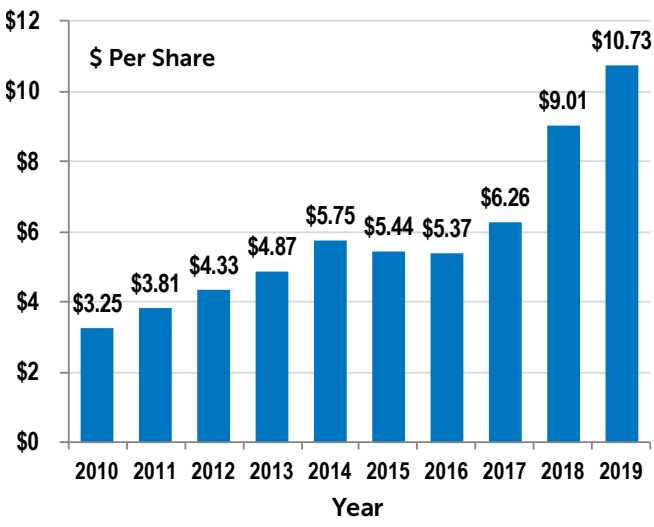
TELEDYNE TECHNOLOGIES
Everywhereyoulook™

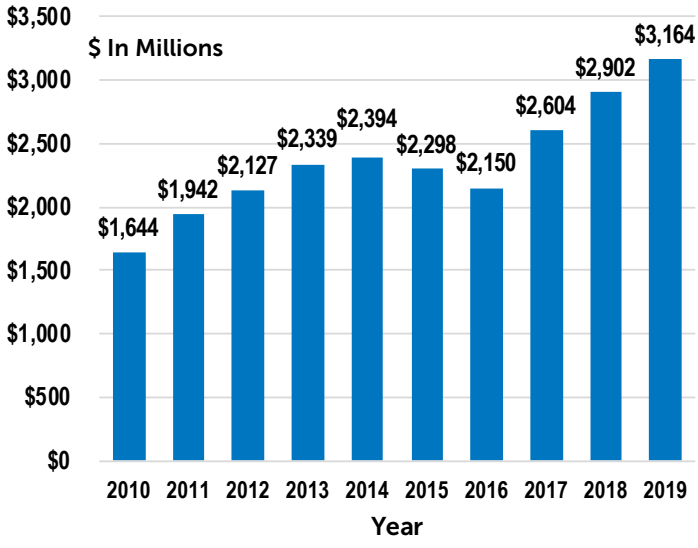
2019 ANNUAL REPORT

Making a Measurable Impact...
Everywhereyoulook™

GAAP EPS[(a)]



Sales



(a) Represents total GAAP earnings per diluted share for 2013 through 2019 and GAAP EPS from continuing operations for 2010 through 2012.

Financial Highlights

Selected Consolidated Financial Data

(In millions, except per share data)

Summary Financial Information

	2019	2018	2017	2016	2015
Sales	$3,163.6	$2,901.8	$2,603.8	$2,149.9	$2,298.1
Net income attributable to Teledyne	402.3	333.8	227.2	190.9	195.8
Diluted earnings per common share	10.73	9.01	6.26	5.37	5.44
Weighted average diluted common shares outstanding	37.5	37.0	36.3	35.5	36.0

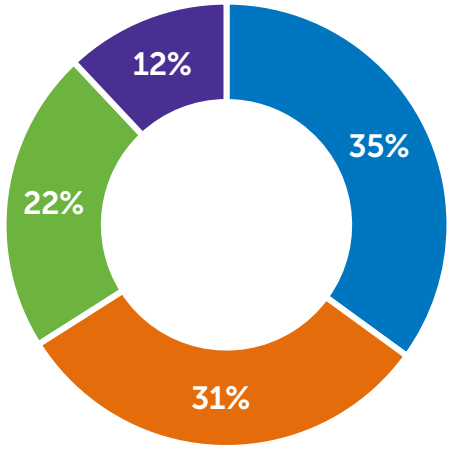
Summary Balance Sheet Data

	2019	2018	2017	2016	2015
Cash and cash equivalents	$199.5	$142.5	$70.9	$98.6	$85.1
Total assets	4,579.8	3,809.3	3,846.4	2,774.4	2,717.1
Long-term debt	750.0	610.1	1,063.9	509.7	754.1
Total equity	2,714.7	2,229.7	1,947.3	1,554.4	1,344.1

See "Management's Discussion and Analysis of Financial Condition and Results of Operations" and the "Notes to Consolidated Financial Statements" in the 2019 Form 10-K for additional information regarding Teledyne Technologies Incorporated's financial data.

2019 Sales by Segment

- **Instrumentation**
  Test and measurement, monitoring and control instrumentation, and power and communications connectivity devices for marine, environmental, electronics and other applications
- **Digital Imaging**
  High performance sensors, cameras and systems within the visible, infrared, ultraviolet and X-ray spectra, used in industrial, government and medical applications
- **Aerospace and Defense Electronics**
  Sophisticated electronic components, subsystems and communications products, including defense electronics, commercial avionics and harsh environment interconnects
- **Engineered Systems**
  Innovative systems engineering, manufacturing and specialized products for government, space, energy and industrial customers

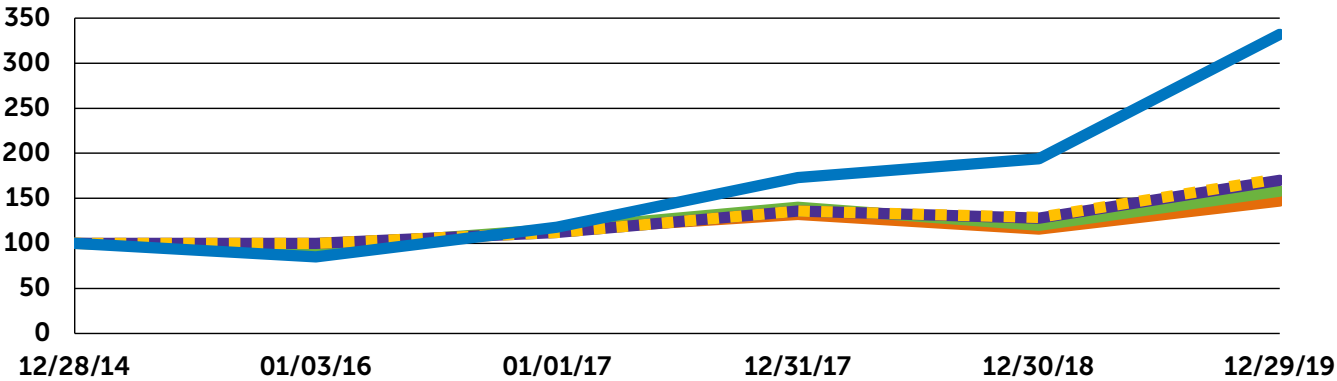


Cumulative Total Stockholder Return

The graph set forth below shows the cumulative total stockholder return (i.e. price change plus reinvestment of dividends) on our common stock for the five fiscal years ending December 29, 2019, as compared to the Standard & Poor's 500 Composite Index, the Russell 1000 Index, the Russell 2000 Index and the Standard & Poor's 1500 Industrials Index.

The graph assumes $100 was invested on December 26, 2014.

In accordance with the rules of the SEC, this presentation is not incorporated by reference into any of our registration statements under the Securities Act of 1933.



	12/28/14	01/03/16	01/01/17	12/31/17	12/30/18	12/29/19
Teledyne Technologies	100	85	118	173	194	332
Russell 2000	100	95	115	132	116	147
S&P 1500 Industrials	100	96	116	140	120	158
Russell 1000	100	100	112	136	128	170
S&P 500 Composite	100	100	112	136	129	172

Letter to **Stockholders**

Making a Measurable Impact—Everywhere**you**look™

2019 WAS ANOTHER RECORD YEAR FOR TELEDYNE: full-year sales, earnings, operating margin and cash flow were all-time records.

Total year sales for 2019 were $3,163.6 million, compared with $2,901.8 million for 2018, an increase of 9.0%. Net income was $402.3 million ($10.73 per diluted share) for fiscal year 2019, compared with $333.8 million ($9.01 per diluted share) for fiscal year 2018, an increase of 20.5%.

While we have increased our emphasis on margin improvement, we continue our proven strategy of disciplined capital deployment for compound growth in earnings and cash flow. In 2019, we deployed $484.0 million on complementary acquisitions within our Environmental Instrumentation and Digital Imaging businesses. Furthermore, in early 2020, we acquired OakGate Technology, our third bolt-on acquisition for Teledyne LeCroy.

While we remain committed to consistent financial performance, our businesses also continue to focus on developing solutions to address sustainability and climate challenges facing humanity today.

Ethics and Social Responsibility

Teledyne continuously operates within our Code of Ethical Business Conduct. We firmly believe that improvement is possible only if we measure our performance and constantly raise our standards through ethically-oriented practices, including our contributions and commitment to having a positive measurable impact on humanity.

Our broad range of precision measurement technologies for environmental monitoring and climate research is unique in the world. Our sensors and instruments are deployed everywhere, from pole to pole, in space, on aircraft and drones, on land, on the sea surface, in the water column, and on the seafloor. They operate around the clock, measuring greenhouse gases from space, precisely monitoring air and water quality throughout the world, and are continuously profiling all of Earth's oceans.

Applications of our instruments provide scientists information that spans time from the origin of the Universe to providing real-time data regarding air pollution and dangerous storms, such as time-critical warning of hurricanes and tsunamis.

In the following sections, we provide additional information of our contributions to global environmental and climate science.

2020 and Beyond

As we completed our 20th year as a public company, we believe that we have the capability and commitment to continue the path that we have set out as we move into this new decade.

Teledyne continues to benefit from our balanced portfolio of common technologies serving different, complementary markets. We begin 2020 with the largest backlog in the company's history, and we remain optimistic about Teledyne's future.

We thank all of our employees, as well as our Board of Directors, for their contributions to Teledyne's success. We also thank our stockholders for their continued loyalty and support.

Kind regards,

Al Pichelli
President and Chief Executive Officer

Robert Mehrabian
Executive Chairman

February 24, 2020


Credit: NASA

Making a Measurable Impact
Helping Humanity

Environment

Ninety percent of the world's population is exposed to air pollution above acceptable limits. Teledyne is a global leader in breakthrough design, production and distribution of sophisticated air quality instruments that measure hazardous gases and particulate matter in real-time.

- We provide sophisticated water samplers and flowmeters to monitor wastewater, irrigation flow, storm water, industrial discharge, construction site run-off and municipal wastewater collection, treatment and reuse.
- Every second of every day, our hazardous gas detection monitors are making industrial workplaces safer around the world.
- We build precision air quality instruments that measure common air pollutants and particulate matter (NOx, SO_2, ozone, PM_{10} and $PM_{2.5}$) that are considered hazardous to human health and the environment. Our instruments enable government agencies around the world to detect and monitor the quality of the air we breathe in real-time to assess their compliance with air quality regulations and ultimately reduce air pollution.

Ocean

The ocean covers over 70% of the Earth's surface, holds 97% of its water, produces more than half the world's oxygen, and stores 50 times more carbon dioxide than Earth's atmosphere. Changes in the ocean affect weather patterns, climate, and food security. Despite its vital importance, more than 80% of our ocean is unmapped and unexplored.

- Our floats, gliders and instruments assist climate research by providing access to accurate data, including subsurface temperatures and velocities of currents throughout the world's oceans. On a shorter timescale, scientists are employing our instruments to provide essential inputs for computer models of dangerous storms, providing real-time information to help save lives.
- Teledyne works with maritime agencies around the world, preserving free and safe navigation of the world's oceans.

Space

Teledyne's contributions to space exploration through our visible and infrared sensors have advanced our scientific understanding of the formation and evolution of the Universe, solar system, planets and moons and how humankind's actions affect Earth's climate, atmosphere, oceans and land.

Business

- We operate within a Code of Ethical Business Conduct with four key pillars: Integrity, Respect, Responsibility and Citizenship. Teledyne has a zero tolerance policy when it comes to violating the Code.
- Our Board of Directors and its committees regularly review matters related to compliance with environmental laws and the health and safety of employees. We continually evaluate our policies and practices and monitor our efforts in areas of legal and social responsibility, diversity and sustainability.
- We have made progress in our efforts to promote diversity and inclusion. Today, approximately one-third of our executive management team, as well as our Board of Directors, are women.

Community

- We invest in projects to develop and secure tomorrow's long-term energy sources.
- Teledyne businesses around the world support local charities and participate in volunteer opportunities to help those in need.
- Teledyne's products enhance the reliability and safety of global transportation and protect the security of our nation, our military and our allies.
- We partner with local universities to provide mentor and internship programs, especially for Science, Technology, Engineering and Math (STEM) students.

Making a Measurable Impact **Across Time and Space**

Space | Atmosphere | Land | Waterways | Ocean

Our understanding of Earth's weather, environment and climate advances continuously as scientists make new discoveries and refine their predictive models. These advances are only possible if scientists have access to accurate, repeatable measurements of environmental and climate data. We believe that our range of sensors and instruments for these applications are the most extensive in the world.

Time

Applications span time from researching the origin of the Universe to providing immediate warnings of air pollution and dangerous storms.

On the longest timescale, astronomers use our visible and infrared light sensors as a time machine to study the origin of the Universe, the sun, our solar system and our own planet.

Annual variations in ocean temperatures and currents affect worldwide weather. Our instruments enable scientists to more accurately forecast floods or droughts thereby allowing farmers to better plan for planting crops and providing irrigation.

The oceans are increasingly threatened by floating plastics that are constantly moving. We support ocean cleanup agencies with both airborne and space based instruments that track and analyze the debris.

Improving real-time forecasts for the trajectory and intensity of developing hurricanes and typhoons is extremely important. Scientists now position our ocean gliders directly in the path of developing hurricanes to monitor real-time current and temperature conditions via satellite link allowing them to continually update their forecasts.

Space

Our sensors and instruments span the globe from pole to pole and from space to the seafloor.

Our precision visible and infrared sensors enable climate scientists to measure atmospheric greenhouse gases from Earth observation satellites.

Over 70,000 of our instruments are used in over 100 countries to measure air quality. Our newest instruments set the standard for measurement of fine particles that pose the greatest risk to human health.

Clean water is crucial for life, but drinking water is often contaminated. We provide water samplers used to collect and safely store water for transport to laboratories. We also provide laboratory instruments used for pollution analysis and instruments that continually measure water flow rates.

Changing ocean temperatures have multiple impacts, such as sea level rise and increases in extreme weather events. Twenty-one countries rely on over 1,000 of our free-drifting profiling floats which continuously monitor physical parameters, from the surface to a depth of 2,000 meters in all the world's oceans.

The following section provides a more detailed overview of our space-based sensors for Earth observation and astronomy.

Making a Measurable Impact
Exploring the Universe

Teledyne's Space Technologies are Everywhereyoulook™

Teledyne's heritage in space spans over 60 years from the development and launch of the first successful U.S. satellite, Explorer 1. Since that time, Teledyne has made important contributions to every aspect of space, including astronomy, planetary exploration, manned spaceflight, Earth observation and satellite communications.

Since the beginning of the space program, Teledyne's imaging sensors have been the enabling elements of over 300 space missions and ground-based observatories.

While each of the missions we support has unique requirements, they all benefit humanity by:

- Advancing our scientific understanding of the formation and evolution of the Universe.
- Searching for life beyond our planet.
- Learning more about our solar system including planets and moons that may harbor life. Understanding how humankind's actions affect Earth's climate, atmosphere, oceans and land.
- Providing seasonal recommendations for agriculture and fisheries and real-time forecasts of the track and intensity of dangerous storms.

For all of these uses and more, we are proud to provide the technology that enables scientists to

Explore the Universe and Understand Our Impact.

Exploring the Universe—Remote Sensing of Light

ELECTROMAGNETIC RADIATION (light) is the primary messenger of information in the Universe and detection of light is critical to many areas of scientific research. This is especially true in fields where "remote sensing" of distant objects is the only way to study those objects, such as astronomy (from ground and space), planetary exploration, heliophysics (physics of the Sun and its effects on the solar system), and Earth observation from airborne and space-based instrumentation.

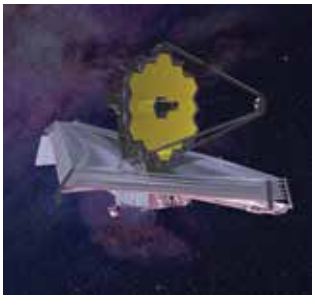
Remote sensing depends on measurement of the natural light emitted or reflected by the object under study. It is not possible to illuminate faint distant objects as can be done in a laboratory setting. Therefore, the forefront of science requires the most sensitive detectors of light. Since Teledyne produces the world's highest performance visible and infrared detectors, most of the leading facilities and missions rely on Teledyne's products. Some missions would not even be possible without Teledyne's state-of-the-art imaging technology. Examples are the James Webb Space Telescope (JWST), the Wide Field Infrared Survey Telescope (WFIRST), the PLAnetary Transits and Oscillations of stars (PLATO) space telescope, and the Kepler space telescope. All of these missions are enabled by the large format, high performance infrared and visible detectors made by Teledyne.

Teledyne is honored to partner with the passionate scientists around the world who dedicate their careers to exploration of the Universe.

This annual report presents two areas of space science where Teledyne plays a vital role:

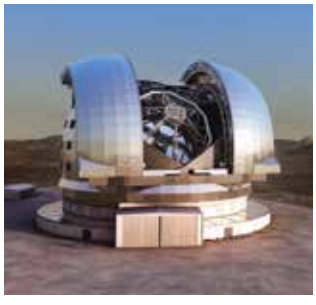
- Monitoring of greenhouse gases: Teledyne supplies the visible and infrared imaging sensors that enable NASA's OCO and GeoCarb missions that measure carbon dioxide and methane in the Earth's atmosphere.
- Study of asteroids, which are time capsules of the material that formed the solar system: NASA's OSIRIS-REx asteroid rendezvous / sample mission is presently orbiting and studying an asteroid with visible imaging, visible-infrared spectroscopy, and lidar ranging that depend on Teledyne's imaging technologies.

Examples of Facilities and Missions that rely on Teledyne's Visible and Infrared Detectors



James Webb Space Telescope

2021 launch

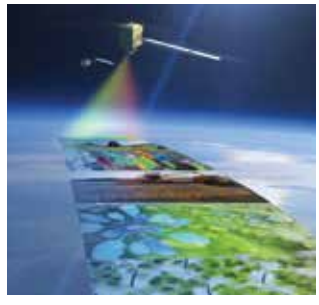


Extremely Large Telescope 39-meter aperture

2024 first light

JUICE mission to Jupiter and Galilean moons

2022 launch



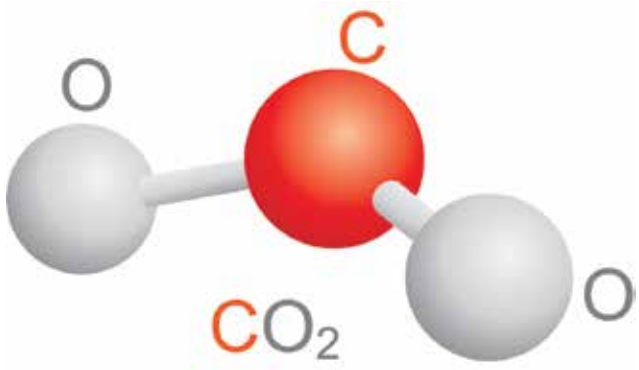
FLEX mission to measure Earth's photosynthesis

2022 launch

Credits (left to right): NASA/Northrop Grumman; European Southern Observatory (ESO)/L. Calçada; Spacecraft: ESA/ATG medialab; Jupiter: NASA/ESA/J. Nichols (University of Leicester); Ganymede: NASA/JPL; Io: NASA/JPL/University of Arizona; Callisto and Europa: NASA/JPL/DLR; ESA

Watching the Earth Breathe from Space—Measuring CO_2 from Orbiting Carbon Observatories

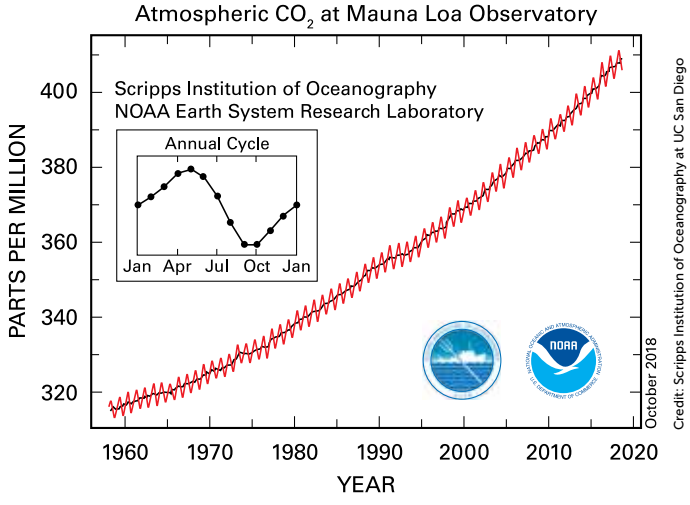
Teledyne's sensors enable spectrometers in NASA's Orbiting Carbon Observatories to make space-based measurements of atmospheric carbon dioxide (CO_2) with the precision, resolution, and coverage needed to characterize the distribution of CO_2 around the globe.



