. Participants included external technology experts and representatives from our customer base, such as the COO of IBM Research. This year's conference was centered around the theme of ‘Moore to explore’, which discussed the view that EUV industrialization does not mean the end for Moore’s Law. Rather, it signals a new departure for further exploration within EUV, with High NA offering at least 10 more years of development opportunity. Matching this with the potential for further innovation in DUV and Applications shows that we still have many challenges ahead of us.

Knowledge management

Our major investment in R&D means it is crucial for us to share and protect our inventions and knowledge. Knowledge management is a key focus area for us. In 2018, it enabled ASML to rapidly grow the organization and to effectively onboard many new employees.

To maintain our technological leadership and pace of innovation, we need to develop the right knowledge and share it quickly and efficiently. We share our knowledge internally and externally, with partners such as suppliers and customers. Faster access to knowledge spurs faster development, allowing problems to be solved more quickly. It also makes our investments in knowledge creation more effective and efficient.

Our ambition is to ensure that the right knowledge is available to the right people at the right time. This means we must acquire or develop the required competencies at an early stage, maintaining a knowledge pipeline that allows us to build the system functions we need. This process is facilitated by our Technical Training Center. Our line managers regularly assess the technical competencies we need, varying from software programming to laser physics, and take steps to fill capability gaps where necessary.

Our ‘MyLearning’ management system, which covers the activities of all our training centers, helps our employees and their managers decide what courses to attend to develop their skills and competencies. The system provides information on training hours, and the kinds of training our employees are receiving. It also helps employees design their individual Development Action Plans. See also Management Board Report - People - Talent management. The number of technical training hours per full-time D&E

employee increased to 31.4 in 2018 from 18.2 in 2017. This increase is due to a significant influx of new employees, who received additional onboarding training, and the successful introduction of several new training programs.
In 2018, we continued with the Onboarding Success Planner, which is a series of trainings to be followed in an employee's first year. The purpose of the Onboarding Success Planner is to help speed up the learning curve of the large number of new employees we need to onboard to be able to implement our many new product-development programs.

To gauge the effectiveness of our knowledge management, we measure our Technical Competence maturity and Functional Ownership maturity. Technical Competence maturity measures the capabilities and spread of technical competencies among our people, as well as the extent to which they are embedded in our processes and operations. We have identified over 80 different competencies that are relevant to our technology. Functional Ownership maturity measures the level of required knowledge among our teams of experts about the system functions they are responsible for. A system is divided into about 90 distinct functions, and responsibility for each function is assigned to a function owner and his/her team.
We score the maturity KPIs on a scale of 1 to 5. Levels 1 and 2 cover the basic requirements, showing that teams are establishing links with departments they cooperate with, setting individual targets, etc. Levels 3, 4 and 5 are more advanced, reflecting mechanisms to gather and process feedback, make processes predictable, and ensure they function well at customers' sites.
In 2019, we will reassess the present competence function framework to bring it to the next level. The current framework and metrics will remain in place until we have completed this reassessment and defined new metrics.
While continuing to build and maintain a solid knowledge base, in 2018 we focused on raising the maturity level of our employees in terms of their technical and functional knowledge. For Functional Ownership we paid particular attention to using feedback from customers, e.g. feedback loops. In terms of Technical Competence and Functional Ownership, we met our targets to achieve an average maturity score of 3.8 in 2018. See Products and technology objectives in the table near the end of this chapter.
We have roadmaps in place for system functions. These plans are updated on a regular basis. We have mechanisms to process feedback from customers and co-development partners, helping to reduce the recurrence of technical function issues.
Protecting our intellectual property
We rely on intellectual property rights such as patents, copyrights and trade secrets to protect our proprietary technology. We aim to acquire ownership rights on technology developed by us or for us or, alternatively, to have license rights in place with respect to such technology.
In our management of our intellectual property rights, we focus on protecting ASML's intellectual property and respecting the intellectual property of others. Preservation of intellectual property and other assets is one of our Business Principles and part of our Code of Conduct.
As of December 31, 2018, we had approximately 12,000 patents and patent applications across the main equipment and chip-manufacturing countries around the world and covering various fields of our business, including about 300 new patent applications which may be extended to other countries in the coming years.
See also Management Board Report - Risk Factors - Failure to adequately protect the intellectual property rights upon which we depend could harm our business and Defending against intellectual property claims brought by others could harm our business.
Product stewardship
While putting continuous effort into innovation and effectively managing and protecting our knowledge, we also strive to make sure our products are manufactured and can be operated responsibly. Our commitment to product stewardship means that we work to make our manufacturing processes and systems more environmentally friendly, improving their resource efficiency.
As we brought our EUV systems to the point of high-volume production in 2018, we began exploring how we can achieve energy savings for these systems. Together with a supplier, we looked into how to redesign the pre-vacuum systems for our EUV systems in a way that they use less energy. At year-end, we had not concluded this investigation.
We continued research, in partnership with suppliers, into increasing the recycling rate of the H_2 used in our systems.

We also continued exploring the possibility that some sections of the EUV system can operate at higher temperatures. This will allow us to reduce energy used for cooling purposes in these systems at our customers' sites.
We support the circular economy concept - a model for industry moving from the linear model of ‘Take, Make, Dispose’ to one where we extract the maximum value from resources we use, and then recycle and regenerate products at the end of their lives. We believe this is essential to ensuring the future success and competitiveness of the semiconductor equipment industry. To this end, we have incorporated the circular economy into our Business Principles. We are committed to playing our part, not only by enhancing energy efficiency and the efficient use of other resources and materials, but also by refurbishing systems, remanufacturing parts (‘As-new’ program), and upgrading systems to a higher performance level while in use ‘in the field’, to extend their lives. Our systems have a modular design, which allows for reuse and upgrades. About 45 percent of the weight of a typical NXT system consists of a fixed architecture that can be kept when upgrading the system. See Graphic: ASML NXT system: Modular upgradeable design, in this section.

Extending our systems' lifetime

Our Mature Products and Services business refurbishes older lithography systems and offers associated services. A well-maintained ASML lithography system has a useful life that is measured in decades. Typically, an ASML lithography system will be used in a leading-edge Fab for many years, and will then be given a second life with, for example, a manufacturer that makes specialized devices, such as accelerometers, radio frequency chips, thin-film heads for hard disk drives, or LEDs, which require relatively less sophisticated chips. The vast majority of the systems we have previously sold are currently still operational in

our customers'
factories.

In 2018, we upgraded dozens of our older-generations NXT systems, and began upgrades to some of our EUV systems. Due to the new software and hardware, we can significantly extend the lifespan of a significant part of our systems currently in use at our customers' production locations.
We also further engaged with our customers around the introduction of 'As-new' modules into our mainstream manufacturing. 'As-new' modules (segments of our systems) are those suitable for multiple product life cycles. They are returned from the field and, after a thorough re-qualification process, restored to an as-new condition. Their performance level is equal to that of new ones. In 2018, we continued a pilot project launched in 2016 to explore how we can effectively use 'As-new' parts and modules in new systems. In collaboration with our customers and suppliers, we aim to increase the number of 'As-new' parts used in the future.
By working to make the production of computer chips cheaper and more powerful, we also fuel the development of new electronic applications. This poses a challenge for our entire industry, as these new applications may use more energy and need potentially scarce resources. For us, it emphasizes the importance of working with all relevant stakeholders in the value chain to make our industry more sustainable, and of contributing to this process through research and innovation.

RoHS and REACH

We are committed to complying with EU guidelines for handling hazardous materials and chemicals, the so-called RoHS directive and the REACH regulation, even though the products we manufacture are currently excluded from the RoHS directive. We aim to, whenever possible, reduce and eliminate use of hazardous substances and replace non-compliant parts with RoHS-compliant alternatives.

Product safety and compliance

Our products must be safe to work with, starting at the design stage. Our engineers develop systems that meet international safety regulations. We require product designers to pay attention to nine risk areas we have identified, and to alert risk experts if they believe their design might pose a safety risk. This lets us address any potential safety issue at an early stage.

Our products and non-commercial tools comply with all relevant legislation, including EU safety regulations and SEMI S2, the semiconductor industry guidelines. A third party verifies our compliance with SEMI S2. In 2018, a report confirming SEMI S2 compliancy was available for each and every product type we shipped. See Non-Financial Statements - Non-financial Indicators - Products and technology - Product Stewardship.

Products and technology objectives

Theme	Objective	Target year	How we did
Innovation	Realize the following as part of our Technology Leadership Index: a) DUV performance enabling memory 1x and 7/5 nm logic nodes. b) Enable on product performance. c) Drive economics and extendibility of EUV.	2018	See Innovation drives our business above.
	Realize the following as part of our Technology Leadership Index: a) Enable 3 nm node and the installed base products & services roadmap without compromise to quality b) Enable on product performance c) Drive economics and extendibility of EUV.	2019-2020	
Knowledge management	Maintain the Technical Competence and Functional Ownership maturity score at a level of 3.8.[1]	2018-2020	See Products and technology KPIs in the table below - we achieved a maturity score of 3.8 for Technical Competence and 4.1 for Functional Ownership.
	Realize 17.5 hours of technical training hours per FTE (D&E employees).	2018	See Products and technology KPIs in the table below - the number of training hours was 31.4, exceeding our 2018 target.
Product stewardship	Annual reduction of RoHS non-compliant parts by 15%.	2016 and beyond	In 2018, we have assessed that 91.6% of the parts in scope are RoHS compliant (with 0.8% non-compliant and 7.6% unknown).

We have therefore reduced the RoHS non-compliant parts by 21%, thus exceeding our annual target of 15% reduction. We will continue to investigate unknown parts and further reduce the RoHS non-compliant parts.

1. Technical Competence maturity measures the capabilities and spread of technical competencies among our people, as well as the extent to which they are embedded in our processes and operations. Functional Ownership maturity measures the level of required knowledge among our teams of experts about the system functions they are responsible for.

Products and technology KPIs

KPI	2016	2017	2018
R&D expenses (in million EUR)	1,105.8	1,259.7	1,575.9
Technical Competence maturity score [1]	3.4	3.7	3.8
Function Ownership maturity score [1]	3.6	4.0	4.1
Number of technical training hours per FTE	15.9	18.2	31.4
Sales of lithography systems (in units) [2, 3]	154	197	224

1. Measured on a scale from 0 to 5, with 5 being the top score.
2. Lithography systems do not include metrology and inspection systems. See Management Board Report - Financial Performance - Operating results - Total net sales and gross profit.
3. As of January 1, 2018, ASML has adopted the new Revenue Recognition Standard (ASC 606) and Lease Standard (ASC 842). The comparative numbers have been adjusted to reflect this change in accounting policy.

Talent management

Attracting and retaining talent is crucial to maintaining our fast pace of innovation and essential to our long-term success as a company. Highly skilled people with a technical background are scarce in the labor market and competition to recruit talented people is growing. The complexity of our products means new and existing employees face a steep learning curve. As such, we put significant effort into onboarding newly hired people. To enhance their performance, we need them to be familiar with our technologies and ways of working in a short time. We are continuously looking to grow our talented and highly skilled professionals through tailor-made training and development programs. This allows for continuity in our workforce as we are able to retain our employees' knowledge, skills and competencies. In 2018, we succeeded in hiring the people we need to support ASML's strong growth, as we hired approximately 3,500 new payroll employees and 1,900 temporary employees.

To attract talent, we focus on two areas:

- Internal talent - We assess the development potential of our employees for new roles and identify candidates for critical positions. Employees discuss their career ambitions with managers, jointly considering next steps. Employees can pursue opportunities themselves or be approached within the organization. We also have internal career fairs where people can learn more about internal career opportunities.
- External talent - We cooperate closely with universities in Europe, the US and Asia to attract highly talented staff, including offering internships and scholarships. For positions that we cannot develop or fill internally, we scan the labor market for the skills we need, and run targeted recruitment campaigns.

Developing our people is crucial for the sustained success of our business. Every year, our employees' personal targets and development plans are aligned with our business targets through our People Performance Management process. Our MyGrowth program, established in 2018, lets employees assess their strengths and potential gaps in their competencies. It also helps guide them in deciding how to fill these gaps through development actions. This is part of our process to identify what action we need to take to achieve short-term goals, as well as longer-term career development. Together, managers and employees define individual Development Action Plans.

Our company enjoyed even stronger growth in 2018 than in the previous year. We had to set ambitious recruitment targets to support this growth and make sure we have the skilled people we need. As in previous years, we were successful in meeting our recruitment objectives. We exceeded the target we set at the beginning of the year, and adjusted to our shifting hiring needs. We view our recruitment and employee development efforts as an ongoing process. We continuously seek to improve and professionalize, responding to changing business requirements and developments in the labor market. In 2018, we bolstered the governance structure of our global talent acquisition, adding the position of Head of Recruitment Asia and increasing our recruitment capacity in all countries. To support recruitment, we train line managers to improve their interviewing and selection skills. 'Buddies' are also an important part of our onboarding approach. We aim to ensure that each newcomer is assigned a buddy to help him or her find their way at ASML and in their new job. In addition, we introduced a 'New at ASML' intranet site. Managers can get the information they need here, and are guided through a structured process to onboard different categories of new employees. It is also a useful resource for buddies and new employees.

Our attrition rate, i.e. the number of employees leaving the company, increased slightly to 4.7 percent in 2018 (2017: 4.4 percent). We attribute this mainly to the global shortage of technically skilled people. Our attrition rate is still significantly below the industry benchmark, and we do not expect a significant change in this regard. The attrition rate of our best people ('high performers') was 2.2 percent in 2018 (2017: 1.8 percent). We also measured the extent to which high performers move to higher-level positions. This promotion rate was 40 percent (compared to an overall promotion rate of 14 percent), indicating that our best people were over-proportionally promoted and so able to further develop themselves. We fast-track the careers of our most promising managers through our Potentials Acceleration programs, with 331 people participating in 2018. We also deployed a new management development curriculum to support development of leaders at all levels. In total, more than 1,200 managers attended training in this curriculum in 2018.

Succession management is an essential part of building a pipeline of talent. Our efforts here ensure we have the talent ready to replace managers and employees as they are promoted or if they choose to leave the company. Building on our strong process for this purpose, we completed assessments of about 9,000 employees in 2018 to determine their potential to take over more senior positions. This was up from around 7,200 employees in 2017. We have succession

plans in place for more than 300 senior positions. Two potential successors were identified in most of these cases. We also support technical studies through scholarships. In 2018, 53 students entered our ASML Technology Scholarship program. To build relationships with people before they enter the labor market, we increased the number of internships we offer. In the US, we secured positions on the advisory boards of several universities. This helped us contribute to defining the skills and competencies these institutions could include in the curriculum they offer students. In 2018, our scholarship program was also made available to students in the US, which is expected to increase our total number of scholarships in 2019.

For further information, see Non-Financial Statements - Non-financial Indicators - People - Talent Management.

Sustainable relationship with our people

We strongly believe building sustainable relationships motivates our people to develop themselves, make the most of their talents, and perform to the best of their ability. This serves to boost our productivity, innovative strength and competitiveness.

Employee engagement and employability are the cornerstones of a sustainable relationship with our employees. To us, engagement is the dedication our employees have for their jobs and ASML. Engaged employees feel their efforts make a difference, and they are therefore motivated to go the extra mile. Employability is our employees' capacity to sustain and improve their performance over time and adjust to change.

To build an engaged and enabled workforce, we have our Place to Work, Meet, Learn and Share framework. Our aim is to create an inspiring and safe work environment. This must be beneficial to our employees' personal development and help them strike a good work-life balance. There are three dimensions to the Place to Work, Meet, Learn and Share framework: Our employees (People), our campuses and buildings (Bricks), and IT innovation to improve collaboration and work processes (Bytes).

In 2018, we launched discussions on improvements to our locations in Veldhoven. This aims to improve mobility management in the area, including traffic to and from our premises. To contain travel time and costs, we use Microsoft Surface Hubs, which offer teleconferencing and presentation tools. They have made our interactive design sessions and remote training more efficient. This enables our employees to be more productive and engaged. In Asia, we opened several buildings for our employees that meet all the latest standards, creating a pleasant work environment.

We have also continued our program to convert our offices into activity-based working environments, promoting more interaction and providing the facilities our employees need. In 2018, we added more than 1,800 flexible workplaces. Overall, we now have more than 6,750 flexible workplaces worldwide.

As we adhere to an 18-month cycle for our employee survey, me@ASML, we did not conduct one in 2018. The previous survey showed an average engagement level of 7.0, which was slightly below our target. We aimed to achieve the same level as our peer group benchmark of 7.2. We also began the process of making several changes to the survey. We intend, for example, to add sector-specific surveys for employees in different company units. This will let us gain greater insight into specific developments, such as the integration of acquired businesses, or how newly hired employees view our onboarding processes. We also aim to introduce pulse surveys, as a way of getting feedback on certain topics more quickly. To make our processes more efficient and to help us better learn from each other, we discuss employee feedback from our survey feedback sessions at a team level. In 2018, we continued with these sessions.

Promoting diversity and inclusion

We believe a diverse and inclusive workforce helps us develop new solutions and ideas. Different voices and points of view are necessary to drive our innovation. We maintained our high level of diversity in terms of culture and nationality, employing people of 123 different nationalities in 2018 (up from 115 in 2017). In 2018, about half of our newly hired staff in the Netherlands were non-Dutch. As a result of our continuous efforts to recruit and retain women, our percentage of female employees increased from 11 percent in 2010 to 16 percent in 2018. Gender diversity is, however, still an area where we need to improve. In 2018, more than 40 percent of our scholarship grants in the Netherlands were awarded to women. To increase our future talent pool and get young women interested in technology, ASML supports initiatives in the Netherlands such as Girlsday, where girls aged 10-15 are given the opportunity to learn more about technology. We support similar initiatives in the US and Asia. In 2018, we appointed our first female Fellow. We award this title to experts in our R&D department who have made outstanding contributions to our technology.