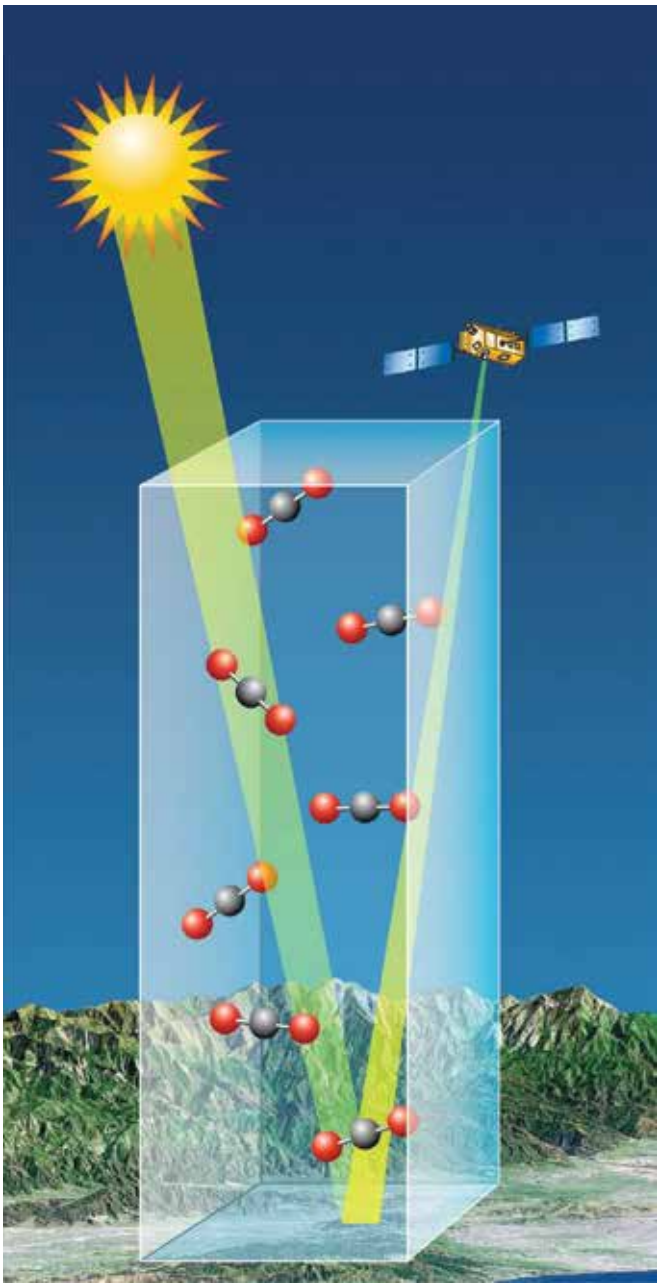
Carbon dioxide: *This simple molecule vibrates at frequencies corresponding to thermal radiation emitted by the Earth's surface. The thermal radiation is re-emitted, with half returning to the Earth's surface. CO_2 is good for the Earth's radiation budget since some CO_2 is needed to keep the Earth warm. However, too much CO_2 will cause the Earth's temperature to increase.*

CO_2 is the most significant of human-produced greenhouse gases (gases that warm the Earth's atmosphere by absorbing thermal radiation emitted from the Earth's surface) and is the principal human-produced driver of changes to Earth's climate. The content of CO_2 in the Earth's atmosphere has risen dramatically since the start of the industrial revolution; the Keeling curve (see figure) shows CO_2 since 1958. The annual oscillation of the CO_2 concentration (inset) shows the plants on Earth breathing. As plants grow in the northern hemisphere summer, the plants absorb CO_2 and the CO_2 concentration decreases, reaching a minimum in September-October. In the northern hemisphere winter, many plants die and the atmospheric CO_2 increases. Since 68% of the Earth's land area is in the northern hemisphere, the annual breathing cycle is dominated by the northern hemisphere seasons.

While scientists understand how CO_2 can affect temperature, they do not fully understand the geographic distribution of the sources and sinks of CO_2 and how the concentrations change over time. Enhancing this understanding is the mission of NASA's two operational Orbiting Carbon Observatories: The Orbiting Carbon Observatory-2 (OCO-2) satellite, launched in 2014, operates in a polar orbit. Orbiting Carbon Observatory-3 (OCO-3) was installed on the International Space Station in May 2019 and is collecting data to complement the OCO-2 data.



Above: *This plot, called the "Keeling curve", presents the longest set of continuous measurements of CO_2 in the Earth's atmosphere. The data is collected at the Mauna Loa Observatory, at altitude of 3,397 meters (11,141 feet), on the Big Island of Hawai'i. The curve is named for the scientist Charles David Keeling who started the monitoring program in 1958 and supervised it until his death in 2005. The Keeling curve is one of the most important scientific works of the 20th century since it was the first significant evidence of rapidly increasing CO_2 levels in the Earth's atmosphere.*



Credit: NASA / JPL–Caltech

Above: *Artist rendition of the carbon dioxide column measured by the Orbiting Carbon Observatories.*

The Orbiting Carbon Observatories determine carbon dioxide levels from space by measuring absorption of reflected sunlight in the near-infrared spectrum (see figure above). OCO-2's science instrument consists of three high-resolution spectrometers, integrated into a common structure and illuminated by a common telescope. The spectrometers make simultaneous measurements of the amount of reflected sunlight absorbed by CO_2 in the 1.61 and 2.06 µm bands. Those measurements are calibrated by measuring molecular oxygen (O_2) at 0.76 µm. The ratio of measured CO_2 to O_2 is used to determine the concentration of atmospheric CO_2 to a precision of 0.3 to 0.5% (1 to 2 parts per million).

The OCO spectrometer optics produce a 2-dimensional image of spectra on Teledyne's 1024 x 1024 pixel H1RG focal plane array (FPA). The focal plane array in the oxygen channel uses a silicon light detecting material, while the CO_2 channels use mercury cadmium telluride (HgCdTe) light detecting material with a 2.5 µm cutoff wavelength.

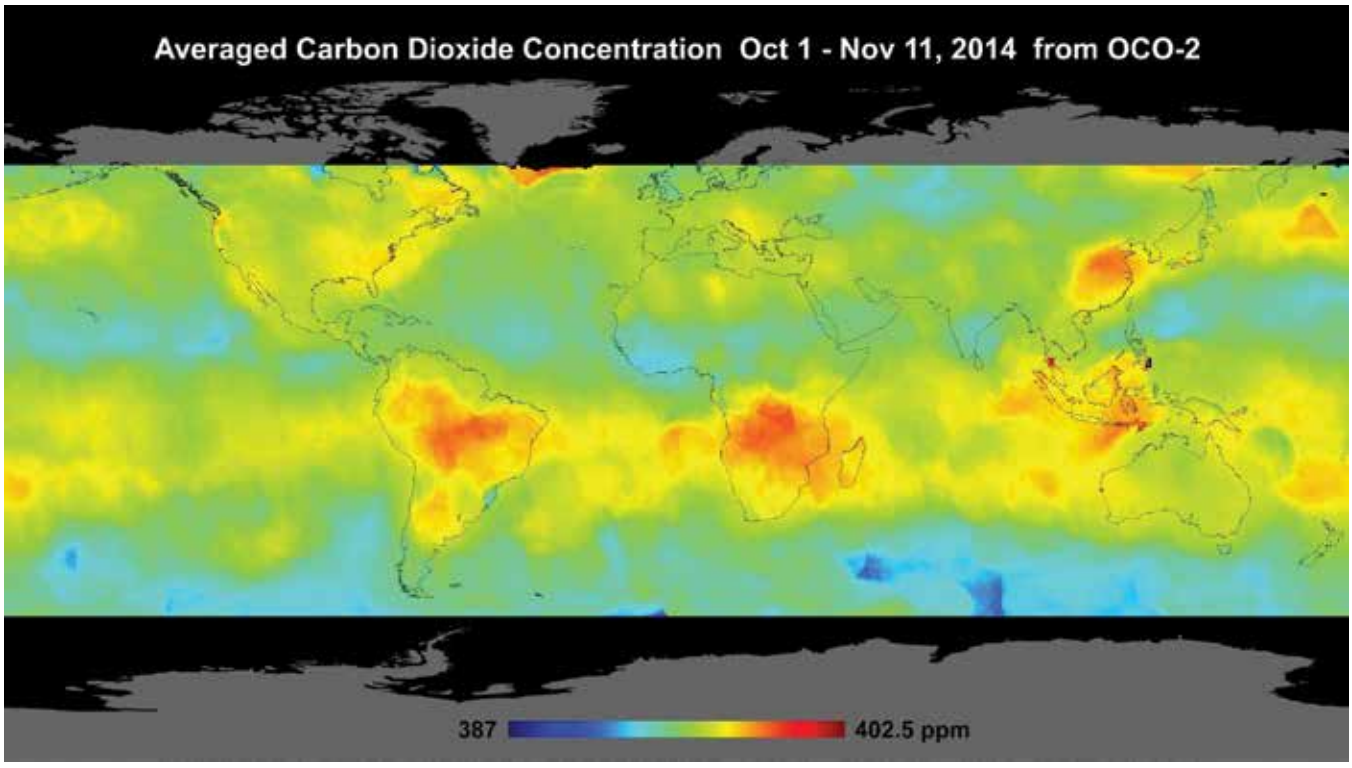
The Orbiting Carbon Observatories (OCO-2 and OCO-3) operate in low Earth orbit (LEO) and while these instruments get fairly good ground resolution (1.3 by 2.3 km), they only can sense a 10.2 km wide swath of the ground during each 99 minute orbit. It takes 87 orbits of OCO-2, 16 days, to sample the full Earth and there is a gap of 16 days between measurements of any location. There is a need for global sampling of CO_2 on a daily basis, even if that sampling has poorer ground resolution.

GeoCarb—Measuring Both Carbon Dioxide and Methane

The GeoCarb instrument, being developed by the University of Oklahoma, will be launched in 2022 and placed in geosynchronous orbit, giving it the ability to image North and South America every day, from the equator to 50° latitude (north and south), at a resolution of 5 to 10 km (lower resolution at higher latitudes). In addition to measuring the three bands used by OCO-2 and OCO-3, GeoCarb will also measure the carbon monoxide (CO) and methane (CH_4) bands near 2.323 µm.

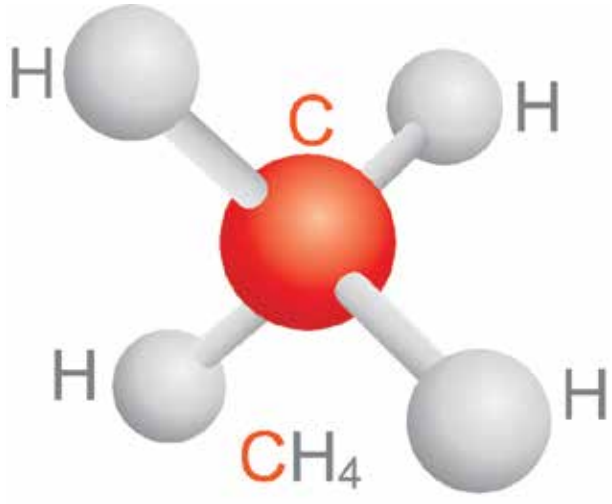
Methane is up to 80 times more efficient than carbon dioxide in trapping heat from the Earth and the increasing amount of methane in the atmosphere is of great interest to climate scientists.

GeoCarb is using the Teledyne's H1RG visible-infrared focal plane arrays (FPAs) in the mission's four spectrometers.

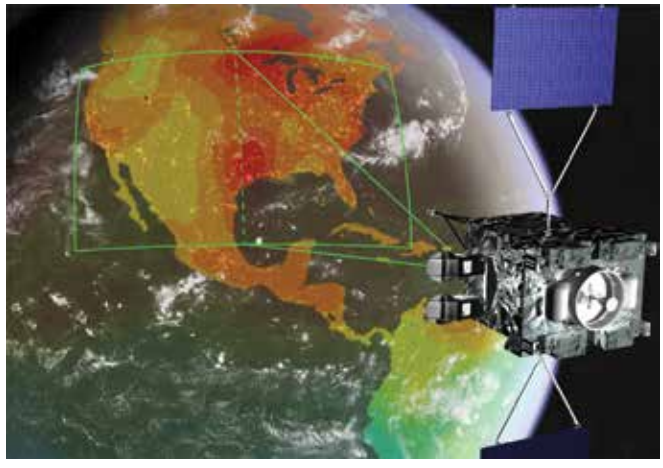


Credit: NASA / JPL–Caltech

Above: *This global map of atmospheric carbon dioxide released by OCO-2 mission shows elevated carbon dioxide concentrations across the southern hemisphere from springtime biomass burning.*



Methane: *Composed of a carbon atom and four hydrogen atoms, methane (CH_4) has more vibrational modes which makes it much more efficient than CO_2 at absorbing thermal radiation. The amount of methane in the Earth's atmosphere is increasing, but the sources and sinks of methane are not well understood.*



Credit: NASA/U. Oklahoma

Above: *Artist concept of the GeoCarb instrument on board an SES communication satellite at geosynchronous orbit above the Americas. It is fortuitous that South America is east of North America, enabling GeoCarb to make a complete scan of South America before the Sun illuminates North America.*

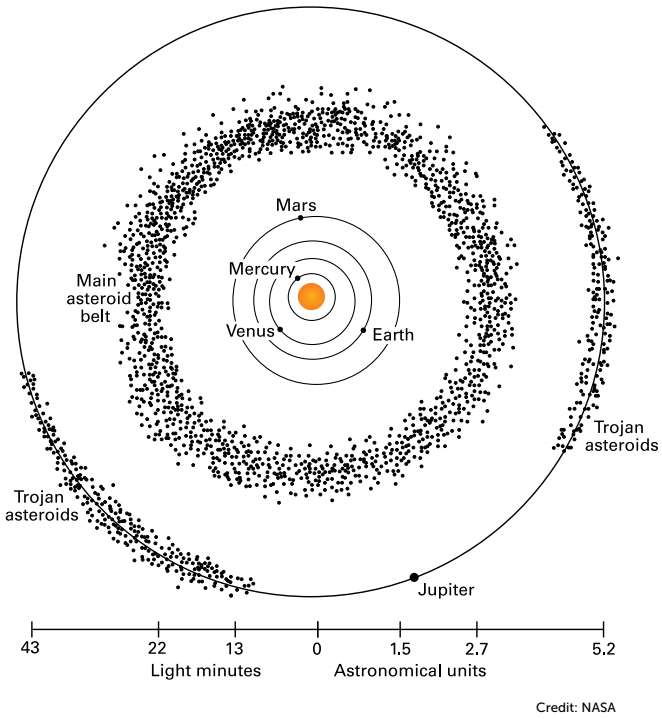
Asteroids — Time Capsules of the Solar System

4.6 billion years ago, the Solar System formed from a large cloud of gas and dust. Most of the material, between 99.8% and 99.9%, was gravitationally condensed into the Sun. Two-thirds of the remaining mass coalesced into Jupiter. Most of the remainder coalesced into the other planets with a small amount left over that formed into asteroids and comets. Asteroids are small rocky bodies whereas comets are composed of dust, rocks, and ice; comets are sometimes referred to as "dirty snowballs". Asteroids are defined as being at least 1 meter diameter with smaller objects called meteoroids (see nomenclature definitions on the next page). The largest asteroid, Ceres, with mean diameter of 953 km, is 28% of the diameter of the Moon.

Most asteroids reside in the main asteroid belt located between the orbits of Mars and Jupiter, with some asteroids trapped by Jupiter's gravity in the same orbit as Jupiter, in the vicinity of Lagrange points L4 and L5 that are 60 degrees ahead and behind Jupiter. These asteroids are referred to as Jupiter's Trojan asteroids. Sometimes the orbit of an asteroid in the main belt will get perturbed by the gravitational attraction of other asteroids or by the planets which causes the asteroid to fly in closer to the Sun becoming a Near Earth Asteroid. Any asteroid that crosses the Earth's orbital path is referred to as an "Earth-crosser" and if the asteroid gets within 0.05 AU*, it is referred to as a Potentially Hazardous Asteroid (PHA).

**An AU (astronomical unit) is the Sun-Earth distance: 150 million km.*

APPROXIMATE NUMBER OF ASTEROIDS (N) LARGER THAN A CERTAIN DIAMETER (D)														
D	0.1 km	0.3 km	0.5 km	1 km	3 km	5 km	10 km	30 km	50 km	100 km	200 km	300 km	500 km	900 km
N	25,000,000	4,000,000	2,000,000	750,000	200,000	90,000	10,000	1,100	600	200	30	5	3	1



Above: *Most asteroids reside in the main asteroid belt with the Trojan asteroids in the orbit of Jupiter.*

There are millions of asteroids in the Solar System but as recently as 1989, only 10,000 asteroids had been discovered. During the past three decades, astronomers have used charge-coupled device or CCD-based survey cameras on ground-based telescopes to discover about 800,000 asteroids. Scientists estimate that the asteroid belt contains about 2 million asteroids larger than 500 meters in diameter, and over 20 million smaller ones. Near-Earth asteroids are being discovered on a daily basis—there are now over 15,000 known, with about 1,000 that are at least 1 km in diameter.

An estimate of the number of asteroids as a function of size is given in the table above.

Asteroids and comets are too small to have evolved since their formation. Asteroids do not have active geology such as plate tectonics or volcanoes, and the asteroid mass is too small to accumulate an atmosphere with weather that would change the surface. Asteroids are time capsules of the materials that formed the solar system 4.6 billion years ago. The next section presents the OSIRIS-REx mission that is presently orbiting an asteroid and will retrieve a sample in Summer 2020 to return to Earth in 2023.

NOMENCLATURE

- **Asteroid:** a small rocky object that orbits the Sun which is at least 1 meter in diameter. The three broad composition classes of asteroids are C-, S-, and M-types.
  - **C-type** (carbonaceous) asteroids are the most common variety, forming about 75% of known asteroids. They have very low albedo (reflectivity) of 3% to 10% — they are very dark because their composition includes a large amount of carbon in addition to rocks and minerals.
  - **S-type** ("stony") asteroids are made of silicate materials and nickel-iron. Approximately 17% of known asteroids are S-type.
  - **M-types** asteroids are metallic (nickel-iron).
- **Comet:** objects made of dust, rocks, and ice that orbit the Sun. Each comet has a small frozen nucleus, often no larger than a few kilometers across. The nucleus contains icy chunks, frozen gases with bits of embedded dust. A comet warms up as it nears the Sun and develops a coma which gets larger as the comet nears the Sun. The coma may extend hundreds of thousands of kilometers. The pressure of sunlight and high-speed solar particles from the Sun (solar wind) blow the coma dust and gas away from the Sun, sometimes forming a long, bright tail. Comets actually have two tails—a dust tail and an ion (gas) tail.
- **Meteoroid:** a small piece of an asteroid or comet that has broken off after a collision of two asteroids or dust evaporated from a comet, less than 1 meter in diameter.
- **Meteor:** a meteoroid that enters the Earth's atmosphere and vaporizes, colloquially referred to as "shooting stars". What is seen is the air that is heated and energized by the meteor.
- **Meteorite:** the portions of meteors that survive passage through the Earth's atmosphere and land on the ground.
- **Regolith:** the layer of unconsolidated rocky material covering bedrock.