We subscribe to the 'Declaration of Amsterdam', a call to action for employers, unions and governments to implement concrete changes that ensure progress in matters affecting LGBTI people. The declaration is an initiative by Workplace Pride, an Amsterdam-based international non-profit organization that strives for greater worldwide acceptance of LGBTI people in the workplace. In November 2018, only a year after becoming a member of Workplace Pride, ASML's LGBTI employee network, Pink ASML, was recognized for its hard work and achievement by receiving the Most Engaged Network Award at the Workplace Pride Foundation Leadership Awards. Pink ASML aims to highlight the increasing importance of LGBTI inclusion in the tech industry. Demonstrating our support for

LGBTI rights, one of our board members joined our ‘Pink ASML’ employee group in attending the 2018 Gay Pride Canal Parade in the Netherlands, riding an ASML-branded boat through the canals of Amsterdam. We take a position in public discussions on diversity and immigration, making it clear that ASML strongly believes in offering jobs to people regardless of their gender, sexual orientation, religion or nationality. We oppose legislation that limits people’s right to travel freely, based on such criteria.

We promote diversity and inclusion through efforts to integrate people with disabilities in our workforce. We pay particular attention to people with autism, hosting lectures and promoting discussion to enhance awareness and accommodate the integration of those with autism, and other minorities in our company. For more information on our diversity and inclusion performance data, see Non-Financial Statements - Non-financial Indicators.

Fair remuneration

We want our remuneration to be fair and balanced, so that it is no distraction from the motivation and engagement our employees experience from their job content, and from working at ASML as a Great Place to Work. In our remuneration policies, we strive for global consistency, while respecting what is common practice in local markets. We want our employees to work together towards shared company goals, and we believe that they are key to the success of our company and deserve to share in this success.

Every year we analyze paid salaries for any gender disparity and, in 2018, as in previous years, we found no major differences in these salaries. See Non-Financial Statements - Non-financial Indicators for details on gender payment.

We continuously review how our remuneration compares to the market benchmark for technology professionals in every region where we operate. Where necessary, we make changes to our remuneration policies and levels. In 2018, we implemented adjustments we made to our remuneration policies the previous year for our operations in all regions. This is to make sure we align with our overall corporate remuneration philosophy. In 2018, remuneration at Cymer and HMI was fully aligned with ASML's current remuneration policies and practices.

At ASML, where we strive for salaries that are competitive in each market and where we have a predominantly highly educated workforce with relatively high levels of remuneration, we are confident that we meet adequate 'living wage' requirements, meaning that employees earn salaries that meet their basic needs.

Human rights and labor relations

We believe that human rights, as defined by the United Nations in its Universal Declaration of Human Rights, are a common standard that all employers should uphold. We support the principles laid down in the OECD Guidelines for Multinational Enterprises and those in the International Labor Organization's Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy. In the spirit of these principles, we support our employees' right to organize in labor unions and to collectively negotiate fair wages and working conditions. We believe these rights must be respected for all ASML employees at our locations worldwide.

We want to provide fair labor conditions and social protection for all our employees, regardless of whether they are on a fixed contract or a flex one. In the Netherlands, we negotiate with and consult labor unions and our company's Works Council, our employees' representative body. As required by Dutch law, our BoM must seek the non-binding advice of the Works Council before taking certain decisions, such as those related to a major restructuring or a change of control. Some decisions directly involving employment matters that apply either to all employees or certain groups of employees may only be taken with the Works Council's approval. In the event the Works Council does not agree with a particular decision, and the BoM still wishes to proceed, the BoM must suspend any further action while the Works Council determines whether to appeal to the Enterprise Chamber of the Amsterdam Court of Appeal.

We strive to comply with the relevant legislation in every country we operate in. In the US, for instance, we aim to comply with all state and federal laws and regulations regarding labor practices and employees' rights to organize. This means we do not interfere with, restrain, or influence employees who want to organize themselves in a labor organization for collective bargaining purposes. In Taiwan, where we have several business operations, all employees, except those working in government administrative organizations, can form unions. ASML seeks to comply with all relevant legislation, such as the Taiwanese Union Act and the Law Governing Collective Bargaining Agreements.

In Korea, the Labor-Management Council (LMC) is a consultative body that aims to promote welfare and cooperation between employers and employees under the Promotion of Worker Participation and Cooperation Act. The LMC discusses ways to enhance productivity, improve working environments, address employee grievances, promote workers' welfare, and other matters. LMC representation for ASML consists of 20 members (10 members each for employer and employees), and holds council meetings at least every three months.

At ASML, the principle of free choice of employment is respected. It applies to every employee in every country we operate in. We adhere to the Responsible Business Alliance Code of Conduct and expect our suppliers to adhere to this code, as well as other human rights principles. See Management Board Report - Partners - Sustainable relationships with suppliers. Our policy stipulates that compliance with human rights standards and other Responsible Business Alliance standards should be included in our supplier agreements.

Protecting privacy

In the countries where we operate we aim for compliance with the legal requirements regarding the protection of our employees' privacy, as well as the privacy of our customers and suppliers, and that of their employees. In Europe

especially, legislation on these matters is developing fast. As such, we are implementing ASML's binding corporate rules, or Privacy codes, on employee data as well as customer, supplier and other business partner data. We are also developing a program to increase privacy awareness globally within our company. We have a Privacy Officer who reports to our Senior Vice President Corporate Legal.

Our flexible labor model

The flexible labor model in the Netherlands consists of employees on fixed or flex contracts. This model allows us to adapt to semiconductor market cycles, including providing support for potential 24 / 7 production activities as and when this is needed. Globally, 14 percent of our employees were flex workers at year-end 2018.

We work with three categories of flex employees: those hired to fill gaps in our fixed workforce and who will be offered a fixed contract after one year; those hired to temporarily increase our operational capacity, with flex contracts of a maximum of two years; and those with skills we need temporarily and who can stay on a flex contract for a maximum of three years. In 2018 there were 1,200 flex employees who received a fixed employment contract.

Overtime

We pay constant attention to protecting our employees from working overtime during peak periods. The nature of our business means employees often need to work significant amounts of overtime, taking responsibility for finishing projects on time. It is our policy to follow local rules regarding working hours. However, we apply our own company standards when these are stricter. Our company standards are based on Responsible Business Alliance norms.

Due to high customer demand and job vacancies, there is still significant overtime. This applies particularly to Dutch employees who are temporarily working at an ASML or a client location abroad.

As overtime remains an important attention point for management, we keep monitoring the use of overtime and take appropriate measures to manage the situation. We continue to raise awareness about our standards.

Community involvement

As a global technology leader and employer, ASML plays an active role in the communities we operate in. By fostering close community ties, we learn more about the world around us and raise awareness of our business, our industry and our interests. Our involvement is also a way for us to fulfill our leadership role, as the community can benefit from our success and position.

Our community relations program, which falls under the remit of our CEO, is built on three pillars:

- Making local communities we operate in attractive places to live for our employees and their families by event sponsoring and our government engagement. In 2018, for example, ASML played a significant role in engaging the Dutch government to invest EUR 130 million in the Brainport / Eindhoven area. Local authorities and the business community will invest EUR 240 million, which amounts to a total investment into the region of around EUR 370 million. This is the first phase of a broader initiative: the Brainport National Action Agenda. ASML is a key partner. Funding will be made available for a significant number of initiatives linked to making the region a more attractive place to work and live for internationals as well as locals.
- Promoting and providing technical education in local communities. For the sixth consecutive year, ASML sponsored the annual Mechatronics competition at Cornell University, in the US. The competition entails about 180 students in 60 teams of three designing and developing autonomous robots that compete against each other. Each year, ASML develops its own robot to compete against the students. ASML volunteers, divided into three teams, held their own internal competition before the winning team traveled to Cornell to challenge the students.
- Giving back to communities by supporting local charities and global education projects (through the ASML Foundation). One of the key activities, launched in October 2018 and due to run until 2021, is ASML's partnership with PLAN International to promote girls in technology. Titled 'STEM - Girls Can Do It', the project will focus on young people in rural China, near ASML's offices in Chengdu and Xi'an. The aim is to promote more gender-balanced STEM education. The project will expose about 1,200 young people, of which 70 percent are girls, to technology, science, engineering and math, and teach them coding and programming. Employees from the local ASML offices intend to participate as role models.

The total amount ASML spent on charities, community involvement, organizations, and its own ASML Foundation in 2018 was around EUR 1.8 million.

A key part of our community focus is education, particularly technology education and upskilling. As the rate of technological advancement speed ups, we are increasingly faced with a critical skills shortage. With technology now ever-present, more companies than ever, including non-technical companies not traditionally needing these skills, are seeking the expertise of engineers and data specialists.

There is a recognized shortage of data experts, with skills such as machine learning and artificial intelligence increasingly in demand. Digital expertise is the most critical skill of the 21st century. At ASML, we believe it is

important to start educating young people as we are involved in co-creating this new age.
We have a responsibility to prepare people for an increasingly digital future. We are looking into opportunities to get more closely involved in education to address the shortage of tech teachers. To this end, ASML, along with many other regional partners, signed the Brainport Talent & Skills Agreement in 2018.

This focus on technology education has a direct impact on developing communities. With digital expertise being in such high demand, lack of skills means those without them will lose out on opportunities.

Our headquarters at Veldhoven is also based in a region where there is significant emphasis on education, through the Brainport initiative. In one of our many activities in 2018, we played a part in developing a program with our Brainport partners to expose teachers to technology upskilling. They spent time at ASML, among other companies, and were able to take their leading-edge technology learnings back to share in their classrooms.