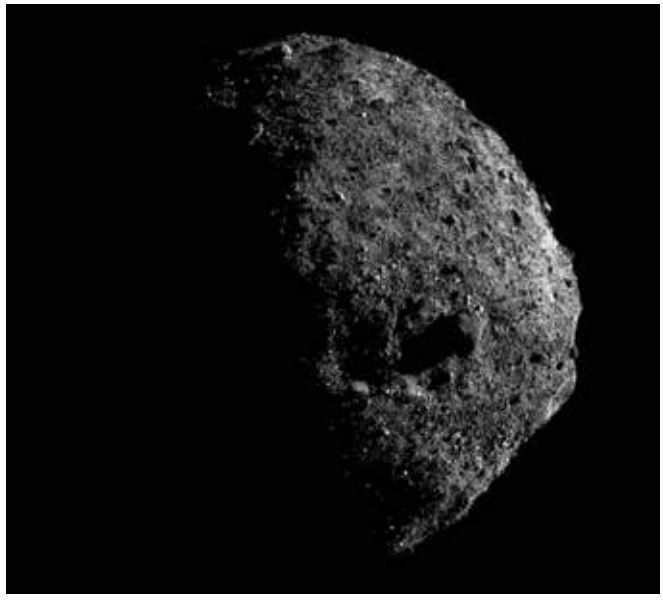
OSIRIS-REx Asteroid Sample Return Mission

NASA is conducting the OSIRIS-REx mission to study an asteroid and return a sample to the Earth for further study. OSIRIS-Rex (Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer) launched from the Kennedy Space Center (Florida) on September 8, 2016, and arrived at the asteroid 101955 Bennu on December 3, 2018. Bennu is a carbonaceous near-Earth asteroid that is 592 meters wide and is a Potentially Hazardous Asteroid (PHA), with a 1 in 2,700 chance of hitting the Earth between 2175 and 2199.

During January 2019 — June 2020, OSIRIS-REx will map and analyze Bennu's surface to identify the best area from which to retrieve a sample to bring back to Earth. The first sampling attempt is planned for August 2020. The mission has three opportunities to retrieve a good sample, with minimum success being 60 grams (2.1 ounces) of material but has the capability to retrieve up to 2.2 kg. OSIRIS-REx will depart Bennu in March 2021 and the sample capsule will land on September 24, 2023, at the U.S. Air Force Test and Training Range in Utah.

Teledyne has a major role in the instruments on OSIRIS-REx, providing the sensors for three of four science instruments:

- OCAMS (OSIRIS-REx Camera Suite): Teledyne's CCD detectors are used in these three visible light cameras that are producing most of the images that are shown of Bennu. OCAMS has mapped the entire asteroid surface and provided detailed imagery of the potential sample sites. One of the cameras will record the entire sampling event during the touch-and-go maneuver.
- OLA (OSIRIS-REx Laser Altimeter): Teledyne's scanning lidar (light detection and ranging) systems emit laser pulses and measure the light reflected from the surface. Precise measurement of the time between sending the outgoing pulse and the sensed return provides high resolution topography of the asteroid surface as shown in the image on page 20. The lidar measurements will enable the mission team to program the spacecraft to adjust its speed for the touch-and-go maneuver for sampling and to avoid collision with large boulders such as the 50 meter tall boulder shown in the image below. The OLA lidar system was provided by the Canadian Space Agency.
- OVIRS (OSIRIS-REx Visible and Infrared Spectrometer): This instrument measures nearly 1,300 colors of visible and infrared light spanning 0.4 to 4.3 μm wavelengths using a Teledyne H1RG detector that simultaneously detects visible and infrared light. Since every chemical and mineral has a unique spectral signature, OVIRS is providing spectral maps that identify mineral and organic material on the asteroid.

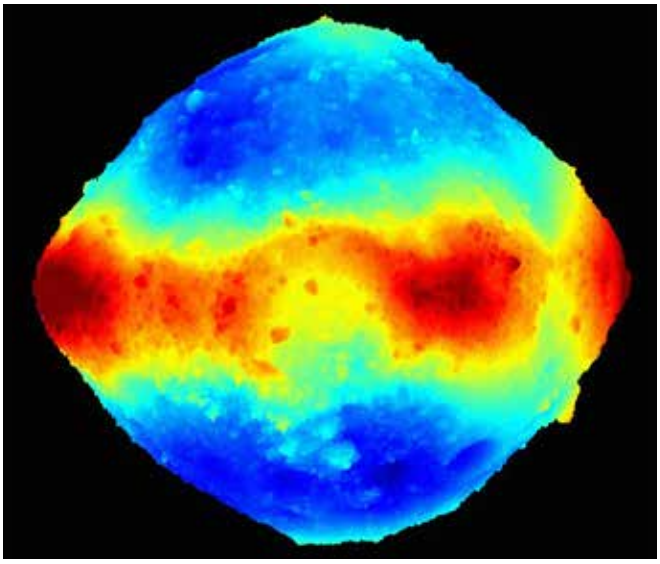


Credit: NASA/Goddard/University of Arizona

Above: *Visible light image of Bennu taken by a Teledyne CCD detector on January 17, 2019, from a distance of 1.6 km (1 mile). The images have been cropped and the contrast has been adjusted to better reveal surface features. The large boulder is about 50 meters (164 feet) across. Bennu is a very dark object with 4% albedo (reflectivity), similar to fresh asphalt or dark wet soil.*

An artist depiction of the OSIRIS-REx spacecraft is shown. The spacecraft is 2.4 meters long, 3.1 meters tall, and 6.2 meters wide (which includes the extended solar panels). OSIRIS-REx will not land on the asteroid but will collect regolith using the sample head that is on the articulated 3.35 meter long arm, shown extended to bottom left.

Credit: NASA/Goddard Space Flight Center Conceptual Image Lab



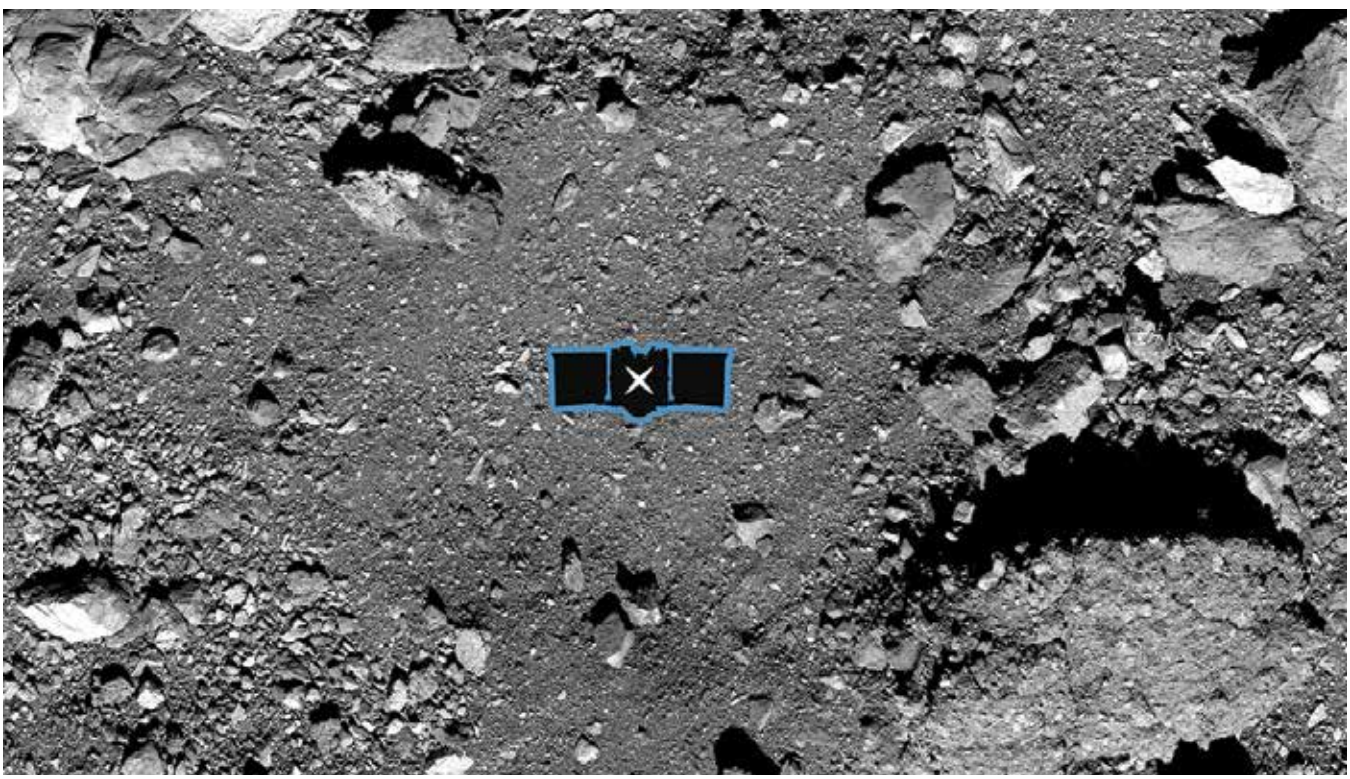
Credit: NASA/University of Arizona/CSA/York/MDA

Above: *Three-dimensional view of Bennu created by the OSIRIS-REx Laser Altimeter (OLA) that uses Teledyne's lidar system. OLA made over 10 million measurements of the distance between the spacecraft and Bennu. This image converts those measurements to surface height of Bennu. The colors represent the distance from the center of Bennu: dark blue areas lie approximately 60 meters (197 feet) lower than peaks indicated in red.*

The combination of information from OCAMS, OLA, and OVIRS was used to select the site to sample the asteroid. In December 2019, NASA announced that the primary site for sampling Bennu will be a location that has been named Nightingale.

The image below shows OSIRIS-REx primary sample collection site on asteroid Bennu. The image is overlaid with a graphic of the OSIRIS-REx spacecraft to illustrate scale. The Nightingale site is a tight fit, since the accessible portion of the crater is only about 20 meters wide, a bit more than three times the width of the spacecraft (in the solar panel direction). In addition, the large rock shown at lower right of the image rises 10 meters above the crater floor.

Because Nightingale is located near the north pole of the asteroid, temperatures in the region are lower than elsewhere on the asteroid and the surface material is well-preserved. Scientists estimate that the Nightingale crater is relatively young, and the regolith (rocky surface material) is "recently" exposed which means that the sample collected will be pristine, with minimal alteration by the solar wind or space radiation.



Credit: NASA/Goddard/University of Arizona

Above: *Nightingale sample site on asteroid Bennu.*

Board of Directors











Top Images Left to Right:

ROXANNE S. AUSTIN [2][3]
President, Austin Investment Advisors
Former President and Chief Operating Officer of DIRECTV, Inc.

DENISE CADE [1][2]
Senior Vice President, General Counsel and Corporate Secretary of IDEX Corporation

CHARLES CROCKER [2][3]
Chairman of the Board and Chief Executive Officer, Crocker Capital
Retired Chairman of the Board and Chief Executive Officer, BEI Technologies, Inc.

KENNETH C. DAHLBERG [1][3]
Retired Chairman of the Board and Chief Executive Officer, Science Applications International Corporation (SAIC)

SIMON M. LORNE [1][2]
Vice Chairman of the Board and Chief Legal Officer, Millennium Management LLC
Former General Counsel, U.S. Securities and Exchange Commission

ROBERT A. MALONE [1][3]
Executive Chairman of the Board, President and Chief Executive Officer, First Sonora Bancshares, Inc.
Retired Chairman of the Board and President, BP America Inc.

Lower Images Left to Right:

ROBERT MEHRABIAN
Executive Chairman,
Teledyne Technologies Incorporated

PAUL D. MILLER [1][2]
Retired Chairman of the Board and Chief Executive Officer, Alliant Techsystems, Inc.
Commander-in-Chief, U.S. Atlantic Command and NATO Supreme Allied Commander — Atlantic (Retired)

WESLEY W. VON SCHACK [2][3]
Chairman of the Board, AEGIS Insurance Services
Former Chairman of the Board, President and Chief Executive Officer, Energy East Corporation

JANE C. SHERBURNE [1][3]
Principal of Sherburne PLLC
Former Senior Executive Vice President, General Counsel and Corporate Secretary, The Bank of New York Mellon Corporation

MICHAEL T. SMITH [1][2][4]
Retired Chairman of the Board and Chief Executive Officer, Hughes Electronics Corporation

[1] Audit Committee
[2] Nominating and Governance Committee
[3] Personnel and Compensation Committee
[4] Lead Director

Executive Management

ALDO (AL) PICHELLI*
President and Chief Executive Officer

CARL ADAMS
Vice President, Business Risk Assurance

CYNTHIA Y. BELAK*
Vice President and Controller

VICKI BENNE
Group Vice President and General Manager, Environmental Instrumentation

STEPHEN F. BLACKWOOD*
Senior Vice President, Strategic Sourcing, Tax and Treasurer

GEORGE C. BOBB, III*
President, Aerospace and Defense Electronics Segment, and Vice President, Teledyne

MELANIE S. CIBIK*
Senior Vice President, General Counsel, Chief Compliance Officer and Secretary

JASON W. CONNELL
Vice President, Human Resources and Associate General Counsel

JANICE L. HESS
President, Engineered Systems Segment

SCOTT HUDSON
Vice President and Chief Information Officer

SUSAN L. MAIN*
Senior Vice President and Chief Financial Officer

ROBERT MEHRABIAN*
Executive Chairman

SEAN O'CONNOR
Chief Operating Officer and Chief Financial Officer, Environmental & Electronic Measurement Instrumentation

KEVIN PRUSSO
Group Vice President and General Manager, Test & Measurement Instrumentation

MIKE R. READ
President, Teledyne Marine Group

EDWIN ROKS*
President, Teledyne Digital Imaging and Vice President, Teledyne

GLENN SEEMANN
Vice President, Contracts

JASON VANWEES*
Executive Vice President

* Section 16 Officer

Stockholder Information

CORPORATE OFFICES
Teledyne Technologies Incorporated
1049 Camino Dos Rios
Thousand Oaks, CA 91360
Telephone: (805) 373-4545
Fax: (805) 373-4775
www.teledyne.com

TRANSFER AGENT AND REGISTRAR
Computershare
P.O. BOX 505000
Louisville, KY 40233-5000
Customer Service: 1-888-540-9867
computershare.com

STOCKHOLDER PUBLICATIONS — FORM 10-K
Information on how to access Annual Reports (including Form 10-K) and proxy statements is mailed to all stockholders of record. Copies of our SEC periodic reports, corporate governance guidelines, code of ethics and committee charters are also available on our website at www.teledyne.com. For additional information, contact Investor Relations.

STOCK EXCHANGE LISTING
The common stock of Teledyne Technologies Incorporated is traded on the New York Stock Exchange (symbol TDY).

ANNUAL MEETING
The Annual Meeting of Stockholders will be held on Wednesday, April 22, 2020, at 9:00 a.m. PDT, at Teledyne Technologies Incorporated, 1049 Camino Dos Rios, Thousand Oaks, CA 91360.

INDEPENDENT AUDITORS
Deloitte & Touche LLP
Los Angeles, California

CURRENT NEWS AND GENERAL INFORMATION
Information about Teledyne is available at www.teledyne.com.

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

FORM 10-K

(Mark One)

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

For the fiscal year ended December 29, 2019
OR

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

For the transition period from _____ to ____
Commission file number 1-15295

TELEDYNE TECHNOLOGIES INCORPORATED

(Exact name of registrant as specified in its charter)

Delaware	25-1843385
(State or other jurisdiction of incorporation of organization)	(I.R.S. Employer Identification Number)
1049 Camino Dos Rios Thousand Oaks California	91360-2362
(Address of principal executive offices)	(Zip Code)

Registrant's telephone number, including area code: (805)-373-4545
Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Trading Symbol(s)	Name of each exchange on which registered
Common Stock, par value $.01 per share	TDY	New York Stock Exchange

Securities registered pursuant to Section 12(g) of the Act: None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ☒ No ☐

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes ☐ No ☒

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

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

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

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

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

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

As of June 28, 2019, the aggregate market value of Common Stock (based upon closing price of the stock on the New York Stock Exchange) of the registrant held by non-affiliates was approximately $9.7 billion.

At February 19, 2020, there were 36,630,917 shares of the registrant's Common Stock outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's proxy statement to be filed subsequently with the Securities and Exchange Commission pursuant to Regulation 14A for the 2020 Annual Meeting of Shareholders are incorporated by reference in Part III of this Report on Form 10-K. Except as expressly incorporated by reference, the registrant's proxy statement shall not be deemed to be part of this report.

INDEX

Explanatory Notes

In this Annual Report on Form 10-K, Teledyne Technologies Incorporated is sometimes referred to as the "Company" or "Teledyne".

For a discussion of risk factors and uncertainties associated with Teledyne and any forward looking statements made by us, see the discussion beginning on page 14 of this Annual Report on Form 10-K.

PART I

Item 1. Business

Who We Are

Teledyne Technologies Incorporated provides enabling technologies for industrial growth markets that require advanced technology and high reliability. These markets include aerospace and defense, factory automation, air and water quality environmental monitoring, electronics design and development, oceanographic research, deepwater oil and gas exploration and production, medical imaging and pharmaceutical research. Our products include digital imaging sensors, cameras and systems within the visible, infrared and X-ray spectra, monitoring and control instrumentation for marine and environmental applications, harsh environment interconnects, electronic test and measurement equipment, aircraft information management systems, and defense electronics and satellite communication subsystems. We also supply engineered systems for defense, space, environmental and energy applications. We differentiate ourselves from many of our direct competitors by having a customer and company-sponsored applied research center that augments our product development expertise.

Our principal executive offices are located at 1049 Camino Dos Rios, Thousand Oaks, California 91360-2362. Our telephone number is (805) 373-4545. Our website address is www.teledyne.com. We are a Delaware corporation that was spun-off as an independent company on November 29, 1999.

Strategy

Our strategy continues to emphasize growth in our core markets of instrumentation, digital imaging, aerospace and defense electronics and engineered systems. Our core markets are characterized by high barriers to entry and include specialized products and services not likely to be commoditized. We intend to strengthen and expand our core businesses with targeted acquisitions and through product development. We continue to focus on balanced and disciplined capital deployment among capital expenditures, product development, acquisitions and share repurchases. We aggressively pursue operational excellence to continually improve our margins and earnings by emphasizing cost containment and cost reductions in all aspects of our business. At Teledyne, operational excellence includes the rapid integration of the businesses we acquire. Using complementary technology across our businesses and internal research and development, we seek to create new products to grow our company and expand our addressable markets. We continue to evaluate our businesses to ensure that they are aligned with our strategy.

Our Recent Acquisitions

Consistent with our strategy, during 2019, 2018 and 2017, we made acquisitions and investments totaling $1,261.2 million, net of cash acquired. Our 2019 and 2017 acquisitions, as well as our most recent 2020 acquisition, include the following:

2020 Acquisition

To extend our protocol test solution and products to the electronic storage industry and data centers:

OakGate Technology, Inc., based in Loomis, California, a provider of software and hardware designed to test electronic data storage devices from development through manufacturing and end-use applications. We paid $28.0 million, net of cash acquired.