The following table provides an overview of some of our community programs and what they have achieved.

Pillars	Key programs	Results
Making local communities we operate in attractive places to live for our employees and their families	Together with our partners in the Brainport Eindhoven region and key public stakeholders in The Hague, we developed the Brainport National Action Agenda, which invites the Dutch government to invest more in our high-tech region. An important part of this is creating a pleasant environment to live in, as we need to be able to attract talented employees from all over the world.	The Dutch government has recognized the unique and valuable contribution of the Brainport Eindhoven region. In collaboration with the new government, the Brainport National Action Agenda will be developed further, moving a step closer towards realization.
	Through our sponsorship program, we support several local organizations, such as The Hub and the Expat Center in Eindhoven, the Netherlands. We also support local events such as the Veldhoven Tasting food festival in Veldhoven, the Netherlands, Habitat for Humanity in San Diego, California, in the US, and Community Food events in San Diego and Wilton, Connecticut, in the US.	We provided funds to the PSV Eindhoven football club, the Muziekgebouw concert hall in Eindhoven, and are the main sponsors of the Eindhoven marathon, in which more than 500 ASML employees participate. For ASML, mastering light is key, and in 2018 and into 2019, we sponsored the GLOW light art exhibition in Eindhoven and Nanjing, in China. For the first time, the light festival in Nanjing gave us an opportunity to blend our own light exhibition and a traditional Chinese light festival.
Promoting and providing technical education in local communities	We run an intensive technology promotion program to boost interest in technology among young people and increase the local and regional talent pool. As such, we also raise awareness of career prospects in a sector offering many development opportunities.	The ASML Foundation financially supports Science Camp Korea. The three-year program provides science education to vulnerable children in disadvantaged areas close to ASML's headquarters. Around 65 ASML employees teach a self-developed science program. In the Netherlands, we organized Girlsday and the Dutch Technology Week. At the Night of the Nerds during Dutch Technology Week, around 4,500 children between 14 and 19 got the opportunity to experience the world of technology and innovation, featuring the latest digital, technological and media developments from ASML and other companies.
	We help technology startups through our active role in the Eindhoven Startup Alliance (HighTechXL) and the Make Next Platform. We focus on providing expertise	We have seen several high-tech hardware startups thrive and some scale up to become more mature businesses. We organized two Get in the Ring events, attracting startups from all over the world.

	and coaching support rather than financial contributions.	Five winners were selected and will get support from ASML to develop their activities.
	• We grant ASML Makers Awards to help develop good ideas into concrete prototypes and prototypes into products that can be produced locally.	•At least four ideas that won an ASML Makers Award were brought to the next level, and one has been made ready for market introduction and production. ASML supports Eindhoven University of Technology's research activities in the new and highly innovative field of integrated or smart photonics with an annual donation of EUR 122,000 for 5 years, ending in 2021.
Giving back to communities by supporting local charities and global education projects		ASML employees in the Netherlands completed a •total of 5,434 hours of volunteer work in 2018.
		Since 2015, we have been supporting Stichting •Leergeld in the Netherlands, which helps students from low-income backgrounds pay for the technical and safety equipment they need for technical studies at MBO schools in the Brainport region.
	• Our volunteer work policy allows ASML employees to do eight hours of volunteer work annually during working hours.	In 2018, we began to support the Boys & Girls Club •Silicon Valley through the ASML Foundation. There is a wide income gap in Silicon Valley between people working in tech and those outside the industry. Studies show that children from high-income families outperform those from low-income areas. With its focus on STEM, the after-school program aims to bridge this gap.
	• We provide financial support to projects related to education for underprivileged children and teenagers, mostly through the ASML Foundation.	
		We have a cooperation with Close the Gap, and •donate about 100 refurbished laptops annually for their programs in developing countries. We also donate about 230 laptops annually to local charities.

The ASML Foundation

The ASML Foundation focuses on the UN's fourth Sustainable Development Goal: to ensure inclusive and quality education for all and promote lifelong learning.

The ASML Foundation aims to increase the self-sufficiency of disadvantaged children through educational initiatives that develop their talents and help unlock their potential. Although closely linked to our company, the ASML Foundation operates independently. The ASML Foundation supported 24 projects in 17 countries and committed over EUR 1.4 million. The Foundation is our charity of choice.

The ASML Foundation mainly supports projects in the regions where ASML operates: Asia, Europe and the US. These projects address the specific needs in that region. In the US for example, projects mainly focus on preventing school drop-outs in underprivileged areas, and the promotion of STEM, especially for girls. Projects in Asia differ per country. In developing areas of Asia, for example, projects focus on education for girls to prevent child marriages, and on vocational training for young people to increase their self-sufficiency. In China, the focus is on STEM for girls in rural areas. In Europe, and the Netherlands specifically, the foundation focuses on education for disadvantaged children, and children lacking in education, that suits their specific needs.

We encourage our employees to support the ASML Foundation, either financially or through volunteer work. For more information, see www.asmlfoundation.org.

People objectives

Theme	Objective	Target year	How we did
Talent management	2018 focus areas:		
	a. Secure Workforce Management and Workforce Planning to support future growth.	2018	Our headcount targets are translated into people plans and specific hiring plans including related competences. Due to additional demand during the year, the initial planned number of hires in 2018 has now been exceeded.
	b. Execute recruitment strategy by implementing the new Applicant Tracking System, focused communication strategy on labor market and deploying a strengthening selection process.		The new Applicant Tracking system went live at the the start of 2018. Specific labor market campaigns helped to exceed the initially planned hiring number. The selection process has been strengthened through global training of line managers and an extension of the existing assessment deployment.
	c. Strengthen onboarding activities on a global scale by further roll-out of our pre-onboarding app, developing a social onboarding program and further deploying of the buddy program.		Our pre-onboarding app has been deployed to all sites. The pre-onboarding app was deployed in Europe and the US in 2018, and will also be deployed in Asia. The buddy program, including documentation and training, was also launched throughout the company.
	Attrition rate of high performers < overall employee attrition.	2017 - 2020	See People KPIs in the table below - our attrition rate of high performers is 2.2%, lower than our overall attrition rate of 4.7%.
	Promotion rate of high performers > overall promotion rate.	2017 - 2020	See People KPIs in the table below - our promotion rate of high performers is 40%, well above the overall promotion rate of 14%.

2019 focus areas:
a. Secure quality of hires
b. Secure effectiveness of new hires
c. Secure internal leadership pipeline 2019
d. Define and deploy a global Culture & Values Framework

People KPIs

KPI	2016	2017	2018
Average engagement score me@ASML survey [1]	7.0	7.0	n/a
Employee Attrition (in %)	3.9	4.4	4.7
Attrition rate of high performers (in %)	1.7	1.8	2.2
Promotion rate of high performers (in %)	35	37	40

1. Measured on a scale from 0 to 10, with 10 being the top score. No survey was held in 2018.

Sustainable relationships with our customers

Our priority is to give our customers the best-possible products and services. We work closely with them to make sure we understand their needs, priorities and challenges. The high cost of new chip-making equipment and factories is a major incentive for building partnerships, sharing knowledge and risks, and aligning our investments in innovation with those of our customers. This is reflected in the commitments made in 2018 by three of our leading customers to ASML's High NA EUV development program for future delivery of up to 12 systems.

Staying close to our customers

Our sales teams market and sell our products directly to our customers, without agencies or other intermediaries. Our account managers, field and application engineers, and service and technical support specialists are located throughout Asia, the US and Europe. In addition to the establishment of industrial sites in Linkou and Tainan, Taiwan, in 2017, we created a new training site in China in 2018. These sites are supplementary engines to drive our long-term growth, providing customer support and training, logistics, refurbishment, technology and application development. The new site in China is a training center to develop worldwide talent for our workforce, clients and customers.

To support and sustain our partnerships with customers, we have a system of customer meetings in place. These take place regularly with our biggest customers, who collectively account for the vast majority of our revenue and the semiconductor equipment market. These meetings include our Executive Review Meetings, at which members of our senior management team and BoM discuss business and general issues with customers, Technology Review Meetings, at which our senior technology experts and CTO discuss technology plans and requirements with customers. These meetings are an opportunity for customers to set out a roadmap for their technology requirements, such as shrinking chip size, and Operational Review Meetings, to review topics related to the operational activities of our customers. These meetings help align our future product plans with our customers' goals, and also help to identify and close gaps. Besides these important planning sessions, we also hold numerous face-to-face meetings between our BoM and customer representatives to discuss business.

Our Voice of the Customer program allows our employees to hear firsthand about our customers' needs and challenges. This is especially important for employees who do not usually have direct access to customers. To reach as many of our people as possible, the program uses different channels of communication: live presentations and Q&As with senior customer representatives; recorded customer interviews; online articles, and personal engagement with customer representatives who are based near our offices in Veldhoven. In 2018, eight of our customers had representatives that were based near Veldhoven. To share feedback with an even bigger audience at ASML, we expanded our Voice of the Customer program in 2018 by adding customer feedback briefings. Our account teams used company gatherings, such as our ASML Day, as an opportunity to share this feedback. This generates more ideas from employees, and helps us act on the feedback and make improvements.