2019 Acquisitions

To expand our range of digital imaging capabilities for life sciences, academic research and customized original equipment manufacturer ("OEM") industrial imaging solutions:

Scientific imaging businesses of Roper Technologies, Inc., principally located in the United States and Canada and including Princeton Instruments, Photometrics and Lumenera. Princeton Instruments and Photometrics manufacture state-of-the-art cameras, spectrographs and optics for advanced research in physical sciences, life sciences research and spectroscopy imaging. Applications and markets include materials analysis, quantum technology and cell biology imaging using fluorescence and chemiluminescence. Lumenera primarily provides rugged USB-based customized cameras for markets such as traffic management, as well as life sciences applications. We paid $224.8 million for these scientific camera businesses, net of cash acquired.

To add complementary industrial gas and flame detection capabilities to our environmental instrumentation businesses:

Gas and flame detection businesses of 3M Company, primarily located in France, the United Kingdom and the United States and including Oldham, Simtronics, Gas Measurement Instruments, Detcon and select Scott Safety products. The gas and flame detection business provides a portfolio of fixed and portable industrial gas and flame detection instruments used in a variety of industries including petrochemical, power generation, oil and gas, food and beverage, mining and waste water treatment. The rugged gas analyzers feature fast response time, intrinsically safe sensors and satisfy multiple international certification standards. We paid $233.5 million for these gas and flame detection businesses, net of cash acquired.

To expand our digital imaging foundry capacity and capabilities for biotech applications:

Micralyne Inc., ("Micralyne") based in Edmonton, Alberta, Canada, a foundry providing micro electromechanical systems ("MEMS") devices. In particular, Micralyne possesses unique microfluidic technology for biotech applications, as well as capabilities in non-silicon-based MEMS (e.g., gold, polymers) often required for human body compatibility. We paid $25.7 million for Micralyne, net of cash acquired.

2017 Acquisitions:

To expand our digital imaging, space science, semiconductor and microwave solutions capabilities:

e2v technologies plc ("e2v") principally located in Chelmsford, United Kingdom and Grenoble, France, which provides high performance image sensors and custom camera solutions and application specific standard products for the machine vision market. In addition, e2v provides high performance space qualified imaging sensors and arrays for space science and astronomy. e2v also produces components and subsystems that deliver high reliability radio frequency power generation for healthcare, industrial and defense applications. Finally, the company provides high reliability semiconductors and board-level solutions for use in aerospace, space and communications applications. We paid $740.6 million for e2v, net of cash acquired.

To expand our environmental and laboratory instrumentation capabilities:

Assets of Scientific Systems, Inc. ("SSI"), located in State College, PA, which manufactures precision components and specialized subassemblies used primarily in analytical and diagnostic instrumentation, such as high performance liquid chromatography systems and specific medical devices. We paid $31.3 million for SSI.

Our Business Segments

Our businesses are aligned in four segments: Instrumentation, Digital Imaging, Aerospace and Defense Electronics and Engineered Systems. Financial information about our business segments can be found in Note 12 of the Notes to Consolidated Financial Statements in this Annual Report on Form 10-K.

Instrumentation

Our Instrumentation segment provides monitoring and control instruments for marine, environmental, industrial and other applications, as well as electronic test and measurement equipment. We also provide power and communications connectivity devices for distributed instrumentation systems and sensor networks deployed in mission critical, harsh environments.

Marine Instrumentation

We offer a variety of products designed for use in harsh underwater environments, instruments that measure currents and other physical properties in the water column, systems that create acoustic images of objects beneath the water's surface, including the bottom of a body of water, and sensors that determine the geologic structure below the bottom. We also design and manufacture vehicles that utilize and transport these sensors over and beneath the water's surface.

We design and manufacture geophysical streamer cables, hydrophones, seismic energy sources and specialty products used in offshore hydrocarbon exploration to locate oil and gas reserves beneath the ocean floor. Our Acoustic Doppler Current Profilers ("ADCPs") precisely measure currents at varying depths in oceans and rivers, and our Doppler Velocity Logs ("DVLs") are used for navigation by civilian and military surface ships, unmanned underwater vehicles and naval divers. We design and manufacture inertial sensing and navigation products, as well as subsea pipe and cable detection systems for offshore energy, oceanographic and military marine markets. We also design and manufacture remotely controlled and tethered instrumentation deployment vehicles used for current measurement, seafloor mapping and measurement of physical parameters such as salinity.

Additionally, we design and manufacture single and multibeam hydrographic survey instrumentation used in port surveys, dredging, pre- and post-installation of offshore energy infrastructure and other challenging underwater applications. Our multibeam sonar systems range from portable high-resolution systems used on tripods, autonomous and remotely operated underwater vehicles ("AUVs" and "ROVs") to full ocean depth vessel-mounted oceanographic systems as well as sub bottom profilers that can survey structures beneath the seafloor. Our multibeam sonar systems can be used to create highly accurate maps of underwater offshore constructions, wrecks or quay walls in harbors, and in particular, high-quality maps of the seafloor. Our products are being utilized in both commercial and defense applications where we provide systems for detecting mines in the water. We provide solutions that are ready-to-operate and fully installed, including a comprehensive software package that ties together the variety of sensors that may be configured on an AUV or ROV platform.

We provide a broad range of end-to-end undersea interconnect solutions to the offshore oil and gas, naval defense, oceanographic and telecom markets. We manufacture subsea, wet-mateable electrical and fiber-optic interconnect systems and subsea pressure vessel penetrators and connector systems with glass-to-metal seals. Our waterproof and splash-proof neoprene and glass reinforced epoxy connectors and cable assemblies are used in underwater equipment and submerged monitoring systems. Our Teledyne Marine group and Teledyne Scientific Company continue to work collaboratively to improve the

reliability of materials exposed to ultra-deep-sea conditions. We also manufacture rugged cable assemblies for land-based energy and other industrial applications.

Other marine products used by the U.S. Navy and commercial customers include acoustic modems for networked underwater communication and optical underwater cameras and LED lighting sources.

We manufacture complete AUV systems. Our marine gliders use a silent buoyancy engine for propulsion that takes advantage of changes in buoyancy in conjunction with wings and tail steering to convert vertical motion to horizontal displacement, thereby propelling the system on a programmed route with low power consumption. Glider applications range from oceanographic research to persistent surveillance systems for the U.S. Navy. The modular design of our battery-powered, man-portable Gavia™ AUV allows for rapid sensor bay reconfiguration and battery replacement capability. Our SeaRaptor™ AUV will permit deep water survey with operational depths of 6000 meters. Our Slocum® gliders, as well as our ADCPs, are being used as part of the National Science Foundation's Ocean Observatories Initiative to collect physical, chemical, geological and biological data from the ocean and the seafloor on coastal, regional and global scales. We design and manufacture Inspection Class ROVs used in maritime security, military, search and rescue, aquaculture, and scientific research applications.

Using our acoustic technology, we also provide quality control and package integrity systems under the Taptone® brand to the food and beverage, personal care and pharmaceutical industries.

Environmental Instrumentation

We offer a wide range of products used for environmental monitoring, instruments that enable measurement and monitoring of key air environmental parameters as well as gas purity and content for industrial and manufacturing applications, sensors for the measurement and monitoring of the physical and chemical properties of untreated water, and laboratory systems that improve sample acquisition, handling and preparation for analysis. We also provide instruments to measure toxic and combustible gases for personnel and site safety.

Our instrumentation monitors trace levels of gases such as sulfur dioxide, carbon monoxide, oxides of nitrogen and ozone, as well as particulate pollution, in order to measure the quality of the air we breathe. We also supply monitoring systems for the detection, measurement and automated reporting of air pollutants from industrial stack emissions, ozone generators and other process gas monitoring instruments. We serve the process control and monitoring needs of industrial plants with instruments that include gas analyzers, and vacuum and flow measurement devices. We were a pioneer in the development of precision trace oxygen analyzers, and we now manufacture a wide range of process gas and liquid analysis products for the measurement of process contaminants, hydrocarbons, combustibles, oil-in-water, moisture, pH and many other parameters. Our instrumentation is also used to detect a variety of water quality parameters. Our sampler products include portable, refrigerated and specialty samplers used in hazardous location applications and water samplers that utilize both peristatic and vacuum technologies. Flow meters include ultrasonic, submerged probe, bubbler and area velocity models. Laser technology is now part of our flow capabilities. Our custom analyzer systems provide turn-key solutions to complex process monitoring and/or control applications found in petrochemical and refinery facilities.

We provide laboratory instrumentation that complements our process or field environmental instrumentation. We manufacture laboratory instrumentation that automates the preparation and concentration of organic samples for the analysis of trace levels of volatile organic compounds by a gas chromatograph and mass spectrometer. We also provide laboratory instrumentation for the detection of total organic carbon and total nitrogen in water and wastewater samples. In addition, we provide inductively coupled plasma laboratory spectrometers, atomic absorption spectrometers, mercury analyzers and calibration standards. We provide laboratory automation and sample introduction systems. Our advanced elemental analysis products are used by environmental and quality control laboratories to detect trace levels of inorganic contaminants in water, foods, soils and other environmental and geological samples. Our high-precision, high pressure syringe pumps measure process extraction rates of fluids ranging from liquefied gases to viscous tars. We manufacture and sell positive-displacement piston pumps utilized in a wide variety of analytical, clinical, preparative and fluid-metering applications. In addition, we manufacture liquid chromatography instruments and accessories for the purification of organic compounds, which include highly sensitive evaporative light scanning detectors. Our liquid chromatography customers include pharmaceutical laboratories involved in drug discovery and development. Finally, we manufacture instruments that are used by pharmaceutical scientists to evaluate the release rate characteristics and physical properties of various dosage forms to ensure the safety and efficacy of medicines worldwide.

As a result of a 2019 acquisition, we manufacture a wide range of gas detection and measurement instruments, both portable and fixed installation, to monitor toxic gases such as hydrogen sulfide and chlorine and to detect combustible gases. These instruments are used at industrial sites such as paper mills and automobile factories as well as in the oil and gas sector at refineries. In addition, utility companies for natural gas and water supply use portable instruments to ensure the safety of their technicians.

Test and Measurement Instrumentation

We develop, manufacture, sell and license high-performance oscilloscopes and high-speed protocol analyzers for various communication links. We also provide related test and measurement equipment, probes, accessories and application solutions. With these additional capabilities, we are able to configure our platforms to provide high-value-testing solutions for customers, developing products in all industry sectors, that rely on increasingly complex electronic signals. To a lesser extent, we provide extended warranty contracts, maintenance contracts and repairs and calibrations on our instruments after their warranties expire.

We believe our test and measurement products provide unique, world-class capabilities that enable the designers of complex electronic systems in many industry sectors to bring their products to market reliably and quickly. Our customers use our equipment in the design, development, manufacture, installation, deployment and operation of electronics equipment in broad range of industry end markets, including aerospace and defense, internet infrastructure, automotive, industrial, computer and semiconductor, consumer electronics and power electronics.

Our oscilloscopes are tools used by designers and engineers to measure and analyze complex electronic signals in order to develop high-performance systems, validate electronic designs and improve time to market. We offer a broad range of real-time oscilloscopes addressing different end user needs. Our five high-definition oscilloscope ("HD") product families address needs from the lower-bandwidth bench top sector to the mid-range general-purpose sector of the market. The HD families offer superior signal fidelity for the ultimate in measurement accuracy and repeatability. Our LabMaster and WaveMaster product families are industry leading high-end oscilloscopes with bandwidths extending to 65GHz. Our WaveProHD product family covers the mid-to high-range performance and the WaveRunner product family covers the mid-range performance and general purpose and bench-top sector. Our WaveSurfer product-line is designed for users in the lower bandwidth bench-top sector of the market and value-oriented users in the economy sector. We also make high-speed, high-resolution modular analog-to-digital conversion systems. These systems are used in many applications including test and measurement, medical imaging, Light Detection and Ranging ("LIDAR") and software defined radio. We recently introduced the WavePulser, using Teledyne InP technology which enables hardware designers and test engineers to characterize and analyze interconnects and cables for high-speed serial protocols such as PCI Express, HDMI, USB, SAS, SATA, Fibre Channel, InfiniBand, Gigabit Ethernet and Automotive Ethernet.

Design and test engineers use our protocol analysis solutions to monitor accurately and reliably high data-rate communication interfaces and diagnose operational problems in a wide range of systems and devices to ensure that they comply with industry standards, including the area of Cloud computing and networks, where PCI Express and related standards are required for high performance data centers. Our protocol test portfolio also covers wireless technologies, including Bluetooth and 802.11 (Wi-Fi), and modern video technologies, such as HDMI and DisplayPort. Both product lines, along with our leadership in USB technology, provide a unique base to service the mobile, internet of things, automotive and consumer electronics test market. Our most recent acquisition of OakGate Technology, Inc. provides protocol validation and test tools for disk drives, both spinning and solid state, and servers used for cloud-based storage.

We also manufacture torque sensors and automatic data acquisition systems that are used to test critical control valves in nuclear power and industrial plants. Our torque sensors are also used in other markets, including automotive and power tools.

Digital Imaging

Our Digital Imaging segment includes high-performance sensors, cameras and systems, within the visible, infrared, ultraviolet and X-ray spectra for use in industrial, government and medical applications, as well as MEMS and high-performance, high-reliability semiconductors including analog-to-digital and digital-to-analog converters. In 2019, we acquired a second MEMS foundry that specializes in BioMedical MEMS, Optical MEMS, industrial sensors and microfabrication. This segment also includes our sponsored and centralized research laboratories benefiting government programs and businesses.

We design, develop and manufacture image capture products, primarily consisting of high-performance image sensors and digital cameras for use in industrial, scientific, academic research and medical applications. We also design, develop and manufacture image processing products, primarily consisting of hardware and software for image processing and automatic data collection in industrial, academic research and medical applications. We develop high-resolution, low-dose X-ray sensors for medical, dental and industrial applications. Our high-performance image sensors utilize both charge coupled device ("CCD") and complementary metal-oxide semiconductor ("CMOS") technology. In particular, our CMOS image sensing technology is used in our large flat panel detectors for X-ray imaging and in most of our sensors used for industrial machine vision applications. Our image processing software allows OEMs and systems integrators to develop vision applications using our image acquisition and processing hardware. Our smart camera products are user-friendly, cost-effective vision appliances for task-specific factory floor applications such as gauging, high-precision alignment, inspection, assembly verification and machine guidance. Our smart cameras are designed to be quickly deployed by technicians on the factory floor. We provide lightweight X-ray sources for the inspection of materials and structures and for the analysis of suspicious objects. We design and manufacture 3D time of flight sensors and modules for industrial robots, warehouse robots and ADAS (Advanced Driver Assistance Systems) for automobiles. Through our 2019 acquisition of the scientific imaging businesses of Roper Technologies, Inc., we manufacture state-of-the-art cameras, spectrographs and optics for advanced research in physical sciences, life sciences research and spectroscopy imaging for applications and markets that include materials analysis, quantum

technology and cell biology imaging using fluorescence and chemiluminescence. We also provide rugged USB-based customized cameras for markets such as traffic management, as well as life sciences applications.

We produce and provide manufacturing services for MEMS. The majority of our semiconductor manufacturing capacity is consumed by external customers with the remaining capacity applied towards supplying unique CCD and microbolometer (for long-wave infrared detection) fabrication services for our internal image sensor requirements.

Additionally, we produce components and sub-systems that deliver high performance and high reliability radio frequency power generation for healthcare, transportation and industrial applications. Such products include critical components used in radiotherapy applications for cancer treatment, magnetrons and thyratrons for X-ray cargo scanning systems and microwave sources for marine and airborne radar.

We also provide high performance semiconductors, sub-systems, and signal and data processing solutions. As a partner of choice for high performance signal and data conditioning solutions for professional applications, we provide solutions that meet the demanding specifications of our customers. Our design capability enables us to partner with customers and ascend the value chain by providing multi-chip modules and boards. Our proprietary high-speed analog-to-digital and digital-to-analog data converters provide market leading performance for space and radio frequency communications.

We provide space and quantum technology products and services, including space-qualified imaging and quantum subsystems, radiation hardened imaging sensors for high radiation and space environments, cold atom quantum technology devices and system development services. We also provide atomic clocks and gravity sensing and ground based astronomical telescope sensors and subsystems.

In addition, our Digital Imaging segment provides LIDAR systems for airborne terrestrial mapping, mobile mapping, bathymetry and laser-based 3D imaging applications through our Optech business. These imaging and mapping systems are used by commercial and government customers serving energy, natural resources and infrastructure applications. We also provide geospatial software designed for the hydrographic and marine community.

We provide research and engineering capabilities primarily in the areas of electronics, materials, optical systems, and information science to military, aerospace and industrial customers, as well as to various businesses throughout Teledyne. We receive funding from the Defense Advanced Research Products Agency ("DARPA") and various other U.S. Department of Defense funding agencies, and we collaborate with researchers at universities and national laboratories to stay at the forefront of emerging technologies. We have developed high-speed electronics, precision timing and navigation devices, advanced functional and structural materials, liquid-crystal based optical devices, and image processing algorithms.

We are a leader in the development and production of large format focal plane array sensors for astronomy, defense and space science markets. Our advanced focal plane arrays, sensors, and subsystems cover a broad spectrum of frequencies from X-ray wavelengths to 15 micron long-wave infrared wavelengths. We deliver advanced imaging solutions to the U.S. Department of Defense, National Aeronautics and Space Administration ("NASA"), the European Space Agency ("ESA"), prime system integrators, other foreign space agencies and commercial customers. Our sensor technologies are on many of NASA's major astronomy missions and can be found operating at nearly every major ground-based observatory telescope. Our image sensors also play a critical role in defense applications in airborne and satellite systems. We have developed sensors, subassemblies and cameras for air- and ground-based applications, including hyperspectral sensors for long-wave infrared and for simultaneous visible-shortwave infrared applications. We also produce a wide variety of infrared photodiodes for the commercial market. Our photodiodes are used in laboratory instrumentation and industrial equipment. In addition, we design and manufacture advanced military laser eye protection spectacles and sensor protection filters.

Aerospace and Defense Electronics

Our Aerospace and Defense Electronics segment provides sophisticated electronic components and subsystems and communications products, including defense electronics, harsh environment interconnects, data acquisition and communications equipment for aircraft, and components and subsystems for wireless and satellite communications, as well as general aviation batteries.

We provide a range of microwave products to our customers ranging from components to highly integrated subsystems and solutions. Our helix traveling wave tubes, commonly called TWTs, are used to provide broadband power amplification of microwave signals. Military applications include radar, electronic warfare and satellite communication. We make TWTs for commercial applications as well, such as electromagnetic compatibility test equipment and satellite communication terminals. We also provide high-power solid-state TWT replacement amplifiers and complete amplifiers that incorporate a TWT and a power supply.

We design and manufacture solid state radio frequency ("RF") and microwave components and subassemblies used in a wide variety of applications. As components which form the building blocks for electronic systems, we produce amplifiers, voltage-controlled oscillators, YIGs, BAWs, low-noise amplifiers ("LNAs"), microwave mixers, and detectors using LDMOS, GaAs, GaN, and SiC technologies. These components form the basis for our line of solid state power amplifiers, RF converters, and modems which are used in systems that provide communications links between ground stations, mobile units,

UAVs, and orbiting satellites. Such products are also used in TV broadcast and commercial data communications networks. In addition, we also provide higher level microwave subsystems and systems for electronic warfare, UAV, radar and military communication applications.

We supply a variety of connectors and cable assemblies, including specialized high voltage connectors and subassemblies and coax microwave interconnects, for defense, aerospace and high-end industrial applications. Additionally, we produce pilot helmet mounted display quick disconnect harnesses for the Joint Helmet Mounted Cueing System ("JHMCS") used in the F-15, F-16 and F-18 aircrafts. The JHMCS system is a multi-role system designed to enhance pilot situational awareness and provides visual control of aircraft targeting systems and sensors. We manufacture microprocessor-controlled aircraft ejection seat sequencers and related support elements to military aircraft programs. We also provide initiators and electronic safe and arm devices for use in military applications.