Based on customer feedback, we focused on communication in 2018, with our teams working on enhancing frequency of communication with customers. This was done, for example, by increasing the number of points of contact with customers, holding more regular meetings, and, in some cases, hosting quarterly reviews with ASML teams from sectors beyond account management. We aim to keep in close contact with customers and update them on improvements and solutions.

According to an annual customer survey conducted by research specialists VLSI, we ranked 3rd (2017: 3rd) on the list of best suppliers of chip-making equipment with a score of 9.1 out of 10.0 (2017: 9.0).

Customer Loyalty Survey

In 2018, we held our biennial Customer Loyalty Survey, which asks our customers to rate our performance. It presents them with multiple-choice questions on the most important areas of improvement for our account teams and business lines. The survey is one of our most important tools for gauging customer satisfaction and receiving feedback. Along with our Voice of the Customer program, it helps us define our improvement priorities for the coming year. Once these areas have been identified, ASML teams come together regularly to track progress. They report back to customers with their findings. For the first time, HMI and Brion were included in the Customer Loyalty Survey. Our latest survey, in September 2018, resulted in a satisfaction score of 73.3 percent. Our next survey will be held in September 2020.

Through our Customer Loyalty Survey, customers asked that we focus on quality improvements, product performance in a high-volume manufacturing environment, and timely solutions for install-base problems. In 2018, we continued using feedback from the survey to improve our service. Our account teams fine-tuned their priorities, and stepped up efforts to proactively inform customers about any expected issues so as to find solutions at an earlier stage. We also continued our efforts to make sure customers receive spare parts at the right time and of the right quality, so reducing downtime in their chip-making operations.

Cost of ownership

Our customers look to us to deliver cost-effective solutions with improved cost of ownership over time to enable the introduction of more advanced process technologies that enable more powerful microchips with lower cost per function, and for a given microchip design to enable cost reduction over time. We aim to deliver this first by introducing new technology that allows the device to shrink cost effectively, for example with EUV that enables smaller features with fewer process steps than with multiple patterning, secondly by introducing higher productivity on our systems to reduce the cost to process a wafer, and lastly by providing upgrades and services to our installed base systems to enhance their output and operating life cycle. In 2018, we showed continued progress with our EUV technology, bringing our systems to the point of high-volume production. See also Management Board Report - Products and Technology - Innovation drives our business. We also continued our program to upgrade our DUV immersion scanners, which enables customers to reuse their installed base, and through our Brion software, allowed them to take advantage of a faster and more efficient patterning process, so helping to reduce the overall cost of ownership. In 2018, the integrated sales teams of ASML and HMI served our customers with our holistic lithographic solution, including accurate patterning information metrology.

Sustainable relationships with suppliers

We rely heavily on our suppliers to develop, manufacture and deliver innovative parts for our systems, on time and with the right quality. It is our strategy to develop and manufacture those parts and modules that are unique for lithography in house, both from a manufacturing and a development competence perspective. If this does not prove possible, supplier partnerships are established and well maintained. Contract manufacturers or Original Equipment Manufacturing suppliers are mainly responsible for delivering modules and / or parts that require non-unique manufacturing. It is crucial that we build a world-class supplier network. One of our major priorities is to work with our suppliers to reduce the total cost of ownership of our systems, while meeting our challenging quality standards. We conduct risk assessments for all key suppliers every year, evaluating risk areas such as our suppliers' financial health, change of ownership, potential for supply disruptions (e.g. as a result of natural hazards), and situations where we depend on a single supplier for certain parts or modules. For product-related suppliers, we conducted 190 risk assessments in 2018 covering more than 90 percent of spend. As suppliers operating in the same industry or market are typically exposed to similar risk, we evaluate suppliers' risk and performance within the context of the supply market category, so enhancing efficiency. Whenever necessary, we mitigate risks by adjusting our sourcing strategy. Our risk assessment includes monitoring of critical raw materials. As our suppliers purchase and process most of the raw materials we require for our products, we have limited exposure to price volatility of these materials. Due to a fire at one of our suppliers of electronics components and modules, work in progress and part of the inventory was lost. Due to the integral cycle time of around one quarter for these modules, we expect ASML's first-quarter sales to be negatively impacted by approximately EUR 300 million, which we expect to largely recover in the second quarter, with the remainder expected to be recovered in the second half of 2019.

We also require our suppliers to meet standards regarding quality, logistics, technology, cost and sustainability. In 2018, we continued our quality program with suppliers. Quality metrics were improved and we introduced Supplier Quality Mission Statements to emphasize both ASML's and suppliers' commitment to achieving quality improvements. We rolled out a new version of the ASML supplier profile, our approach to supplier management and development. This provides an enhanced knowledge base to improve supplier performance dialogue. Supplier capability management is further improved by the implementation of a single framework for supplier assessment and development, allowing ASML to communicate process requirements and compliance expectations clearly to suppliers. We regularly evaluate our risk assessment and supplier profile methodology, and will continue to invest in evolving the norms underpinning the supplier profile to better meet industry requirements. Improvement initiatives for 2019 include further embedding of product safety requirements and information security improvements, including continued focus on GDPR compliance.

Partnership with Carl Zeiss SMT GmbH

Carl Zeiss SMT GmbH is our single supplier, and we are their single customer, of optical columns for lithography systems. Carl Zeiss SMT GmbH is capable of developing and producing these items only in limited numbers and only through the use of manufacturing and testing facilities in Oberkochen and Wetzlar, Germany.

In 2018, 28.3 percent of our aggregate cost of system sales was purchased from Carl Zeiss SMT GmbH (2017: 26.6 percent; 2016: 27.6 percent).

Our relationship with Carl Zeiss AG is structured as a strategic alliance pursuant to several agreements executed in 1997 and subsequent years. These agreements define a framework in all areas of our business relationship. The partnership between ASML and Carl Zeiss AG is run under the principle of ‘two companies, one business’ and is focused on continuous improvement of operational excellence. Pursuant to these agreements, ASML and Carl Zeiss AG have agreed to continue their strategic alliance until either party provides at least three years' notice of its intent to terminate.

In 2017, we completed the acquisition of a 24.9 percent indirect interest in Carl Zeiss SMT GmbH for EUR 1 billion. We also agreed to support Carl Zeiss SMT GmbH’s R&D expenses, capital expenditures and other supply chain investments pertaining to High NA technology over six years, beginning in 2016. The main objective of this partnership is to facilitate the further development of our EUV lithography chip-making systems. See Consolidated Financial Statements - Notes to the Consolidated Financial Statements - Note 10 Equity method investments.

Sustainability criteria

The sustainability criteria that we cascade to our suppliers are based on the Responsible Business Alliance (RBA, formerly known as Electronic Industry Citizenship Coalition) Code of Conduct. This code covers, among other things, standards for human rights, anti-corruption and bribery, and for sound environmental practices. Compliance with the Responsible Business Alliance Code of Conduct is a prerequisite for doing business with us, and we actively pursue our suppliers' adherence to this code. The requirement to meet human rights and other ethical RBA standards is included in our long-term product-related supplier contracts, along with the right to audit RBA compliance. We conduct supplier audits to address risks identified in our regular risk assessments. These audits also help ensure suppliers deliver what we expect. Our objective is to conduct a review of the sustainability efforts of our business-critical suppliers. To further align our efforts with international RBA guidelines we have replaced ASML's own sustainability survey with the RBA self-assessment survey as offered by the RBA platform. We expect the results in the course of 2019 at which point we can tailor supplier interventions. We aim to audit our suppliers' sustainability performance according to a perceived level of risk. If a supplier does not conform to the required standards, it is our policy to discuss mitigating measures.

Responsible Business Alliance

Responsible Business Alliance members commit and are held accountable to a common Code of Conduct and utilize a range of Responsible Business Alliance training and assessment tools to support continuous improvement in the social, environmental and ethical responsibility of their supply chains. The Responsible Business Alliance used to be known as the Electronic Industry Citizenship Coalition and was renamed in 2017. See also www.responsiblebusiness.org.

Supplier Relationship Satisfaction Survey

We have been conducting an annual Supplier Relationship Satisfaction Survey since 2015, which has helped us set priorities to improve how we collaborate with our suppliers. Based on feedback from our 2016 Supplier Relationship Satisfaction Survey, we made our supplier meeting setup more structured and transparent to improve meeting effectiveness and to facilitate involvement of senior management. In 2018, we further strengthened our supplier management approach by implementing category management, meaning we categorize suppliers based on the supply market in which they operate, thereby improving the effectiveness of our sourcing organization.

After revising the survey questions in 2017, we again focused the survey on the critical questions, while still capturing key trends. We recalibrated the scores for multi-year comparison. The weighted average satisfaction scores for 2018 were 81 percent for product-related and 77.6 percent for non-product related suppliers. These ratings represented 1.3 percent increase for product related suppliers and a 2.7 percent increase for non-product related suppliers, compared to 2017, see Partners KPIs in the table near the end of this section.

Across non-product related suppliers, most individual topics faced an increase in rating compared to 2017. The business relationship with our suppliers is, in particular, highly valued. It is important that we continue to improve what we communicate towards our suppliers and with what frequency. We believe that close collaboration with our suppliers, and increasing transparency on future roadmaps and strategies during regular business review meetings, will make this happen.