We provide high performance, high reliability semiconductor solutions which address critical functions of the complete signal chain and RF signal path, including design, assembly and test, packaging, qualification and long-term support for customer's program life cycle management.

We supply electromechanical relays, solid state power relays and coaxial switching devices to military, aerospace and other industrial markets. Applications include microwave and wireless communication infrastructure, RF and general broadband test equipment, test equipment used in semiconductor manufacturing, and industrial and commercial machinery and control equipment. On commercial aircraft, our solid state and electromechanical relays are used in a variety of applications, including jet engine fuel control, management of control surfaces and other on-board applications.

We are a supplier of digital flight data acquisition and analysis systems to the civil aviation and military aircraft markets. These systems acquire data for use by the aircraft's flight data recorder as well as record additional data for the airline's operation. We provide the means to transfer this data, using Teledyne's wireless technology, from the aircraft to the airline operation center. We also design and manufacture airborne networking products, including servers, wireless access points and aircraft interface device software, as well as aircraft data loading equipment, flight data analysis software, and data distribution software used by commercial airlines and the U.S. military, and we provide services related to our products. We also provide lead acid aircraft batteries for general aviation, business and light jet, and U.S. military applications.

Engineered Systems

Our Engineered Systems segment provides innovative systems engineering and integration and advanced technology development as well as complex manufacturing solutions for defense, space, environmental and energy applications. This segment also designs and manufactures electrochemical energy systems and manufactures specialty electronics for demanding military applications.

Teledyne Brown Engineering, Inc. is a well-recognized engineering and manufacturing company providing advanced solutions across the whole lifecycle of systems in space, missile defense, maritime, environmental and energy markets.

We lead and support air and missile defense programs, including the Optical Signatures Code ("OSC") and Optical Signature In-Line Generator ("OPTISIG") tools for modeling, simulation and analysis of next-generation hypersonic weapons. In addition, our patent-pending test and evaluation solutions can enable ground test facilities to produce more effectively simulated conditions a hypersonic vehicle, engine or subsystem may encounter to include; temperature and time of flight. We are also the prime contractor for the Extended Air Defense Simulation ("EADSIM") contract providing analysis, training, test, and operational planning in a single integrated package for the U. S. Army Space and Missile Defense Command ("SMDC"). Under the Naval Health Research contract, we provide medical modeling and simulation tools. We are the prime contractor for SMDC's Design, Development, and Integration ("D3I") Domain 1 - Space/High Altitude and Missile Defense contract. Under this contract we provide a suite of threat-realistic ballistic target missiles ("Zombie" targets) used for testing missile defense systems. We recently joined with Raytheon to produce several large systems in direct support of the missile defense radar systems.

We specialize in marine systems design, development, and manufacturing. For the U.S. Special Operations Command, contracted through Naval Sea Systems Command ("NAVSEA"), we are the prime contractor for the design, development, test, manufacture and sustainment of the Shallow Water Combat Submersible ("SWCS") vehicle which will replace the current SEAL Delivery Vehicle. With the design and development test phase of the SWCS engineering development model completed, we began low-rate initial production in late 2016 with production scheduled through 2023. We are responsible for the production, test and training of maintenance and operation crews for the Pluto Gigas remotely operated mine countermeasure system sold to the Egyptian Navy through the NAVSEA Foreign Military Sales Office. We are producing the Littoral Battlespace Sensing Glider ("LBS-G") system for the U.S. Navy Program Executive Office - Command, Control, Communications, Computers, and Intelligence. Teledyne Webb Research is the Glider developer and manufacturer on the LBS-G program. For Northrop Grumman, we manufacture gun mounts and surface to surface mission modules for the Littoral Combat Ship program. Under contract to Raytheon, we continue to manufacture advanced mine detection and neutralization systems.

We are active in U.S. space programs and continue to play a vital role in the science operations area of the International Space Station ("ISS"). We provide 24-hour-per-day payload operations in the ISS Payload Operations and Integration Center, located at NASA's Marshall Space Flight Center ("MSFC"). Under contract with MSFC, we have designed and are manufacturing the Launch Vehicle Stage Adapter, a critical element of NASA's Space Launch System. Flight Unit 1 will be delivered by June 2020 with Flight Unit 2 under contract and delivery scheduled for 2022. Flight Unit 3 is scheduled for contract finalization in the first half of 2020 with anticipated delivery in 2024. We have developed a commercial platform that hosts payloads for earth imaging and other scientific applications known as the Multi-User System for Earth Sensing ("MUSES"). The first instrument affixed to MUSES was built in cooperation with the German Aerospace Center ("DLR"). This DLR Earth Sensing Imaging Spectrometer ("DESIS") was declared fully operational in September 2019, achieving revolutionary spectral resolution of 2.55 nanometers and demonstrating the ability to detect ocean-borne plastics as well as surface deposits of rare earth elements from space. DLR retains the scientific rights to the imagery while Teledyne has the commercial rights. Hyperspectral imagery from the DESIS instrument will be sold to U.S. Government and industrial customers for scientific research and commercial applications. We also design, develop, and manufacture components for scientific payloads and human space flight vehicles.

We provide specialty electronic manufacturing services. We develop and manufacture custom microelectronic modules that provide both high reliability and extremely dense packaging for military applications. We also develop custom tamper-resistant microcircuits designed to provide enhanced security in military communication. We serve the market for high-mix, low-volume manufacturing of sophisticated military electronics equipment.

We have delivered a prototype for a new method of processing enriched uranium at the U.S. Department of Energy Y-12 National Security Complex and have begun manufacture of production units with delivery through 2021. We also operate a facility that supports test and development of nuclear technology.

We operate a full-service radiological analysis laboratory in Knoxville, Tennessee, which principally supports nuclear power plants in the United States. We also manage and operate a separation, purification, and analysis of atmospheric samples laboratory for the U.S. Government. Additionally, we provide engineering and manufacturing for customers in the commercial nuclear market. Continuing our historic facilities and plant management services to the commercial chemical industry, we currently lead on-site and off-site management and support of research services and facility management at several sites.

We manufacture high quality machined components that we integrate into complex products and systems for customers across the spectrum of our core business base, including NASA, the U.S. Department of Defense, the U.S. Department of Energy, foreign militaries and commercial customers.

We provide advanced thermoelectric material technology and generators for challenging applications. The NASA Curiosity rover is powered by a thermoelectric generator designed and built by Teledyne Energy Systems, Inc., and we are developing the next generation system based on advanced thermoelectric materials.

We provide leading edge battery and fuel cell energy technology solutions for use in U.S. Government programs and underwater power applications. These are lightweight compact systems are for underwater vehicles, aircraft, launch vehicles, spacecraft and umbilical replacements. Both technologies can be customized to meet challenging applications for extended duration missions.

We manufacture hydrogen/oxygen gas generators used worldwide in electrical power plant generation plants, semiconductor manufacturing and other industrial processes. Our sales of hydrogen generators have been primarily in developing countries and domestic applications where delivered merchant gas is not practical.

We manufacture small gas turbine engines for military markets. Our engines power the Boeing/U.S. Navy Harpoon Missile systems.

Customers

We have a large number of customers in the various industries we serve. No commercial customer accounted for more than 10% of any segment net sales during 2019, 2018 or 2017. No commercial customer in 2019, 2018 or 2017 accounted for more than 3.0% of total net sales.

Sales to international customers accounted for approximately 44% of total sales in 2019, compared with 47% in 2018 and 46% in 2017. In 2019, we sold products to customers in over 100 foreign countries. Approximately 90% of our sales to foreign-based customers were made to customers in 25 foreign countries. In 2019, the top five countries for international sales were China, the United Kingdom, Germany, Japan and South Korea and represented approximately 21% of our total sales.

Approximately 24%, 23% and 24% of our total net sales for 2019, 2018 and 2017, respectively, were derived from contracts with agencies of, and prime contractors to, the U.S. Government. Information on our sales to the U.S. Government, including direct sales as a prime contractor and indirect sales as a subcontractor, is as follows (in millions):

U.S. Government sales by segment:	2019	2018	2017
Instrumentation	**$ 80.4**	$ 68.3	$ 65.2
Digital Imaging	**107.4**	90.5	85.7
Aerospace and Defense Electronics	**225.3**	177.2	157.2
Engineered Systems	**346.7**	319.3	311.6
Total U.S. Government sales	**$759.8**	$655.3	$619.7

Our principal U.S. Government customer is the U.S. Department of Defense, which totaled $545.5 million, $494.9 million and $479.7 million of our total net sales for 2019, 2018 and 2017, respectively. In 2019 and 2017, our largest program with the U.S. Government was the Mission Operations and Integration contract with the NASA Marshall Space Flight Center, which represented 1.4% and 1.5% of our total net sales, respectively. In 2018, our largest program with the U.S. Government was the Objective Sim Framework program with the Missile Defense Agency, which represented 1.6% of our total net sales.

As described under risk factors, there are risks associated with doing business with the U.S. Government. In 2019, approximately 64% of our U.S. Government prime contracts and subcontracts were fixed-price type contracts, compared to 67% in 2018 and 58% in 2017. Under these types of contracts, we bear the inherent risk that actual performance cost may exceed the fixed contract price. Such contracts are typically not subject to renegotiation of profits if we fail to anticipate technical problems, estimate costs accurately or control costs during performance. Additionally, U.S. Government contracts are subject to termination by the U.S. Government at its convenience, without identification of any default. When contracts are terminated for convenience, we recover costs incurred or committed, settlement expenses and profit on work completed prior to termination. We had three U.S. Government contracts terminated for convenience in 2019, compared with 15 in 2018 and nine in 2017.

Our total backlog of confirmed and funded orders was approximately $1,699.3 million at December 29, 2019, compared with $1,568.8 million at December 30, 2018, and $1,250.2 million at December 31, 2017. We expect to fulfill a majority of such backlog of confirmed orders during 2020.

Seasonality

No material portion of our business is considered to be seasonal.

Raw Materials and Suppliers

Generally, our businesses have experienced minimal fluctuations in the supply of raw materials, but not without some price volatility. While some of our businesses provide services, for those businesses that sell hardware and product, a portion of the value that we provide is labor-oriented, such as design, engineering, assembly and test activities. In manufacturing our products, we use our own production capabilities and third-party suppliers and subcontractors, including international sources. Some of the items we use for the manufacture of our products, including certain gyro components for some marine navigation applications, certain magnets and helix wire for our traveling wave tubes, certain infrared detectors substrates and certain ceramics and molding compounds used in our sonar systems, as well as certain scintillator materials used in the production of our X-ray detectors, are purchased from limited or single sources, including international sources, due to technical capability, price and other factors. At times we have experienced difficulty in procuring raw materials, components, sub-assemblies and other supplies required in our manufacturing processes due to shortages and supplier-imposed allocation of components.

Sales and Marketing

Our sales and marketing approach varies by segment and by products within our segments. A shared fundamental tenet is the commitment to work closely with our customers to understand their needs, with an aim to secure preferred supplier and longer-term relationships.

Our segments use a combination of internal sales forces, third-party distributors and third-party commissioned sales representatives to market and sell our products and services. Our businesses have been working over the years to consolidate or share internal sales and servicing efforts. Several Teledyne businesses have been marketing and selling products collaboratively to similar customers to promote “one-stop” shopping under singular “brand” names, including Teledyne Marine, Teledyne Oil & Gas, Teledyne Defense Electronics, Teledyne Microwave Solutions, Teledyne HiRel Electronics and Teledyne Advanced Chemistry Systems.

Products are also advertised in trade journals and by means of various websites. To promote our products and other capabilities, our personnel regularly participate in trade shows and professional associations.

Many of our government contracts are awarded after a competitive bidding process in which we seek to emphasize our ability to provide superior products and technical solutions in addition to competitive pricing.

Through Teledyne Technologies International Corp. and other subsidiaries, we have established offices in foreign countries to facilitate international sales for various businesses. Locations include Brazil, China, France, Germany, India, Italy, Japan, Malaysia, Singapore, South Korea and the United Arab Emirates.

Competition

We believe that technological capabilities and innovation and the ability to invest in the development of new and enhanced products are critical to obtaining and maintaining leadership in our markets and the industries in which we compete. Although we have certain advantages that we believe help us compete effectively in our markets, each of our markets is highly competitive. With regard to our defense businesses, it is common in the defense industry for work on programs to be shared among several companies, including competitors. In any event, because of the diversity of products sold and the number of markets we serve, we encounter a wide variety of competitors, none of which we believe offer the same product and service lines or serve all of the same markets as we do. Our businesses vigorously compete on quality, product performance and reliability, technical expertise, price and service. Many of our competitors have, and potential competitors could have, greater name recognition, a larger installed base of products, more extensive engineering, manufacturing, marketing and distribution capabilities and greater financial, technological and personnel resources than we do.

Intellectual Property

While we own and control various intellectual property rights, including patents, trade secrets, confidential information, trademarks, trade names, and copyrights, which, in the aggregate, are of material importance to our business, we believe that our business as a whole is not materially dependent upon any one intellectual property or related group of such properties. We own several hundred active patents and are licensed to use certain patents, technology and other intellectual property rights owned and controlled by others. Similarly, other companies are licensed to use certain patents, technology and other intellectual property rights owned and controlled by us.

Patents, patent applications and license agreements will expire or terminate over time by operation of law, in accordance with their terms or otherwise. We do not expect the expiration or termination of these patents, patent applications and license agreements to have a material adverse effect on our business, results of operations or financial condition.

Environment and Sustainability

Teledyne's businesses continue to focus on developing solutions to address sustainability and climate challenges facing humanity today. We provide a broad range of precision measurement technologies for environmental monitoring and climate research. Our sensors and instruments are deployed everywhere, from pole to pole, in space, on aircraft and drones, on land, on the sea surface, in the water column, and on the seafloor. They operate around the clock, measuring greenhouse gases from space, precisely monitoring air and water quality throughout the world, and continuously profiling all of Earth's oceans. Applications of our instruments provide scientists information that spans time from the origin of the universe to providing real-time data to quality of air pollution and dangerous storms, such as time-critical warning of hurricanes and tsunamis.

More specific examples of our contributions to global environmental and climate science include the following:

- We provide sophisticated water samplers and flowmeters to monitor wastewater, irrigation flow, storm water, industrial discharge, construction site run-off and municipal wastewater collection, treatment and reuse.
- Our hazardous gas detection monitors are making industrial workplaces safer around the world.
- We build precision air quality instruments that measure common air pollutants (NOX, SO2, CO, ozone, PM10 and PM2.5) that are considered hazardous to human health and the environment. Our instruments enable government agencies around the world to detect and monitor the quality of the air we breathe in real-time to assess their compliance with air quality regulations and ultimately reduce air pollution. We provide the visible and infrared imaging sensors that enable NASA's Orbiting Carbon Observatory 2 and GeoCarb missions that measure carbon dioxide and methane in the Earth's atmosphere,
- Our floats, gliders and instruments assist climate research by providing access to accurate data, including subsurface temperatures and velocities of currents throughout the world's oceans. On a shorter timescale, scientists are employing our instruments and in particular our ocean gliders to provide essential inputs for computer models of dangerous storms, providing real-time information to save lives. Our instruments enable scientists to forecast more accurately floods or droughts thereby allowing farmers to better plan for planting crops and providing irrigation.
- We work with maritime agencies around the world, preserving free and safe navigation of the world's oceans.
- The oceans are increasingly threatened by floating plastics that are constantly moving. We support ocean cleanup agencies with both airborne and space-based instruments that track and analyze the debris.
- We have products designed to improve the efficiency of motors, motor drives and industrial automation systems to reduce energy consumption. Our line of motor drive analyzers measure performance dynamically. The high-

resolution display and sensitive software tools enable engineers to look inside the motor and motor drive to optimize performance and energy efficiency.

Pursuant to the mandate in their respective charters, the audit committee of our board regularly reviews matters related to compliance with environmental laws and the health and safety of employees, and the nominating and governance committee of our board reviews and evaluates our policies and practices and monitors our efforts in areas of legal and social responsibility, diversity and sustainability.

Employees

We consider our relations with our employees to be good. At December 29, 2019, our total workforce consisted of approximately 11,790 employees, of which approximately 7,150 employees were in the United States.

Information about our Executive Officers

Teledyne's executive management includes:

Name and Title	Age	Principal Occupations Last 5 Years
Executive Officers:		
Robert Mehrabian* Executive Chairman; Director	78	Dr. Mehrabian has served as Executive Chairman since January 1, 2019. Prior to January 1, 2019, he was Teledyne's Chairman, President and Chief Executive Officer for more than five years.
Aldo Pichelli* President and Chief Executive Officer	68	Mr. Pichelli has been the President and Chief Executive Officer since January 1, 2019 and Chief Operating Officer of Teledyne since October 2015. Prior to his promotion to Chief Operating Officer, Mr. Pichelli had been an Executive Vice President of Teledyne having responsibility for the Instrumentation and Aerospace and Defense Electronics segments since July 2013.
Jason VanWees* Executive Vice President	48	Mr. VanWees has been Executive Vice President since January 1, 2019. Prior to his promotion he was Senior Vice President, Strategy and Mergers & Acquisitions for more than five years.
Stephen F. Blackwood* Senior Vice President, Strategic Sourcing, Tax and Treasurer	57	Mr. Blackwood has been Senior Vice President, Strategic Sourcing, Tax and Treasurer since January 1, 2019. Prior to his promotion, he was Vice President and Treasurer of Teledyne for more than five years.
Melanie S. Cibik* Senior Vice President, General Counsel, Chief Compliance Officer and Secretary	60	Miss Cibik has been Senior Vice President, General Counsel and Secretary since September 2012 and Chief Compliance Officer since August 2016. In August 2019, Miss Cibik became a director of OPUS Bank.
Susan L. Main* Senior Vice President and Chief Financial Officer	61	Ms. Main has been Senior Vice President and Chief Financial Officer of Teledyne since November 2012. In July 2017, Ms. Main became a director of Ashland Global Holdings, Inc., a specialty chemical company. In October 2018, Ms. Main became a director of Garrett Motion Inc., a technology provider to vehicles.
Cynthia Belak* Vice President and Controller	63	Ms. Belak has been Vice President and Controller of Teledyne since May 2015. Prior to her promotion, Ms. Belak had been Vice President, Business Risk Assurance of Teledyne since January 2012.
George C. Bobb III* Vice President of Teledyne and President - Aerospace and Defense Electronics	45	Mr. Bobb has been Vice President of Teledyne for more than five years. Since July 29, 2019, he has been the President of the Aerospace and Defense Electronics segment. Prior to that, he had been and President - Teledyne Aerospace Electronics since August 2017. He has been President of Teledyne Controls LLC since April 2018. From January 2017 until April 2018 he was President of Teledyne Scientific & Imaging LLC. He was Vice President-Contracts, Information Technology and Selected Operations and Deputy General Counsel for Litigation of Teledyne from August 2016 to August 2017. Prior to that he was Chief Compliance Officer, Vice President-Information Technology and Deputy General Counsel for Litigation of Teledyne.
Edwin Roks* Vice President of Teledyne and Group President - Teledyne Digital Imaging - Teledyne DALSA and Teledyne e2v	55	Dr. Roks has been a Vice President of Teledyne since January 2014 and Group President - Teledyne Digital Imaging, Teledyne DALSA and Teledyne e2v, since March 2017. Dr. Roks has been President of Teledyne DALSA, Inc. since October 2015. From January 2014 to October 2015, Dr. Roks had been the Chief Technology Officer of Teledyne. Prior to that since April 2010, Dr. Roks served as Executive Vice President and General Manager of the professional imaging division of Teledyne DALSA, Inc. (formerly known as DALSA Corporation).

Name and Title	Age	Principal Occupations Last 5 Years
Other Executives:		
Carl Adams Vice President, Business Risk Assurance	50	Mr. Adams has been Vice President, Business Risk Assurance of Teledyne since May 2015. Prior to that, upon joining Teledyne in April 2015, he was Senior Director, Finance. Prior to that, he was the Chief Financial Officer and Vice President of NeuroSigma, Inc. since March 2014.
Vicki Benne Vice President and General Manager of Teledyne Environmental Instrumentation	58	Ms. Benne has been Vice President and General Manager of Teledyne Environmental Instrumentation since September 2018. Prior to that she was Vice President and General Manager, Teledyne ISCO since April 2014.
Jason Connell Vice President - Human Resources and Associate General Counsel	44	Mr. Connell has been Vice President - Human Resources since December 2016. Prior to that he was and remains Associate General Counsel and General Counsel of the Engineered Systems segment.
Janice L. Hess President, Engineered Systems Segment	60	Ms. Hess has been the President of the Engineered Systems segment of Teledyne since May 2014. Prior to her promotion, Ms. Hess was the Executive Vice President and Chief Financial Officer for the Engineered Systems segment and Teledyne Scientific and Imaging for more than five years.
Scott Hudson Vice President - Chief Information Officer	58	Mr. Hudson has been Vice President and Chief Information Officer since August 2017 and Chief Information Officer since June 2014.
Sean O'Connor Chief Operating Officer and Chief Financial Officer of Teledyne Environmental and Electronic Measurement Instrumentation ("EEMI")	55	Mr. O'Connor has been Chief Operating Officer and Chief Financial Officer of Teledyne Environmental and Electronic Measurement Instrumentation since September 2018. Prior to that he was Vice President and Chief Financial Officer of Teledyne Environmental and Electronic Measurement Instrumentation, which included Teledyne LeCroy, Inc. for more than five years.
Kevin Prusso Vice President and General Manager of Teledyne Test and Measurement Instrumentation	56	Mr. Prusso has been Vice President and General Manager of Teledyne Test and Measurement Instrumentation since August 2018. Prior to that he was Vice President of Sales and Marketing for Teledyne LeCroy, Inc. since April 2018 and prior to that he was Vice President of Sales and Marketing for the Protocol Solutions Group of Teledyne LeCroy, Inc.
Michael Read President, Teledyne Marine Group	61	Mr. Read has been President, Teledyne Marine Group since August 2016. Prior to that since August 2009 he was President, Teledyne Oil & Gas.
Glenn A. Seemann Vice President, Contracts	62	Mr. Seemann has been Vice President - Contracts since August 2017. Prior to that since April 2015 he was Associate Vice President, Corporate Contracts, Procurement, and Property Management. Prior to that since July 2009 he was Vice President, Contracts - Teledyne Instruments, Inc.

* Such officers are subject to the reporting and other requirements of Section 16 of the Securities Exchange Act of 1934, as amended.

Dr. Robert Mehrabian and Teledyne are parties to a Sixth Amended and Restated Employment Agreement dated as of October 23, 2018 (the "Mehrabian Employment Agreement"). The Mehrabian Employment Agreement provides that effective January 1, 2019, Dr. Mehrabian shall be employed by the Company as Executive Chairman. The Executive Chairman shall have primary responsibility to manage the affairs of the Board and to manage and direct mergers and acquisition activities and strategic planning and margin expansion initiatives of Teledyne. Its term continues through December 31, 2023.

The Mehrabian Employment Agreement also provides that Dr. Mehrabian's base salary of $995,000 continued through December 31, 2019, after which date his base salary was reduced to and remains $900,000. Such base salary may be increased annually at the discretion of the Personnel and Compensation Committee.

The Mehrabian Employment Agreement further provides, among other things:

- Annual Incentive Plan ("AIP"): Dr. Mehrabian shall participate in the AIP with a target opportunity of 120% of base salary.
- Performance Share Plan ("PSP"): Through December 31, 2019, Dr. Mehrabian shall participate in the PSP at the target opportunity of 150% of base salary. Effective January 1, 2020, Dr. Mehrabian shall participate in the PSP at a target opportunity equal to 300% of base. The applicable percentage for Dr. Mehrabian's current 2018-2020 PSP award is prorated, with this increased percentage effective as of January 1, 2020.
- Restricted Stock: Dr. Mehrabian shall participate in Teledyne's restricted stock award program with annual grants of restricted stock equal to at least 100% of Base Salary as of the date of the grant subject to meeting targets set forth in the restricted stock award.
- Stock Options: Dr. Mehrabian's stock option grant in 2019 shall have a fair value equal to the amount he received in 2018 (which was $2,422,000), and future annual grants thereafter, as determined by the Committee, shall have a fair value as of the grant date equal to $900,000. With respect to options granted to Dr. Mehrabian on or after the date of the Mehrabian Employment Agreement, the Mehrabian Employment Agreement provides that in the event of Dr. Mehrabian's separation of service for any reason other than death, outstanding stock options shall continue to vest and

the right of Dr. Mehrabian to exercise vested stock options, when and as vested, shall continue, but in no event may any such vested options be exercised after the expiration of any applicable option period. With respect to options granted to Dr. Mehrabian on or after the date of the Mehrabian Employment Agreement, the Mehrabian Employment Agreement provides that in the event of the death of Dr. Mehrabian, all outstanding options shall vest in full and the right of Dr. Mehrabian's beneficiary to exercise the stock options shall terminate upon the expiration of twelve months from the date of Dr. Mehrabian's death, but in no event may such stock options be exercised after the expiration of any applicable option period.

- Supplemental Pension Benefit: With respect to Dr. Mehrabian's Non-Qualified Pension Benefit, which provides for payments supplemental to any accrued pension under Teledyne's qualified pension plan equal to 50% of his base salary for ten years following Dr. Mehrabian's retirement, the Mehrabian Employment Agreement provides that the base salary rate to be used for calculating the payments shall be the rate in effect for 2018 (which was $995,000).
- Post-Retirement Medical Coverage: Commencing on Dr. Mehrabian's separation from service (for any reason) and continuing for the longer to live of Dr. Mehrabian and his spouse, Dr. Mehrabian and his spouse shall be deemed participants in Teledyne's medical benefit plan offered to all employees of Teledyne and be deemed to be eligible to receive the benefits under the medical plan. Dr. Mehrabian shall be charged for such deemed participation at a rate equal to the monthly rate the medical plan charges former participants and spouses eligible for continuation coverage under COBRA, plus the rate payable by the employer, as each such COBRA rate is adjusted from time to time.

Mr. Pichelli and Teledyne are parties to an Employment Agreement dated October 23, 2018 (the "Pichelli Employment Agreement"). The Pichelli Employment Agreement provides that Teledyne will employ Mr. Pichelli as President and Chief Executive Officer and is effective from January 1, 2019, through December 31, 2021. The Pichelli Employment Agreement provides that effective January 1, 2019, Mr. Pichelli's annual base salary shall be $800,000. Such base salary may be increased annually at the discretion of the Personnel and Compensation Committee.

The Pichelli Employment Agreement further provides, among other things, that effective January 1, 2019:

- AIP: Mr. Pichelli shall participate in the AIP at an opportunity of 110% of base salary if targets are reached at 100%, or such greater percentage if provided in the AIP for any year.
- PSP: Mr. Pichelli shall participate in the PSP at an opportunity equal to 300% of base salary if targets are reached at 100%. The applicable percentage for Mr. Pichelli's current 2018-2020 PSP award will be prorated, with this increased percentage effective as of January 1, 2019.
- Restricted Stock: Mr. Pichelli shall participate in Teledyne's restricted stock award program with annual grants of restricted stock equal to at least 100% of Base Salary as of the date of the grant subject to meeting targets set forth in the restricted stock award.
- Stock Options: Mr. Pichelli will be eligible to receive future annual grants of options having a fair value of at least $800,000 as of the grant date, or such other higher value as determined by the Committee. With respect to options granted to Mr. Pichelli on or after the date of the Pichelli Employment Agreement, the Pichelli Employment Agreement provides that in the event of Mr. Pichelli's separation of service for any reason other than death, outstanding stock options shall continue to vest and the right of Mr. Pichelli to exercise vested stock options, when and as vested, shall continue, but in no event may any such vested options be exercised after the expiration of any applicable option period. With respect to options granted to Mr. Pichelli on or after the date of the Pichelli Employment Agreement, the Pichelli Employment Agreement provides that in the event of Mr. Pichelli's death, all outstanding options shall vest in full and the right of Mr. Pichelli's beneficiary to exercise the stock options shall terminate upon the expiration of twelve months from the date of Mr. Pichelli' death, but in no event may such stock options be exercised after the expiration of any applicable option period.
- Benefits: Mr. Pichelli will continue to be eligible to participate in other employee benefit plans and programs available to executive-level employees, including but not limited to an automobile allowance.

Ten current members of management have entered into change of control severance agreements. The agreements have a three-year, automatically renewing term, except as noted below. The executive is entitled to severance benefits if (1) there is a change in control of the Company and (2) within three months before or 24 months after the change in control, either we terminate the executive's employment for reasons other than cause or the executive terminates the employment for good reason. "Severance benefits" currently consist of:

- A cash payment equal to three times in the case of Dr. Mehrabian or two times in the other cases the sum of (i) the executive's highest annual base salary within the year preceding the change in control and (ii) the Annual Incentive Plan bonus target for the year in which the change in control occurs or the average actual bonus payout for the three years immediately preceding the change in control, whichever is higher.
- A cash payment for the current AIP bonus cycle based on the fraction of the year worked times the AIP target objectives at 100%.

- Payment in cash for unpaid performance share program awards, assuming applicable goals are met, at 120% of performance targets (100% of performance targets in some agreements).
- Continued equivalent health and welfare (e.g., medical, dental, vision, life insurance and disability) benefits at our expense for a period of up to 36 months (including Dr. Mehrabian) (24 months in some agreements, including Mr. Pichelli) after termination (with the executive bearing any portion of the cost the executive bore prior to the change in control); provided, however, such benefits would be discontinued to the extent the executive receives similar benefits from a subsequent employer.
- Removal of restrictions on restricted stock issued under our restricted stock award programs.
- Full vesting under the Company's pension plans (within legal parameters) such that the executive shall be entitled to receive the full accrued benefit under all such plans in effect as of the date of the change in control, without any actuarial reduction for early payment.
- Up to $25,000 (including Dr. Mehrabian) ($15,000 in some agreements, including Mr. Pichelli) reimbursement for actual professional outplacement services.
- Immediate vesting of all stock options, with options being exercisable for the full remainder of the term.
- There is no "gross up payment" to hold the executive harmless against the impact, if any, of federal excise taxes imposed on executive as a result of "excess parachute" payments as defined in Section 280G of the Internal Revenue Code. The executive will receive the better of, on an after-tax basis, (a) the unreduced excess parachute payment with no tax gross up payment, or (b) a parachute payment reduced to a level below which an excise tax is imposed.
- Certain payments are deferred for six months following a separation of service to assure compliance with Section 409A of the Internal Revenue Code.

The Company has entered into individual Indemnification Agreements with directors and certain officers and executives of Teledyne, including those members of Executive Management listed above. The Indemnification Agreements provide the directors and executives who are parties to the agreements with a stand-alone contractual right to indemnification and expense advancement to the greatest extent allowable under Delaware law. The Indemnification Agreements also provide:

- In a third-party proceeding, an indemnitee is entitled to indemnification if the indemnitee acted in good faith and in a manner he or she reasonably believed to be in or not opposed to the best interests of the Company and, if in a criminal action or proceeding, if the indemnitee had no reason to believe that his or her conduct was unlawful. In a third-party proceeding, the indemnification obligation covers reasonable expenses, judgment fines, and amounts paid in settlement actually and reasonably incurred by the indemnity.
- In proceedings by or in the name of the Company (e.g., derivative suits), an indemnitee is entitled to indemnification if the indemnitee acted in good faith and in a manner he or she reasonably believed to be in or not opposed to the best interests of the Company. In derivative suits, the indemnification obligation covers reasonable expenses, but in proceedings where the Company is alleging harm caused by the indemnitee, the indemnitee would generally not be entitled to be indemnified for judgments, fines and amounts paid in settlement (otherwise the Company would effectively not recover any damages), unless a Delaware or other court determines otherwise despite the finding of liability.
- The Company has an obligation to advance, on an unsecured and interest free basis, reasonable expenses incurred by the indemnitee within 30 days of the indemnitee's request. The indemnitee does not need to meet any standard of conduct to be entitled to advancement of expenses and there is no determination requirement to be made by the Board in connection with the advancements of expenses. An indemnity must repay any amounts advanced if it ultimately determined that the indemnity is not entitled to indemnification.

Our indemnification obligations do not cover the following situations: (1) where indemnification payments have been made under director's and officer's insurance or other indemnification provisions; (2) where the claim is based on disgorgement of short-swing profits under Section 16(b) of the Exchange Act; (3) where the claim is based on reimbursement by the indemnitee to the Company of a bonus or other incentive-based or equity-based compensation if required under the Exchange Act (e.g., in connection with a restatement as a result of the Company's noncompliance with the financial reporting requirements required by Section 304 of the Sarbanes-Oxley Act); or (4) where the proceeding is initiated by the indemnitee (other than proceedings that are consented to by the Board or that the indemnitee initiates against the Company to enforce the Agreement).

Under the Indemnification Agreements, in the event of a change in control or we reduce or do not renew our director's and officer's insurance coverage, we are required to purchase (or cause the acquirer or successor to the Company to purchase or maintain) a six-year tail policy, subject to a 200% premium cap. The agreements continue until the later of (i) 10 years after the indemnitee ceases to serve as a director or officer, and (ii) one year following the final termination of any proceeding subject to the agreement.

Available Information

Our Annual Report on Form 10-K, our Quarterly Reports on Form 10-Q, any Current Reports on Form 8-K, and any amendments to these reports, are available free-of-charge on our website (www.teledyne.com) as soon as reasonably practicable after we electronically file such materials with, or furnish them to, the Securities and Exchange Commission (the "SEC"). The SEC also maintains a website that contains these reports and other information we file, including our proxy statements, at www.sec.gov. In addition, our Corporate Governance Guidelines, our Global Code of Ethical Business Conduct, our Codes of Ethics for Financial Executives, Directors and Service Providers and the Charters of the standing committees of our Board of Directors are available on our website. We intend to post any amendments to or waivers of these policies, guidelines and charters on our website. Alternatively, if you would like a paper copy of any report we file with the SEC (without exhibits) or other document, please write to Melanie S. Cibik, Senior Vice President, General Counsel, Chief Compliance Officer and Secretary, at Teledyne Technologies Incorporated, 1049 Camino Dos Rios, Thousand Oaks, California 91360-2362, and a copy of such requested document will be provided to you, free-of-charge.

Item 1A. Risk Factors

Risk Factors; Cautionary Statement as to Forward-Looking Statements

The following text highlights various risks and uncertainties associated with Teledyne. These factors could materially affect "forward-looking statements" (within the meaning of the Private Securities Litigation Reform Act of 1995) that we may make from time to time, including forward-looking statements contained in "Item 1. Business" and "Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations" of this Form 10-K and in Teledyne's 2019 Annual Report to Stockholders. It is not possible for management to predict all such factors, and new factors may emerge or existing factors may change. Additionally, management cannot assess the impact of each such factor on Teledyne or the extent to which any factor, or combination of factors, may cause actual results to differ materially from those contained in any forward-looking statements.

Escalating global trade tensions and the adoption or expansion of tariffs and trade restrictions could negatively impact us.

Starting in 2018, the U.S. Government imposed tariffs on a wide range of goods imported from China and a trade war ensued between the two nations. Several countries affected by these tariffs imposed retaliatory tariffs. In January 2020, under a U.S.-China trade agreement, China agreed to purchase $200 billion in additional goods and services from the United States over the next two years, in exchange for the United States agreeing to reduce tariffs on $120 billion in Chinese products from 15% to 7.5%. It is not yet known what if any impact this deal may have on our businesses or what impact there may be if either party fails to live up to the terms of the deal, more so with China given the Coronavirus health crisis threatening its already slowing economic growth. In any event, high tariffs generally increase the cost of materials for our products, which could result in our products becoming less competitive or generating lower margins. With high tariffs imposed on our products, we may also need to find new suppliers and components for our products, which could result in production delays. To the extent our products are the subject of retaliatory tariffs, customers in some countries or regions, such as China, may begin to seek domestic or non-U.S. sources for products that we sell, or be pressured or incentivized by foreign governments not to purchase U.S.-origin goods, which could harm our future sales in these markets. Additionally, if China were to enact laws or regulations requiring the use of local suppliers, it could have a negative impact on Teledyne's revenues.

Furthermore, as global tensions increase, more countries are enhancing their export regulations. For example, the U.K. has recently limited the sale of certain defense equipment to Middle Eastern countries. We also have seen a recent increase in denial of export licenses for sales into Russia, Turkey and the Middle East.

Additionally, a number of well-established customers and suppliers have become listed on Government restricted party lists without much warning. In particular, U.S. export enforcement agencies have placed several Chinese and Russian companies and many of their international subsidiaries on such lists, prohibiting the export of most commercial and dual-use items subject to the Export Administration Regulations. Multiple Teledyne companies had large pending orders with some of those companies that had to be either cancelled or for which Teledyne submitted export license applications that have a low probability of approval. For example, Huawei Technologies, Co., Ltd. ("Huawei"), and its affiliates were added to the U.S. Department of Commerce Bureau of Industry and Security Entity list on May 16, 2019. Huawei was a customer of our test and measurement business, and pending license applications have not yet been approved. The U.S. Government has also made efforts to increase restrictions on some of those listed entities, including proposals to expand U.S. export jurisdiction over certain foreign made products containing U.S.-origin materials. For example, the U.S. Government had proposed modifying the minimum amount of U.S. content permitted within products before they become subject to U.S. export restrictions from 25% to 10% for anything sold to Huawei. While we will continue to work to mitigate the impact of tariffs and trade restrictions, they could result in reduction in our revenue, price increases on material used in our products or production delays, which could adversely affect our business, financial condition, operational results and cash flows.

A material amount of our total revenues is derived from companies in the oil and gas industry, especially the offshore oil and gas industry, a historically cyclical industry with levels of activity that are significantly affected by the levels and volatility of oil and gas prices.

A material amount of our total revenues is derived from customers in or connected to oil and gas exploration, development and production, especially the offshore oil and gas industry. The oil and gas industry has historically been cyclical and characterized by significant changes in the levels of exploration and development activities. Oil and gas prices, and market expectations of potential changes in those prices, significantly affect the levels of those activities. Any prolonged reduction in the overall level of offshore oil and gas exploration and development activities, whether resulting from changes in oil and gas prices or otherwise, could materially and adversely affect our financial condition and the results of our businesses within our Instrumentation segment.

Some factors that have affected and are likely to continue affecting oil and gas prices and the level of demand for our services and products include the following:

- worldwide demand for oil and gas;
- general economic and business conditions and industry trends;
- the ability of the Organization of Petroleum Exporting Countries, or OPEC, to set and maintain production levels;
- the level of production by non-OPEC countries;
- the ability of oil and gas companies to generate or raise funds for capital expenditures;
- domestic and foreign tax policy;
- laws and governmental regulations that restrict exploration and development of oil and gas in various offshore jurisdictions;
- laws and governmental regulation that restrict the use of hydraulic fracturing;
- technological changes;
- the political environment of oil-producing regions;
- the price and availability of alternative fuels; and
- climate change regulations that provide incentives to conserve energy or use alternative energy sources.

Teledyne manufactures seismic energy sources, interconnects and data acquisition products that are used in offshore energy exploration. When crude oil and natural gas prices are low, the level of marine seismic exploration activity typically decreases, potentially resulting in reduced demand for our products used in offshore energy exploration. In addition, a decline in the level of capital spending by oil and natural gas companies may result in a reduced rate of development of new energy reserves, which could adversely affect demand for our products related to energy production, and, in certain instances, result in the cancellation, modification or rescheduling of existing orders and a reduction in customer-funded research and development related to next generation products.

A new global recession or an economic downturn in China may adversely affect us.