For product related suppliers, the overall rating score increased for almost all individual topics. Insights into our long-term roadmap and collaboration between ASML and suppliers were especially highly rated. It is important that we continue to improve on the effectiveness and communication of our supplier performance management system. We changed the way we measure performance in 2018, and started the roll out to our critical suppliers. In 2019, we will further integrate the use of supplier

performance information in our sourcing decisions. We believe that using the new supplier profile during regular business review meetings, together with clear communication on objectives, will help to make our collaboration with suppliers more effective.

One way in which we strengthen our relationship with suppliers is our Supplier Day in Veldhoven. In 2018, this brought together some 130 representatives from about 90 product-related suppliers from across the globe to participate in workshops and attend presentations by our senior management, including our CEO and CTO. Workshops and presentations were centered around the theme of 'Sustaining Growth', translating our priorities into concrete tasks that we need to complete, as well as the contribution from our suppliers needed to meet these targets. In 2018, we also facilitated a Supplier Day for our non-product related suppliers, bringing together around 65 representatives from approximately 55 suppliers. These Supplier Days offer our suppliers the opportunity to familiarize themselves with our business strategy and targets. Additionally, about 100 quality specialists from approximately 70 suppliers are invited this year to our ‘crossing event’. These are meetings organized by our Supplier Network Management unit, which provide a platform to discuss operational improvements for our products, such as improvements in quality or production volume.

‘As-new’ program helps cut waste

As part of our commitment to the circular economy, we work together with customers and suppliers to remanufacture used system parts so that they can be reused as if they were new parts. See also Management Board Report - Products and Technology - Product stewardship. Our first pilot scheme under this ‘As-new’ program, conducted in collaboration with our customers and suppliers, demonstrated the positive environmental impact: total valuable parts returned from upgrades amount to 795,400 kilograms. We discussed the program with more than 20 suppliers and decided to expand it to boost the circular economy model even further.

'Return 4 Reuse' enables circular use

In addition to the 'As-new' program, we are improving the reuse of packing, locking and transport materials, aiming to return 80 percent or more for reuse in the next install or relocation. Starting with the EUV systems, the ‘Return 4 Reuse program’ is now expanding the concept to the DUV systems. All packing, locking and transport materials are reused at use level (highest level of reuse). The concept is driven by an automated circular process triggering the limited manual interventions to return and reuse the materials by itself. This makes the process sustainable and enables ASML to focus on increasing the number of materials to be reused.

Conflict minerals

As of 2012, Section 1502 of the Dodd-Frank Act in the US requires companies to publicly disclose their use of conflict minerals originating from the Democratic Republic of the Congo or any neighboring countries. These include minerals mined under conditions of armed conflict and human rights abuses. The four main minerals concerned are tin, tantalum, tungsten and gold, also known as 3TG.

We closely monitor use of these materials in our supply chain. We encourage our suppliers and sub-suppliers to have policies and due diligence measures in place that will enable us to investigate if the products and components they supply us with contain any conflict minerals from the Democratic Republic of the Congo or neighboring countries. We have also developed our own due diligence process to identify and manage the sourcing of our components, focusing especially on 3TG. As such, we have been conducting due diligence reviews with relevant suppliers to trace the supply chain back to the smelter and will seek confirmation from the selected suppliers that potential 3TG minerals are responsibly sourced.

We are collaborating with both the Responsible Business Alliance (formerly known as the Electronic Industry Citizenship Coalition) and the Global e-Sustainability Initiative, as well as with other semiconductor and electronics companies, to address conflict-free mineral sourcing on an industry-wide level. The Responsible Business Alliance and Global e-Sustainability Initiative have provided us with the standards and templates we use in reporting and implementing our due diligence. As a member of the Responsible Business Alliance we support initiatives which foster better working conditions in raw material production, as well as the Responsible Business Alliance’s efforts to build a trustworthy system that ensures the social and environmental responsibility of mineral sources. We will

continue to work with our suppliers on due diligence in the supply chain, supporting industry initiatives and taking appropriate action to comply with the SEC rules and guidance regarding the Dodd-Frank Act. We hope this concerted effort will dissuade perpetrators of violence and human rights violations and encourage transparent mineral sourcing. Our Conflict Minerals Report is publicly available on our Website.

Partners objectives

Theme	Objective	Target year	How we did
Sustainable relationships with customers	Respond to customer feedback by improving the quality of spare parts upon arrival and addressing cost of ownership issues.	2015 - 2020	We continued initiatives taken at various levels within the organization to increase quality and address cost of ownership issues (e.g. Account teams have received / are receiving training on Cost of Ownership, Voice of the customer sessions, Quality as one of our Corporate Priorities).
	Continue to strengthen executive alignment.	2016-2020	In 2018, regular meetings and numerous face-to-face meetings between our BoM and customer representatives took place to discuss business and general issues.
	Additional emphasis on account teams driving customer quality issues through the organization.	2016-2020	Account teams are supporting the Voice of the Customer sessions to ensure customer feedback is widely shared at ASML.
	Achieve top three ranking among large suppliers of semiconductor equipment.	2016-2020	ASML ranked 3rd on the list of best suppliers.
Sustainable relationships with suppliers	More extensive review of sustainability efforts at our business critical suppliers.	2016-2018	All business critical suppliers were invited to fill out a business continuity quickscan and RBA self-assessment. Next step is the evaluation of the results by the Supplier Account Teams. In addition, 34 suppliers were invited to an information security self-assessment.
	Introduce revised supplier profiling to separate out performance, capability and risk indicators.	2017-2018	Roll out of the new supplier profile to all 70 key suppliers has been concluded. The focus has shifted to monitor adherence, specifically for the closure of supplier improvement plans and risk mitigation plans.

Partners KPIs

KPI	2016	2017	2018
Supplier Relationship Satisfaction Survey (overall rating score) [1]	77.4 %	77.0 %	79.3 %
Supplier Relationship Satisfaction Survey (overall rating score) Product related suppliers [1]	77.5 %	79.7 %	81.0 %
Supplier Relationship Satisfaction Survey (overall rating score) Non-product related suppliers [1]	77.1 %	74.9 %	77.6 %
Overall Loyalty Score (Customer Loyalty Survey) [2]	75.4 %	n/a	73.3 %
VLSI Survey results [3]			
Large suppliers of chip-making equipment - score	8.9	9.0	9.1
Suppliers of Fab equipment - score	8.9	9.0	9.1
Technical leadership for lithography equipment - score	9.6	9.4	9.6

1. The overall rating score covers both product-related suppliers and non-product related suppliers. In 2019 we will review and revise the survey to ensure that we continue to identify meaningful improvement areas.
2. The Customer Loyalty Survey is held every two years.
3. Measured on a scale from 0 to 10, with 10 being the top score.

Operational excellence

We have a long track record of innovation, having introduced several generations of cutting-edge chip-making systems that help our customers produce ever-smaller microchips (‘shrink’) at affordable prices. ASML has evolved along the axis of technology leadership, always first to market with leading-edge technology and products. We have been successful in this technology journey, to the point where we now have significant market share in lithography systems. As products mature, however, customers increasingly focus on cost of ownership and customer experience. Their expectations are changing.

Our value proposition needs us to balance technology leadership with operational excellence. In certain sectors of the market, operational excellence will become our key differentiator. Our challenge is to maintain both business models. For the higher end of the market such as EUV and High NA, we need to retain our technology leadership edge. While for DUV, there will be more of a drive for operational excellence over technology as our competitors match us in certain areas. This will require different sets of behaviors and changes to our culture. Eventually both EUV / High NA and DUV will need a combination of innovation power and operational excellence.

To meet our customers’ expectations, we set up a comprehensive and organized portfolio for structural improvement projects to achieve operational excellence. We aim to deliver products and services with the right quality, on time, at a competitive cost, in a safe work environment and with the optimum use of capital.

Efforts to enhance operational excellence are led by our Operations organization, and more specifically our Department of Operational Strategy and Excellence (OSE). A policy deployment exercise was conducted to make sure strategic goals are being driven at every level. In October 2018, the OSE department held an all-hands meeting at Veldhoven, which served to identify the most pressing challenges and breakthroughs needed and how to achieve them.

Lean principles

As our industry evolves and our company grows, which requires a strong drive for standardizing our processes and ways of working, we need to ensure that our Operations organization and way of working are scalable, agile, effective and efficient. To achieve this, we carry on developing our Centers of Excellence network where we bring together and exchange expert knowledge and experience from across our business to support best-practice decision-making and execution. We are monitoring the maturity level of the competence centers rated on a scale of 0 to 5. Secondly, we work to adjust our basic processes to ensure they meet future needs and support them with state-of-the art IT systems. Thirdly, to achieve the cost, quality and delivery improvements we seek for our customers, we use the Lean principles to build a continuous improvement mindset. This means, among other things, that we seek to eliminate anything that does not add value for our customers. Lean also helps us define a clear end goal, and foster a culture of continuous improvement.

Lean is proving to be an effective tool with quantifiable results. In one example of Lean implementation in the TWINSCAN factory in 2018, 300 employees who were trained and coached daily by Lean experts were shown over the period of a year to have generated nearly 400 new ideas. These were aimed at improving quality, reducing costs and enhancing efficiencies.