If another global recession emerges, if economic uncertainty in Europe continues or worsens, or if economic growth in China substantially slows, we may experience declines in revenues, profitability and cash flows from reduced orders, payment delays, collection difficulties, increased price pressures for our products, increased risk of excess and obsolete inventories or other factors caused by the economic problems of our customers. Our sales to China-based customers represented 6.6% of total revenues in 2019, 6.7% of total revenue in 2018 and 6.3% of total revenue in 2017. Economic growth in China has moderated, with a health crisis threatening already slowing economic growth. Continued growth in many of our businesses, including those in our Environmental and Electronic Measurement Instrumentation group, could be negatively impacted if an economic downturn persists in China. If negative conditions in the global credit markets prevent our customers from having access to credit or render them insolvent, orders for our products may decrease, which would result in lower revenue. Likewise, if our suppliers face challenges in obtaining credit, in selling their products, or otherwise in operating their businesses or remaining solvent, they may become unable to offer the materials we use to manufacture our products. These events could adversely impact our ability to manufacture affected products and could also result in reductions in our revenue, increased price competition, and increased operating costs, which could adversely affect our business, financial condition, operational results, and cash flows.

We develop and manufacture products for customers in the energy exploration and production markets, domestic and international commercial aerospace markets, the semiconductor industry, and the consumer electronics, telecommunications and automotive industries; each of which has been cyclical, exhibited rapid changes and suffered from fluctuating market demands. A cyclical downturn in these markets may materially affect future operating results.

In addition, we sell products and services to customers in industries that are sensitive to the level of general economic activity and consumer spending habits and to customers in more mature industries that are sensitive to capacity constraints. Adverse economic conditions affecting these industries may reduce demand for our products and services, which may reduce our revenues, profits or production levels. Some of our businesses serve industries such as power generation and petrochemical

refining, which may be negatively impacted in the event of future reductions in global capital expenditures and manufacturing capacity.

Our indebtedness, and any failure to comply with our covenants that apply to our indebtedness, could materially and adversely affect our business.

As of December 29, 2019, we had $851.8 million total outstanding indebtedness, including $295.0 million in senior unsecured fixed rate notes, $279.8 million in Euro denominated fixed rate notes, $150.0 million in term loans and $125.0 million outstanding under our $750.0 million floating rate credit facility. Our indebtedness or a failure to comply with our covenants that apply to our indebtedness could harm our business by, among other things, reducing the funds available to make acquisitions, capital expenditures, stock repurchases, or reducing our flexibility in planning for or reacting to changes in our business or market conditions. Our indebtedness exposes us to interest rate risk since a portion of our debt obligations are at variable rates. Our indebtedness or a failure to comply with our covenants that apply to our indebtedness could also have a material adverse effect on our business by increasing our vulnerability to general adverse economic and industry conditions or a downturn in our business. General adverse economic and industry conditions or a downturn in our business could result in our inability to repay this indebtedness in a timely manner.

Further, the Financial Conduct Authority (the authority that regulates LIBOR) has announced that it intends to stop compelling banks to submit rates for the calculation of LIBOR after 2021. The Alternative Reference Rates Committee ("ARRC") has proposed that the Secured Overnight Financing Rate ("SOFR") is the rate that represents best practice as the alternative to USD-LIBOR for use in debt instruments, derivatives and other financial contracts that are currently indexed to USD-LIBOR. ARRC has proposed a paced market transition plan to SOFR from USD-LIBOR and organizations are currently working on industry wide and company specific transition plans as it relates to derivatives, debt and cash markets exposed to USD-LIBOR. It is unclear as to what the new method of calculating LIBOR that may evolve and this new method could adversely affect the Company's interest rates on the Company's indebtedness. The Company is monitoring the ARRC transition plan and is evaluating potential related risks. As of December 29, 2019, approximately 32.5% of the Company's long-term debt is variable and can be indexed to USD-LIBOR. A 2019 amendment to our $750.0 million credit facility includes a procedure to switch to LIBOR alternative replacement rates in the future.

We are subject to the risks associated with international sales and international operations, which could harm our business or results of operations.

During 2019, sales to international customers accounted for approximately 44% of our total revenues, compared with 47% in 2018 and 46% in 2017. In 2019, we sold products to customers in over 100 countries. In 2019, the top five countries for international sales were China, Germany, the United Kingdom, Japan and South Korea, constituting approximately 21% of our total sales. We anticipate that future sales to international customers will continue to account for a significant and increasing percentage of our revenues, particularly since business and growth plans for many Teledyne businesses focus on sales outside of the United States, including to emerging markets such as China, India, Brazil and West Africa.

Risks associated with international sales and operations include, but are not limited to:

- political and economic instability;
- international terrorism;
- export controls, including U.S. export controls related to China, sanctions related to Russia, and increased scrutiny of exports of marine instruments, digital imaging and other products;
- failure to comply with anti-bribery legislation, including the U.S. Foreign Corrupt Practices Act;
- changes in legal and regulatory requirements;
- U.S. and foreign government policy changes affecting the markets for our products;
- changes in tax laws and tariffs;
- changes in U.S. - China and U.S. - Russia relations;
- difficulties in protection and enforcement of intellectual property rights;
- failure to comply with the foreign data protection laws, including the EU General Data Protection Regulation ("GDPR") in the European Union;
- inadvertent transfers of export-controlled information due to increased cross-border technology transfers and the use of offshore computer servers;
- transportation, including piracy in international waters;
- currency exchange rate fluctuations; and
- challenges relating to managing a global workforce with diverse cultures and backgrounds.

Any of these factors could have a material adverse effect on our business, results of operations and financial condition. Exchange rate fluctuations may increase the cost of our products to international customers and therefore reduce our competitive position.

In June 2016, the United Kingdom ("U.K.") held a referendum in which voters approved an exit from the European Union ("E.U."), commonly referred to as "Brexit." The U.K. formally left the E.U. on January 31, 2020 and has entered a transition period until December 31, 2020. During the transition period, the U.K. and the E.U. will seek to negotiate a trade deal, and the U.K. will remain in both the E.U. customs union and single market. The announcement of Brexit caused significant volatility in global stock markets and currency exchange rate fluctuations that resulted in the strengthening of the U.S. dollar against foreign currencies in which we conduct business. The withdrawal of the U.K. from the E.U. may also create further global economic uncertainty, which may adversely impact the economies of the U.K., the E.U. countries and other nations, may cause our current and future customers to reduce their spending on our products and services, and may cause certain E.U.-based customers to source products from businesses based outside of the U.K. For example, Brexit-related uncertainty could lead to a reconsideration by Airbus as to future investment and spending in the U.K., which could reduce sales for our U.K.-based businesses that supply Airbus. Potential Brexit-related risks for our U.K.-based businesses also include increased import duties, loss of customers in the E.U., delays in the movement of goods between the U.K. and the E.U. and loss of access to the E.U. labor pool. Given our several U.K.-based businesses, volatility in the value of the British pound relative to the U.S. dollar, or other foreign currencies, could increase the cost of raw materials and components for our U.K.-based businesses and could otherwise adversely affect the business, operations and the financial condition of our U.K.-based businesses.

Acquisitions involve inherent risks that may adversely affect our operating results and financial condition.

Our growth strategy includes acquisitions. Acquisitions involve various inherent risks, such as:

- our ability to assess accurately the value, strengths, weaknesses, internal controls, contingent and other liabilities and potential profitability of acquisition candidates;
- the potential loss of key personnel of an acquired business;
- our ability to integrate acquired businesses and to achieve identified financial, operating and other synergies anticipated to result from an acquisition;
- our ability to assess, integrate and implement internal controls of acquired businesses in accordance with Section 404 of the Sarbanes-Oxley Act of 2002;
- the distraction of management resulting from the need to integrate acquired businesses;
- increased competition for acquisition targets, which may increase acquisition costs;
- the potential impairment of assets;
- potential unknown liabilities associated with a business that we acquire or in which we invest, including environmental liabilities;
- the risks associated with acquiring privately-held companies, which generally do not have the same formal or comprehensive internal controls and compliance systems in place as public companies;
- production delays associated with consolidating acquired facilities and manufacturing operations;
- risks associated with owning and operating businesses internationally, including those arising from U.S. and foreign government policy changes or actions and currency exchange rate fluctuations;
- unanticipated changes in business or economic conditions affecting an acquired business; and
- exposure to new and unfamiliar regulations in new jurisdictions.

While we conduct financial and other due diligence in connection with our acquisitions and generally seek some form of protection, such as indemnification from the seller, insurance coverage, and sometimes placing a portion of the purchase price in escrow to cover potential liabilities, such acquired companies may have weaknesses or liabilities that are not accurately assessed or brought to our attention at the time of the acquisition. Further, indemnities, insurance or escrow arrangements may not fully cover such matters.

In connection with our acquisitions, including those acquisitions that we do not complete, we may incur significant transaction costs. We are required to expense, as incurred, such transaction costs, which may have a material adverse impact on our financial results.

Changes in future business conditions could cause business investments, goodwill and other long-lived assets to become impaired, resulting in significant losses and write-downs that would reduce our operating income.

On December 29, 2019, Teledyne's goodwill was $2,050.5 million and net acquired intangible assets were $430.8 million. Under current accounting guidance, we are required to test annually both acquired goodwill and other indefinite-lived intangible assets for impairment based upon a fair value approach, rather than amortizing the value over time. We have chosen to perform our annual impairment reviews of goodwill and other indefinite-lived intangible assets during the fourth quarter of each fiscal year. We also are required to test goodwill for impairment between annual tests if events occur or circumstances change that would more likely than not reduce our enterprise fair value below its book value. These events or circumstances could include a significant change in the business climate, including a significant sustained decline in an entity's market value, legal factors, operating performance indicators, competition, sale or disposition of a significant portion of the business, or other factors. If the fair market value is less than the carrying value, including goodwill, we could be required to record an impairment charge. The valuation of reporting units requires judgment in estimating future cash flows, discount rates and estimated product life

cycles. In making these judgments, we evaluate the financial health of the business, including such factors as industry performance, changes in technology and operating cash flows. As we have grown through acquisitions, the amount of goodwill and net acquired intangible assets is a significant portion of our total assets. As a result, the amount of any annual or interim impairment could be significant and could have a material adverse effect on our reported financial results for the period in which the charge is taken. We also may be required to record an earnings charge or incur unanticipated expenses if, as a result of a change in strategy or other reason, we were to determine the value of other assets had been impaired.

For additional discussion of business investments, goodwill and other long-lived assets, see the discussion under "Item 7. Management's Discussion and Analysis of Operations and Financial Condition" and Note 3 of the Notes to Consolidated Financial Statements.

United States and global responses to terrorism, increasing tension between the U.S., and Russia, China and Iran; concerns regarding nuclear proliferation and the safety of nuclear energy; potential epidemics such as the Coronavirus; continuing turmoil in Middle Eastern countries; and potential future financial issues impacting airlines and volatile energy prices increase uncertainties with respect to many of our businesses and may adversely affect our business and results of operations.

United States' and global responses to terrorism, continuing turmoil in Middle Eastern countries and nuclear proliferation concerns increase uncertainties with respect to U.S. and other business and financial markets and could adversely affect our business and operations. Increasing tensions between the U.S. and Russia, and between the U.S. and China, as well as the U.S. and Iran, could disrupt the economy.

Air travel declines have occurred after terrorist attacks and heightened security alerts, as well as after the high-profile outbreaks of disease, including the recent outbreak and spread of the Wuhan, China-originated Coronavirus. Additional declines in air travel resulting from these factors and other factors could adversely affect the financial condition of many of our commercial airline and aircraft manufacturer customers and, in turn, could adversely affect our Aerospace and Defense Electronics segment. In addition, a prolonged virus epidemic or pandemic, or the threat thereof, could result in worker absences, lower productivity, voluntary closure of our offices and manufacturing facilities, disruptions in our supply chain, travel restrictions on our employees, and other disruptions to our businesses. Moreover, health epidemics may force local health and government authorities to mandate the temporary closure of our offices and manufacturing facilities.

With the outbreak of the Coronavirus, Chinese authorities quarantined many cities and restricted travel within the country. We asked our approximately 140 employees based in China not to report to our facilities and restricted travel to China. Similar actions have been taken by our China-based and other suppliers and customers. Many commercial airlines and countries have canceled flights and restricted travel to and from China. If the virus spreads further and Chinese business continue to be shutdown or delayed, it could adversely affect our business and results of operations.

Higher oil prices could adversely affect commercial airline-related customers of our Aerospace and Defense Electronics segment. Conversely, lower oil prices have decreased oil exploration and petrochemical refining activities and have hindered our Marine and other Instrumentation businesses. In addition, instability in the Middle East or other oil-producing regions could adversely affect expansion plans of the oil and gas industry customers of our Instrumentation businesses.

Our revenue from government contracts subjects us to many risks:

Our revenue from U.S. government contracts depends on the continued availability of funding from the U.S. Government, and, accordingly, we have the risk that funding for our existing contracts may be canceled or diverted to other uses or delayed or that funding for new programs will not be available.

We perform work on a number of contracts with the U.S. Department of Defense and other agencies and departments of the U.S. Government including subcontracts with government prime contractors. Sales under contracts with the U.S. Government, including sales under contracts with the U.S. Department of Defense, as prime contractor or subcontractor, represented approximately 24% of our total revenue in 2019, compared with 23% in 2018 and 24% in 2017. Performance under government contracts has inherent risks that could have a material effect on our business, results of operations, and financial condition.

Government contracts are conditioned upon the continuing availability of Congressional appropriations and the failure of Congress to appropriate funds for programs in which we participate could negatively affect our results of operations. U.S. Government shutdowns have resulted in delays in anticipated contract awards and delayed payments of invoices for several of our businesses and any new shutdown could have similar or worse effects. The failure by Congress to approve future budgets on a timely basis could delay procurement of our products and services and cause us to lose future revenues. Any renewed emphasis on Federal deficit and debt reduction could lead to a further decrease in overall defense spending. Budgetary concerns could result in future contracts being awarded more on price than on other competitive factors, and smaller defense budgets could result in government in-sourcing of programs and more intense competition on programs that are not in-sourced, which could result in lower revenues and profits.

Although the U.S. President has indicated his desire for increased defense spending, continued defense spending does not necessarily correlate to continued business for us, because not all of the programs in which we participate or have current capabilities may be provided with continued funding. Changes in policy and budget priorities by the President, his Administration and the U.S. Congress for various defense and National Aeronautics and Space Administration ("NASA") programs could continue to impact our Engineered Systems, Aerospace and Defense Electronics and Digital Imaging segments. Our Aerospace and Defense Electronics segment may be impacted by volume or price reductions in connection with the F-35 Joint Strike Fighter program, to the extent they are imposed. The timing of program cycles can affect our results of operations for a quarter or year, and cancellations of significant programs such as the Space Launch System ("SLS"), Launch Vehicle Stage Adapter ("LVSA"), International Space Station ("ISS"), Mission Operations and Integration ("MO&I"), or the Shallow Water Combat Submersible ("SWCS") would affect our results. It is also not uncommon for the U.S. Department of Defense to delay the timing of awards for major programs for six to twelve months. Reductions and delays in research and development funding by the U.S. Government could impact our revenues. Uncertainty over budgets or priorities with the existing or a different U.S. Presidential Administration following the 2020 election could result in delays in funding and the timing of awards, and changes in funded programs that could have a material impact on our revenues.

Our participation in government programs may decrease as those programs evolve over time.

Over time, and for a variety of reasons, programs can evolve and affect the extent of our participation. We have been a significant participant in NASA programs, primarily through our Engineered Systems segment and through Teledyne Scientific and Imaging, LLC. The prior U.S. Presidential Administration introduced significant changes to the national space policy, including the cancellation of NASA's Constellation Program which includes Ares launch vehicles. Delayed funding and changes in support for NASA's current space policy, including the Space Launch System ("SLS"), International Space Station ("ISS"), or Artemis Mission to the Moon could negatively impact our business. Furthermore, while funding for national space has been more positive under the current U.S. Presidential Administration, a different U.S. Presidential Administration following the 2020 election could make changes to funding for national space that could be less favorable.

Furthermore, the U.S. Government continues to place emphasis on small business quotas and may continue to increase small business contract set asides and minimum work percentages. In some cases, prime contractors are required to reduce participation by large subcontractors like Teledyne in order to fill small business quotas and be responsive to proposals and bids. As a result, our Engineered Systems segment could lose participation in some government programs.

Our contracts with the U.S. Government are subject to termination rights that could adversely affect us.

Most of our U.S. Government contracts are subject to termination by the U.S. Government either at its convenience or upon the default of the contractor. Termination for convenience provisions provide only for the recovery of costs incurred or committed, settlement expenses, and profit on work completed prior to termination. Termination for default clauses impose liability on the contractor for excess costs incurred by the U.S. Government in re-procuring undelivered items from another source. We had three U.S. Government contracts terminated for convenience in 2019, compared with 15 in 2018 and nine in 2017. No contracts were terminated for default during such three-year period.

We may lose money or generate less than expected profits on our fixed-price and other government contracts; and if we fail to meet certain pre-specified targets in government contracts, we may lose money.

There is no guarantee that U.S. Government contracts will be profitable. A number of our U.S. Government prime contracts and subcontracts are fixed-price type contracts (64% of our total revenue from U.S. Government contracts came from fixed-price in 2019, 67% in 2018 and 58% in 2017). Under these types of contracts, we bear the financial risk that actual performance cost may exceed the fixed contract price. Under such contracts, we must absorb cost overruns, notwithstanding the difficulty of estimating all of the costs we will incur in performing these contracts. We cannot assure that our contract loss provisions in our financial statements will be adequate to cover all actual future losses. As the technological complexity and required performance levels for our products increase, which is occurring in many of our businesses, it becomes more challenging to estimate costs. We may lose money or generate lower profits on some contracts if we fail to meet these estimates. We may also lose money on non-fixed price, cost-reimbursement contracts that contain penalties related to cost, schedule or performance. Furthermore, some of our research and development programs for the government may get canceled or descoped should we fail to meet certain technical goals.

Additionally, as we continue to support legacy defense programs certain components become more difficult to source, there is a risk that we may not be able to source critical components which could lead to cost overruns.

Our U.S. Government contracting business is subject to government contracting regulations, including increasingly complex regulations on cybersecurity, and our failure to comply with such laws and regulations could harm our operating results and prospects.

Our U.S. Government contracting businesses, like other government contractors, are subject to various audits, reviews and investigations (including private party "whistleblower" lawsuits) relating to our compliance with applicable federal and state laws and regulations. More routinely, the U.S. Government may audit the costs we incur on our U.S. Government contracts, including allocated indirect costs. Such audits could result in adjustments to our contract costs. Any costs found to be improperly allocated to a specific contract will not be reimbursed, and such costs already reimbursed would need to be refunded. We have recorded contract revenues based upon costs we expect to realize after final audit. In a worst case scenario, should a business or division involved be charged with wrongdoing, or should the U.S. Government determine that the business or division is not a "presently responsible contractor", that business or division, and conceivably our Company as a whole, could be temporarily suspended or, in the event of a conviction, could be debarred for up to three years from receiving new government contracts or government-approved subcontracts. In addition, we could expend substantial amounts defending against such charges and in damages, fines and penalties if such charges were proven or were to result in negotiated settlements.

The Department of Defense as well as other U.S. Government contracting agencies have adopted rules and regulations requiring contractors to implement a set of cyber security measures to attain the safeguarding of contractor systems that process, store, or transmit certain information. Implementation and compliance with these cyber security requirements is complex and costly, and could result in unforeseen expenses, lower profitability and, in the case of non-compliance, penalties and damages, all of which could have an adverse effect on our business.

Our pension expense and the value of our pension assets are affected by factors outside of our control, including the performance of plan assets, the stock market, interest rates and actuarial experience.