In another exercise in 2018, in which we analyzed the different steps in our production processes (‘value stream maps’), our end-to-end factory lead time of XT systems was reduced by 70 percent in the period from the third quarter of 2016 up to and including the first quarter of 2018. Production capability increased by 50 percent and employee productivity in ‘natural teams’ (those working together on a common product or function to improve performance) by 20 percent.

One of the ways of gauging progress in achieving operational excellence is measuring the number of employees we have reached with our initiatives to implement Lean principles. Our overall objective is to familiarize over 10,000 operations employees with our Lean way of working. We will do so gradually, targeting a specific number of employees each time. In 2018, we met our target to reach a group of around 3,500 employees by year-end.

Quality

Quality is an integral part of operational excellence. It is the essential ingredient that protects and enhances ASML's reputation as an innovative company that delivers excellence, helps to improve profitability and drives change. Ultimately, quality from a customer perspective is an outcome - that our products and services are delivered as promised to our customers.

The Quality roadmap we launched in 2016 addresses customer needs by implementing a range of products to improve quality. Some of the key parts, such as managing parts quality, reducing issues at install, reduction of software patch hits and improved supplier performance, are included in this roadmap.
These initiatives resulted in improvements in 2018. For example, the mature parts quality framework for DUV has seen the dead-on-arrival rate being reduced to 0.45 percent from 1.5 percent three years ago. The number of issues per install has dropped from 6.5 to 3.7 for DUV, Yieldstar and upgrades. There were also improvements in software quality with the need to install patches being reduced in EUV / DUV from 130 to 90 patches per year.

A mature risk assessment framework including implementation of FMEAs (failure mode & effects analysis) has seen prevention of “extra-long downs” at our customers. Pilots focused on packaging have seen a reduction in packaging-related issues in transfers by 85 percent. Our suppliers met with our renewed quality demands as we saw a reduction in material quality performance (defects) from 0.8 percent at the end of 2015 to 0.25 percent at the end of 2018. In 2018 we reintroduced Statistical Process Control (SPC) in our factories - starting with the Linkou Factory in Taiwan.

Many of these projects have reached a stage of maturity due to increased focus, proactive risk assessment and a consolidated view across our entire value chain. While customers recognize and appreciate our efforts around quality, it will remain an area of focus for the foreseeable future.

The Executive Committee has enforced a culture of quality, committing, for example, to improvements via 'gemba' walks. These entail in-person, on-site observations in an effort to understand workplace challenges. In 2018, the ASML quality principles of first-time right, zero defect and zero repeat were introduced. These form a simple and easy to understand quality model. Quality Training was also launched worldwide as part of the 'creating a culture of quality' change program - created with input from our key customers, senior management, and employee feedback. Nearly 90 percent of the ASML employees have completed the training displaying an appetite for learning and willingness to be part of the Quality drive at ASML. In addition, in 2018, several suppliers signed the Quality First agreement, reinforcing their commitment to accompany us on our journey to excellence.

Environment, health and safety

At ASML, we take responsibility for protecting our people and planet. We aim to invent, develop, manufacture and service our products in a safe and sustainable manner, striving towards zero incidents and zero emissions. Employee health and safety is crucial to creating a trusted working environment, where our employees feel respected and can thrive. Our corporate responsibility strategy is based on the premise that all workplace-related injuries and occupational illnesses are preventable.

We are working to reduce CO_2 emissions by ensuring all of our electricity usage will be ‘green’ by 2020. Other measures include the implementation of safety programs, as well as energy and waste-saving projects.

How we manage environment, health and safety

Our line managers are responsible for day-to-day EHS management, with processes and policies set and overseen by the Corporate EHS Committee, a subcommittee of our Corporate Risk Committee. All employees can access our global online EHS incident reporting tool. It is mandatory to report incidents and unsafe / near-miss situations as this is the first step towards improving our EHS performance. We investigate all incidents and the near-misses that could potentially create a hazardous situation to determine the root causes and take corrective actions to prevent them from recurring or materializing.

Our EHS Competence Center gathers the best-known practices, defines EHS standards for ASML, and helps managers across the business to implement these. Our EHS management system complies with ISO 14001 requirements, and is structured based on the basic idea and purpose of ISO 45001. Since the early 2000s, we have held certificates for ISO 14001. Recertification is scheduled for 2020. As well as helping to improve results on environmental goals, and meet the requirements of involved regulatory bodies, the certificates give ASML and our stakeholders the confidence that we are a learning organization. We provide employees with EHS training to raise their awareness and operational skills, and familiarize them with EHS standards. Based on risk and hazard evaluations, we gain insight into our main risk and hazard areas. We identify and manage our lines of defense and take appropriate action to mitigate risk.

How we did in 2018

Our ‘recordable incident rate’ in 2018 was 0.24, an improvement on our target of 0.31. No work-related fatalities were recorded in 2018, just as in previous years. We register EHS-related incidents in line with the US Occupational Health and Safety Act. Given our ambition to have zero incidents, we will continue to take any necessary action to improve safety and remain focused on preventing incidents.

We organized a global ‘Have a safe day’ campaign to take action on safety topics and raise overall awareness. Managers used this day to again stress the importance of safety, urging employees to always take action on safety issues and encourage others to do the same. To prevent incidents, we focus on the learning value of near-miss and unsafe situations with a high risk value across the organization. For this, we introduced a standardized incident

investigation method to identify and eliminate common root causes.

We are on track with our aim to achieve 100 percent renewable electricity (scope 2) by 2020. One of the ways we are working to achieve this priority objective is by our contributions to financing renewable projects generating Guarantees of Origin (GO2). These include the 1MW hydropower project initiated in Sandvik, Norway, which was commissioned in March 2018. In addition, we replaced the wind turbine project we had selected in 2017 in Sweden (this was shelved due to a lack of financing) with a 3.5MW hydropower project in Skånevik in Norway. In 2018, we continued to invest in hydropower, ramping up to 6MW.

Enhancing energy efficiency is another priority. Our target for 2020 is to achieve an energy saving of 111 TJ, which equates to a 10 percent reduction of our 2015 energy consumption. The energy savings at year-end 2018 are on track to achieve this target. Some important projects have been initiated for completion in 2020. This action, together with quantification of ongoing energy-saving opportunities, put us on track to achieve 111 TJ in 2020.

We aim to cut the amount of waste we generate by five percent by 2020, compared to the amount of waste generated in 2015. Waste-saving projects in 2018 included, among other efforts, a reduction in organic waste. This resulted in waste reduction of 0.4 percent, due to less kitchen waste, at our headquarters in Veldhoven. We need to develop further initiatives to reach our targets.

Several regulatory inspections were carried out at our locations across the world in 2018, none of which resulted in any significant EHS-related sanctions or fines. ASML was granted all legally required EHS permits required for our operations. In 2018, three environmental incidents were reported to the local authorities. These included one minor oil spill (less than one pint), a small leak, of unknown duration, in the sewage system, and a leak of five gallons of hydrofluoric acid. These took place at our production location in Wilton, Connecticut, in the US. These spills did not cause any significant damage to the environment and were contained according to local regulatory requirements.

For further information, see Non-Financial Statements - Non-financial Indicators - Operations.

Environment, health and safety objectives

Theme	Objective	Target year	How we did
Employee safety	Reduce recordable incident rate by 15% compared to average of previous three years (which results in a target for 2018 of 0.31).	2018	Our recordable incident rate of 0.24 is better than our target of 0.31.
Environmental efficiency own operations	100% Renewable electricity.	2020	We are on track. We achieved a 86.3% renewable electricity level in 2018 and have a plan in place to meet our 2020 target.
	10% Energy savings through projects.	2020	We are on track with our energy savings to achieve our target of 111 TJ by the end of 2020.
	5% Waste savings through projects.	2020	We ran some waste-reduction initiatives though more needs to be done since we have only achieved 1.6% (since 2016) of our targeted waste savings (of 5% of our waste generated in 2015).

Environment, health and safety KPIs

KPI	2016	2017	2018
ASML recordable incident rate [1]	0.44	0.26	0.24
Renewable electricity (of total electricity purchased)	71.0 %	70.2 %	86.3 %
Energy savings worldwide through projects (in TJ) [2]	35.1	48.8	77.3
Waste savings worldwide through projects [2]	1.2 %	1.2 %	1.6 %

1. The number of work-related injuries and illnesses, per 100 full-time workers. We use OHSA guidelines to determine work-related injuries and illnesses. Minor (first-aid level) injuries are excluded from the calculation of the recordable incident rate.
2. In 2016 we started a new master plan period which concludes in 2020. The savings reported are cumulated compared to base year 2015.

ASML operations update on key performance indicators

The following table presents the KPIs used by our BoM and senior management to regularly measure performance.

Year ended December 31	2017[1]		2018	
(in millions, unless otherwise indicated)	EUR	%[2]	EUR	%[2]
Sales				
Total net sales	8,962.7		10,944.0	
Increase in total net sales (%)	30.4		22.1	
Net system sales	6,424.4		8,259.1	
Net service and field option sales	2,538.3		2,684.9	
Sales of lithography systems (in units) [3]	197		224	
Immersion systems recognized (in units)	76		86	
EUV systems recognized (in units)	11		18	
Profitability				
Gross profit	4,020.2	44.9	5,029.2	46.0
Income from operations	2,439.7	27.2	2,965.3	27.1
Net income	2,066.7	23.1	2,591.6	23.7
Liquidity				
Cash and cash equivalents	2,259.0		3,121.1	
Short-term investments	1,029.3		913.3	
Net cash provided by operating activities	1,818.3		3,072.7	
Free cash flow [4]	1,460.3		2,463.2	

1. As of January 1, 2018, ASML has adopted the new Revenue Recognition Standard (ASC 606) and Lease Standard (ASC 842). The comparative numbers have been adjusted to reflect these changes in accounting policies, see Note 1 General information / summary of significant accounting policies.
2. As a percentage of total net sales.
3. Lithography systems do not include metrology and inspection systems.
4. Free cash flow is a non-GAAP measure and is defined as net cash provided by operating activities (2018: EUR 3,072.7 million and 2017: EUR 1,818.3 million) minus purchase of property, plant and equipment (2018: EUR 574.0 million and 2017: EUR 338.9 million) and purchase of intangible assets (2018: EUR 35.5 million and 2017: EUR 19.1 million). We believe that free cash flow is an important liquidity metric, reflecting cash that is available for acquisitions, to repay debt and to return money to our shareholders by means of dividends and share buybacks. Purchase of property, plant and equipment and purchase of intangible assets are deducted from net cash provided by operating activities because these payments are necessary to support the maintenance and investments in our assets to maintain the current asset base. Free cash flow therefore provides an alternative measure (in addition to net cash provided by operating activities) for investors to assess our ability to generate cash from our business. For further details about the purchase of property, plant and equipment and the purchase of intangible assets see Consolidated Financial Statements - Consolidated Statements of Cash Flows.

Operating results

Results of operations 2018 compared to 2017

The following discussion and analysis of our results of operations should be viewed in the context of the risks that may interfere with our business objectives or otherwise affect our results of operations, see Management Board Report - Risk Factors.

Set out below are our Consolidated Statements of Operations data for the years ended December 31, 2017 and 2018:

Year ended December 31	2017[1]	2018
(in millions)	EUR	EUR
Total net sales	8,962.7	10,944.0

Total cost of sales	(4,942.5)	(5,914.8)
Gross profit	4,020.2	5,029.2
Other income	95.8	—
Research and development costs	(1,259.7)	(1,575.9)
Selling, general and administrative costs	(416.6)	(488.0)
Income from operations	2,439.7	2,965.3
Interest and other, net	(50.3)	(28.3)
Income before income taxes	2,389.4	2,937.0
Provision for income taxes	(306.0)	(351.6)
Income after income taxes	2,083.4	2,585.4
Profit (loss) related to equity method investments	(16.7)	6.2
Net income	2,066.7	2,591.6

1. As of January 1, 2018, ASML has adopted the new Revenue Recognition Standard (ASC 606) and Lease Standard (ASC 842). The comparative numbers have been adjusted to reflect these changes in accounting policies, see Note 1 General information / summary of significant accounting policies.

Set out below are our Consolidated Statements of Operations data for the years ended December 31, 2017 and 2018 expressed as a percentage of our total net sales:

Year ended December 31	2017[1]	2018
Total net sales	100.0	100.0
Total cost of sales	(55.1)	(54.0)
Gross profit	44.9	46.0
Other income	1.1	—
Research and development costs	(14.1)	(14.4)
Selling, general and administrative costs	(4.7)	(4.5)
Income from operations	27.2	27.1
Interest and other, net	(0.5)	(0.3)
Income before income taxes	26.7	26.8
Provision for income taxes	(3.4)	(3.2)
Income after income taxes	23.3	23.6
Profit (loss) related to equity method investments	(0.2)	0.1
Net income	23.1	23.7

1. As of January 1, 2018, ASML has adopted the new Revenue Recognition Standard (ASC 606) and Lease Standard (ASC 842). The comparative numbers have been adjusted to reflect these changes in accounting policies, see Note 1 General information / summary of significant accounting policies.

For further information, see Other Appendices - Appendix - Selected Financial Data and Other Appendices - Appendix - Results of Operations 2017 Compared to 2016.

Total net sales and gross profit

The following table shows a summary of sales data, units sold and gross margin for the years ended December 31, 2017 and 2018:

Year ended December 31	2017[1]	2018
(in millions, unless otherwise indicated)	EUR	EUR
Total net sales	8,962.7	10,944.0
Net system sales	6,424.4	8,259.1
Net service and field option sales	2,538.3	2,684.9
Sales of lithography systems (in units) [2]	197	224
Gross margin	44.9	46.0

1. As of January 1, 2018, ASML has adopted the new Revenue Recognition Standard (ASC 606) and Lease Standard (ASC 842). The comparative numbers have been adjusted to reflect these changes in accounting policies, see Note 1 General information / summary of significant accounting policies.
2. Lithography systems do not include metrology and inspection systems.

We had another record year in 2018, with contributions from each of our wide range of product offerings in Holistic Lithography solutions.

Total net sales increased by 22.1 percent, driven by an increase in net system sales of 28.6 percent and an increase in net service and field option sales of 5.8 percent in 2018 compared to 2017.

The increase in net system sales is mainly driven by an increase in the number of systems sold in all products as well as the relative increase in system sales towards more high-end systems. The memory sector was the largest end-user growth driver, increasing by over 50%, whereas the logic sector was the largest consumer of our most advanced EUV systems. Shipments of EUV systems in 2018 are intended for high volume manufacturing of advanced logic and DRAM devices in 2019. In addition, China saw the largest geographic regional system sales growth at over 100% in

support of multiple new factories in the region.

The increase in net service and field option sales is mainly driven by an increase in the sales of productivity and focus upgrade packages in combination with a growing installed base.

Gross profit increased by EUR 1,009.0 million due to an increase in sales and profitability. Gross profit as a percentage of net sales increased from 44.9 percent in 2017 to 46.0 percent in 2018 primarily driven by improved margins on our high-end systems. The increase in gross profit as percentage of net sales is negatively impacted by the provision related to the settlement of our legal dispute with Nikon, see Note 20 Legal contingencies.

Other income

In 2017 other income consisted of contributions for R&D programs under the NRE Funding Agreements from certain Participating Customers in the CCIP. In 2018 there is no other income (2017: EUR 95.8 million) due to the NRE funding being completed by the end of 2017.

Research and development costs

R&D costs (net of credits and excluding contributions under the NRE Funding Agreements from Participating Customers in the CCIP) were EUR 1,575.9 million in 2018 as compared to EUR 1,259.7 million in 2017. R&D costs for both 2018 and 2017 were primarily focused on programs supporting our Holistic Lithography solutions in EUV, DUV immersion, and Applications. In 2018, R&D activities mainly related to:

- EUV - Further improving availability and productivity focused on the final stages of industrialization related to our NXE:3400B system, as well as introduction of the NXE:3400C. In addition, we are extending our roadmap by including High NA to support our customers with 3 nm logic and beyond.
- DUV immersion - Mainly dedicated to the development of our next generation Immersion system NXT:2000i, of which we shipped our first systems in 2018. In addition we are completing industrialization of new modules and further improving our roadmaps on alignment/overlay and productivity.
- Applications - HMI expansion, including multi-beam innovation, and further development of YieldStar and process window control solutions.

Selling, general and administrative costs

SG&A costs increased by 17.1 percent mainly driven by an increase in the number of employees as a result of the growth of our business and an increase in legal fees as a result of litigation.

Interest and other, net

Interest and other, net decreased by EUR 22.0 million in 2018 compared to 2017. This decrease is mainly due to lower hedging costs resulting from the change in functional currency of the US business.

Income taxes

The increase in the provision for income tax in absolute numbers is primarily caused by an increase in the Income before income taxes. The effective tax rate decreased to 12.0 percent of income before income taxes in 2018 compared to 12.8 percent in 2017, mainly resulting from an internal restructuring which resulted in release of deferred tax liabilities on intangible assets that were initially included in the business combination accounting for HMI.

Profit (loss) related to equity method investments

The profit related to equity method investments, which consists of the result of our 24.9 percent equity interest in Carl Zeiss SMT Holding GmbH & Co. KG, was EUR 6.2 million for 2018 (2017: loss of EUR 16.7 million). For more details see Note 10 Equity method investments.

Net income

Net income in 2018 amounted to EUR 2,591.6 million, or 23.7 percent of total net sales, representing EUR 6.10 basic net income per ordinary share, compared with net income in 2017 of EUR 2,066.7 million, or 23.1 percent of total net sales, representing EUR 4.81 basic net income per ordinary share.

Liquidity and capital resources

Our principal sources of liquidity consist of cash and cash equivalents as of December 31, 2018 of EUR 3,121.1 million, short-term investments as of December 31, 2018 of EUR 913.3 million and available credit facilities as of December 31, 2018 of EUR 700.0 million. In addition, we may from time to time raise additional capital in debt and equity markets. Our goal is to remain an investment grade rated company and maintain a capital structure that supports this.

Our cash and cash equivalents increased to EUR 3,121.1 million as of December 31, 2018 from EUR 2,259.0 million as of December 31, 2017 and our short-term investments decreased to