Our domestic qualified defined benefit pension plans cover most of our U.S. employees hired prior to 2004 or approximately 10% of our active employees. We also have several small domestic non-qualified and foreign-based pension plans. As of December 29, 2019, the value of the combined pension assets is greater than our combined pension benefit obligations. The accounting rules applicable to our pension plans require that amounts recognized in the financial statements be determined on an actuarial basis, rather than as contributions are made to the plan. Two significant elements in determining our pension income or pension expense are the expected return on plan assets and the discount rate used in projecting pension benefit obligations. Declines in the stock market and lower rates of return could increase required contributions to our qualified pension plan and/or result in a change to shareholders' equity. Our investment strategy may not produce the expected returns if the credit, financial or stock markets deteriorate. Any decreases or increases in market interest rates will affect the discount rate assumption used in projecting pension benefit obligations. In addition, changes in other actuarial assumptions such as mortality assumptions or change due to legislative or regulatory actions could impact our pension income or expense as well as funding obligations. Each year, beginning in 2014, the Society of Actuaries has released revised mortality tables, which updated life expectancy assumptions. In consideration of these tables, each year we review the mortality assumptions used in determining our pension and post-retirement benefit obligations. The impact of these mortality assumptions could increase our pension obligation and increase future pension expense. No contributions have been made to the domestic qualified pension plan since 2013. If, and to the extent, decreases in our pension assets are not offset by voluntary contributions, recovered through future asset returns, mitigated by an increase in the rate at which the benefit obligation is discounted, or other actions, our required cash contributions and pension expense could increase under the plans. In addition, we have sold approximately $63.9 million in pension liability to third parties. To the extent any of these counterparties are unable to fulfill their obligations to retirees, we may have residual liability, particularly to the extent state guarantee funds are inadequate. For additional discussion of pension matters, see the discussion under "Item 7. Management's Discussion and Analysis of Operations and Financial Condition" and Notes 2, 11 and 15 of the Notes to Consolidated Financial Statements.

Our business and operations could suffer in the event of cyber security breaches.

Attempts by others to gain unauthorized access to our information technology systems have become more sophisticated and are sometimes successful. These attempts, which might be related to industrial or foreign government espionage, crime, activism, or other motivations, include covertly introducing malware into our computers and computer networks, performing reconnaissance, impersonating authorized users, extortion, stealing, corrupting or restricting our access to data, among other activities. We continue to train our personnel and update our infrastructure, security tools and processes to protect against security incidents, including both external and internal threats, and to prevent their recurrence. Company personnel and third parties have been tasked to detect, respond to, and investigate such incidents, but it is possible that we might not prevent or be aware of or be able to react to an incident or its magnitude and effects. The theft, corruption, unauthorized use or publication of our intellectual property or confidential business information could harm our competitive position, reduce the value of our investment in research and development and other strategic initiatives or otherwise adversely affect our business. We are subject to U.S. Department of Defense regulations applicable to certain types of data residing on or transiting through our information systems, and these regulations have been and will continue to be incorporated into certain U.S. Department of

Defense contracts that we hold. To the extent that any security breach results in inappropriate disclosure of confidential or controlled information of employees, third parties or the U.S. Government, or any of the deployed security controls are deemed insufficient, we may incur liability or the loss of contracts or security clearances. As a result, we expect to continue to devote additional resources to the security of our information technology systems. More resources may be required in the defense arena to the extent the U.S. Government increases its cyber security mandates. Unauthorized access to or control of our products, devices or systems could impact the safety of our customers and other third parties which could result in legal claims against us. Security breaches also could result in a violation of applicable U.S. and international privacy and other laws, including the EU General Data Protection Regulation ("GDPR"), Health Insurance Portability and Accountability Act ("HIPAA"), Payment Card Industry Data Security Standard ("PCI") and California Consumer Privacy Act ("CCPA") and subject us to private consumer or securities litigation and governmental investigations and proceedings, any of which could result in our exposure to material civil or criminal liability.

We may not have sufficient resources to fund all future research and development and capital expenditures or possible acquisitions.

In order to remain competitive, we must make substantial investments in research and development of new or enhanced products and continuously upgrade our process technology and manufacturing capabilities. Our research and development efforts primarily involve engineering and design related to improving existing products and developing new products and technologies in the same or similar fields. Our Teledyne Scientific Company subsidiary, which serves as our primary research center, has been actively promoting and funding joint research and development projects with other Teledyne businesses, including Teledyne Oil & Gas, Teledyne Defense Electronics, Teledyne Digital Imaging and our Test and Measurement businesses. The business of e2v, for which the design and development of specialized technology for high performance systems and equipment is integral, also requires substantial investments in research and development. Additionally, some of our businesses have sought or are actively pursuing governmental support and funding for some of their research and development initiatives, including funding in 2019 for DALSA's semiconductor foundry in Bromont, Quebec. Nonetheless, we may be unable to fund all of our research and development and capital investment needs or possible strategic acquisitions of businesses or product lines. Our ability to raise additional capital will depend on a variety of factors, some of which will not be within our control, including the existence of bank and capital markets, investor perceptions of us, our businesses and the industries in which we operate, and general economic conditions. Failure to successfully raise needed capital or generate cash flow on a timely or cost-effective basis could have a material adverse effect on our business, results of operations and financial condition. In addition, if we fail to accurately predict future customer needs and preferences or fail to produce viable technologies, we may invest heavily in research and development of products that do not lead to significant revenue, which would adversely affect our profitability.

Limitations in customer funding for applied research and development and limitations in government support for research and development expenditures may reduce our ability to apply our ongoing investments in some market areas.

We may be unable to successfully introduce new and enhanced products in a timely and cost-effective manner or increase our participation in new markets, which could harm our profitability and prospects.

Our operating results depend in part on our ability to introduce new and enhanced products on a timely basis. We have major development activities at some of our businesses, for which a failure to execute in a timely manner could negatively impact those businesses. In order to improve our product development capabilities, we purchased the research center that is now Teledyne Scientific Company in 2006 and in 2011 we purchased DALSA to gain access to a well-equipped MEMS research and development center. In 2013, we opened a 52,000-square-foot technology development center in Daytona Beach, Florida primarily to serve the offshore oil and gas production and exploration industries. We are currently upgrading infrastructure at Teledyne e2v's facility in Chelmsford, U.K. and have expanded Teledyne DALSA's MEMS foundry in Bromont, Quebec, as well as acquired a second MEMS foundry in Edmonton, Alberta as part of the Micralyne acquisition. Successful product development and introduction depend on numerous factors, including our ability to anticipate customer and market requirements, changes in technology and industry standards, our ability to differentiate our product offerings from the product offerings of our competitors, and market acceptance. We may not be able to develop and introduce new or enhanced products in a timely and cost-effective manner or to develop and introduce products that satisfy customer requirements.

Our new products also may not achieve market acceptance or correctly address new industry standards and technological changes. We may also lose any technological advantage to competitors if we fail to develop new products in a timely manner.

Additionally, new products may trigger increased warranty costs as information on such products is augmented by actual usage. Accelerated entry of new products to meet heightened market demand and competitive pressures may cause additional warranty costs as development and testing time periods might be accelerated or condensed.

We intend to both adapt our existing technologies and develop new products to expand into new market segments. We may be unsuccessful in accessing these and other new markets if our products do not meet our customers' requirements, as a result of changes in either technology and industry standards or because of actions taken by our competitors.

Technological change and evolving industry and regulatory standards could cause some of our products or services to become obsolete or non-competitive.

The markets for some of our products and services are characterized by rapid technological development, evolving industry standards, changes in customer requirements and new product introductions and enhancements. A faster than anticipated change in one or more of the technologies related to our products or services, or in market demand for products or services based on a particular technology, could result in faster than anticipated obsolescence of certain of our products or services and could lead to reduced sales of those products, which could have a material adverse effect on our business, results of operations and financial condition. Currently accepted industry and regulatory standards are also subject to change, which may contribute to the obsolescence of our products or services. The political agenda of the U.S. Presidential Administration may affect the level of environmental regulations and enforcement and government spending on scientific research, which could adversely impact the sales of our products and services, including sales of pollution monitoring instruments and instruments used to measure the Earth's climate and climate change, such as undersea gliders and space-based imaging sensors. A change in China's economic policies promoting pollution reduction could result in lower sales or slower sales growth for our pollution monitoring and laboratory instrumentation to China.

We may not be able to reduce the costs of our products to satisfy customers' cost reduction mandates, which could harm our sales or margins.

Cost conscious customers may seek price reductions of our products. While we continually work to reduce our manufacturing and other costs of our products, without affecting product quality and reliability, there is no assurance that we will be able to do so or to do so in a timely manner to satisfy the pricing pressures of our customers. Prices of raw materials and other components used in our products may be beyond our control depending on market conditions. As a result, customers may seek lower cost products from China or other developing countries where manufacturing costs are lower.

The airline industry is heavily regulated, and if we fail to comply with applicable requirements, our results of operations could suffer.

The Federal Aviation Administration ("FAA") and equivalent regulatory agencies have increasingly focused on the need to assure that airline industry products are designed with sufficient cybersecurity controls to protect against unauthorized access or other unwanted compromise. A failure to meet these evolving expectations could negatively impact sales into the industry and expose us to legal or contractual liability.

Governmental agencies throughout the world, including the FAA, prescribe standards and qualification requirements for aircraft components, including virtually all commercial airline and general aviation products. Specific regulations vary from country to country, although compliance with FAA requirements generally satisfies regulatory requirements in other countries. If any material authorization or approval qualifying us to supply our products is revoked or suspended, then sale of the product would be prohibited by law, which would have an adverse effect on our business, financial condition and results of operations.

From time to time, the FAA or equivalent regulatory agencies in other countries propose new regulations or changes to existing regulations, which often are more stringent than existing regulations. If such proposals are adopted and enacted, we may incur significant additional costs to achieve compliance, which could have a material adverse effect on our business, financial condition and results of operations. Recent trends by China's aviation authority to relax restrictions on airspace may be reversed, and anticipated new regulations loosening airspace restrictions may not materialize, which could impact sales prospects in China for our commercial aerospace businesses.

The FAA and the U.S. Department of Justice's Fraud Section, among other agencies and countries, are investigating two Boeing 737 Max 8 aircraft crashes that occurred in October 2018 and March 2019, which resulted in the groundings of such aircraft across the world. While the investigations continue, Boeing announced in December 2019 that it will temporarily suspend production of the 737 Max starting in January 2020. While the impact of this decision has been factored into our business plans, there is a risk that the decision will have further negative impact on our Teledyne Controls' business, particularly if the suspension lasts longer than expected.

Increasing competition could reduce the demand for our products and services.

Each of our markets is highly competitive. Many of our competitors have, and potential competitors could have, greater name recognition, a larger installed base of products, more extensive engineering, manufacturing, marketing and distribution capabilities and greater financial, technological and personnel resources. New or existing competitors may also develop new technologies that could adversely affect the demand for our products and services. We have been experiencing increased competition for some of our key products. Furthermore, some of our patents have or are expiring which could open up further competition. For example, our U.S. patent related to our Wireless GroundLink product expired in 2018, allowing several competitors to enter the market. Additionally, some of our customers have been developing competing products or electing to vertically integrate and replace our products with their own. For example, Airbus has developed its own wireless product, FOMAX, that now competes directly with Teledyne Controls hardware and services. Furthermore, Boeing has announced a vertical integration program, which include avionics. Lastly, some of our products face increasing competition from alternative technologies. For example, the lead acid batteries that Teledyne Battery Products sells face competition from lithium ion batteries, among other competing technologies.

Industry acquisition and consolidation trends, particularly among aerospace and defense contractors, have adversely impacted demand for our aerospace and defense related engineering services as large prime contractors elect to in-source major acquisition programs and expand small business participation to meet Government contracting goals. Such consolidations can also cause delays in business as the newly consolidated organization undergoes integration.

Low-cost competition from China and other developing countries could also result in decreased demand for our products. Increasing competition could reduce the volume of our sales or the prices we may charge, which would negatively impact our revenues. Smaller defense budgets both in the United States and Europe could result in additional competition for new and existing defense programs.

Product liability claims, product recalls and field service actions could have a material adverse effect on our reputation, business, results of operations and financial condition and we may have difficulty obtaining product liability and other insurance coverage.

As a manufacturer and distributor of a wide variety of products, including monitoring instruments, products used in offshore oil and gas production, products used in transportation and commercial aviation and products used in medical devices (including X-ray detectors), our results of operations are susceptible to adverse publicity regarding the quality or safety of our products. In part, product liability claims challenging the safety of our products may result in a decline in sales for a product, which could adversely affect our results of operations. This could be the case even if the claims themselves are proven to be untrue or settled for immaterial amounts.

While we have general liability and other insurance policies concerning product liabilities and errors and omissions, we have self-insured retentions or deductibles under such policies with respect to a portion of these liabilities. Awarded damages could be more than our accruals. We could incur losses above the aggregate annual policy limit as well. We cannot assure that, for 2020 and in future years, insurance carriers will be willing to renew coverage or provide new coverage for product liability.

Product recalls can be expensive and tarnish our reputation and have a material adverse effect on the sales of our products. We cannot assure that we will not have additional product liability claims or that we will not recall any products.

We have been joined, among a number of defendants (often over 100), in lawsuits alleging injury or death as a result of exposure to asbestos. In addition, because of the prominent "Teledyne" name, we may continue to be mistakenly joined in lawsuits involving a company or business that was not assumed by us as part of our 1999 spin-off. To date, we have not incurred material liabilities in connection with these lawsuits. However, our historic insurance coverage, including that of our predecessors, may not fully cover such claims and the defense of such matters. Coverage typically depends on the year of purported exposure and other factors. Nonetheless, we intend to vigorously defend our position against these claims.

Teledyne Brown Engineering, Inc. and other Teledyne companies manufacture components for customers in the nuclear power market, including utilities and certain governmental entities. Certain liabilities associated with such products are covered by the Price-Anderson Nuclear Industries Indemnity Act and other statutory and common law defenses, and we have received indemnities from some of our customers. However, there is no assurance we will not face product liability claims related to such products or that our exposure will not exceed the amounts for which we have liability coverage or protection.

Our business and financial results could be adversely affected by conditions and other factors associated with our suppliers.

Some items we purchase for the manufacture of our products are purchased from limited or single sources of supply due to technical capability, price and other factors. For example, Teledyne Digital Imaging has an internal single source of supply for CCD semiconductor wafers used to assemble image sensors and an external single source of supply for CMOS semiconductor wafers used to assemble X-ray panel products. Furthermore, sole source supply is more common among our research and development businesses because there can be few suppliers in the world capable of producing the products or providing the services with the right highly specialized technology. LeCroy continues to outsource a portion of its research and development activities to third-party engineering firms in Malaysia and India where it may be more difficult for us to enforce our intellectual property rights. We have also outsourced from time to time the manufacturing of certain parts, components, subsystems and even finished products to single or limited sources, including international sources. Disruption of these sources or supplier-imposed rationing of scarce components could cause delays or reductions in shipments of our products or increases in our costs, which could have an adverse effect on our financial condition or operations. We could experience global supply chain disruptions if the Coronavirus heath crisis continues and widens. International sources possess additional risks, some of which are similar to those described above regarding international sales. With any continuing disruption in the global economy and financial markets, some of our suppliers may also continue to face issues gaining access to sufficient credit and materials to maintain their businesses, which could reduce the availability of some components and, to the extent such suppliers are single source suppliers, could adversely affect our ability to continue to manufacture and sell our products.

We face risks related to sales through distributors and other third parties that we do not control, which could harm our business.

We sell a portion of our products through third parties such as distributors, value-added resellers and OEMs (collectively "distributors"). Using third parties for distribution exposes Teledyne to many risks, including concentration, credit risk and legal risk because under certain circumstances we may be held responsible for the action of those third-party sales channels even though we exercise less control over them than we do our directly employed sales personnel. We may rely on one or more key distributors for a product, and the loss of these distributors could reduce our revenue. Distributors may face financial difficulties, including bankruptcy, which could harm our collection of accounts receivables and financial results. Violations of the Foreign Corrupt Practices Act ("FCPA") or similar anti-bribery laws by distributors or other third-party intermediaries could have a material impact on our business. Competitors could also block our access to key distributors. Failing to manage risks related to our use of distributors may reduce sales, increase expenses, and weaken our competitive position, and could result in sanctions against us.

Compliance with increasing environmental and climate change regulations, as well as the effects of potential environmental liabilities, could have a material adverse financial effect on us.

We, like other industry participants, are subject to various federal, state, local and international environmental laws and regulations. We may be subject to increasingly stringent environmental standards in the future, particularly as greenhouse gas emissions and climate change regulations and initiatives increase. Future developments, administrative actions or liabilities relating to environmental and climate change matters could have a material adverse effect on our business, results of operations or financial condition. Environmental regulations on hydraulic fracturing and the use of seismic energy sources for offshore energy exploration could adversely affect some product lines of our Instrumentation segment.

Our manufacturing operations, including former operations, could expose us to material environmental liabilities. Additionally, companies that we acquire may have environmental liabilities that might not be accurately assessed or brought to our attention at the time of the acquisition.

The U.S. Environmental Protection Agency ("EPA") has focused on greenhouse gases ("GHGs"), maintaining GHGs threaten the public health and welfare of the American people. The EPA also maintains that GHG emissions from on-road vehicles contribute to that threat. The EPA's endangerment finding covers emissions of six greenhouse gases. The EPA's continuing efforts to limit GHG emissions could adversely affect our U.S. manufacturing operations, increase prices for energy, fuel and transportation, require us to accommodate changes in parameters, such as the way parts are manufactured, and may, in some cases, require us to redesign certain of our products. This, or other federal or state regulations, could lead to increased costs, which we may not be able to recover from customers, delays in product shipments and loss of market share to competitors. For example, Teledyne Battery Products unit makes lead acid batteries in California and is subject to a variety of environmental regulations and inspections, which have increased over time. Also, some of our sites conduct electroplating, metal finishing and other operations that utilize hazardous materials that are subject to similar regulations. Regulatory changes or failure to meet applicable requirements could disrupt that business or force a closure or relocation of the business.

Our products are subject to various regulations that prohibit or restrict the use of certain hazardous substances. For example, our products placed on the European market are subject to the Registration, Evaluation, Authorization and Restriction of Chemicals ("REACH") and the restriction of the use of certain hazardous substances in electrical and electronic equipment ("ROHS") Directives. Future hazardous substance restrictions or prohibitions may limit our ability to market some products in certain countries.

For additional discussion of environmental matters, see the discussion under the caption "Other Matters – Environmental" of "Item 7. Management's Discussion and Analysis of Results of Operation and Financial Condition" and Note 14 of the Notes to Consolidated Financial Statements. For a discussion of our products that contribute to the environment, sustainability and climate science, see "Item 1. Business – Environment and Sustainability".

Our inability to attract and retain key personnel could have a material adverse effect on our future success.

Our future success depends to a significant extent upon the continued service of our executive officers and other key management and technical personnel and on our ability to continue to attract, retain and motivate qualified personnel. We also have a maturing workforce. Some of our businesses, including our businesses in traveling wave tube and integrated microwave module design and development, draw from a pool of specialized engineering talent that is small and currently shrinking. Some of our businesses have a need for employees with a certain level of security clearance, and competition for such employees has increased. While we have engaged in succession planning, the loss of the services of one or more of our key employees or our failure to attract, retain and motivate qualified personnel could have a material adverse effect on our business, financial condition and results of operations. Low unemployment in the United States has made it more difficult for some of our businesses to attract and retain direct labor in certain markets.

We may not be able to sell or reconfigure businesses, facilities or product lines that we determine no longer meet with our growth strategy or that should be consolidated.

Consistent with our strategy to emphasize growth in our core markets, we continually evaluate our businesses to ensure that they are aligned with our strategy and objectives. Over the years we have also consolidated some of our business units and facilities, in some cases to respond to downturns in the defense and oil and gas industries, among other reasons. We are currently in the process of closing our Teledyne Paradise Datacom facility in State College, Pennsylvania and moving its operations to our Teledyne Microwave Solutions facility in Rancho Cordova, California. We may not be able to realize efficiencies and cost savings from our consolidation activities. There is no assurance that our efforts will be successful. If we do not successfully manage our current consolidation activities, or any other similar activities that we may undertake in the future, expected efficiencies and benefits might be delayed or not realized, and our operations and business could be disrupted. Our ability to dispose of, exit or reconfigure businesses that may no longer be aligned with our growth strategy will depend on many factors, including the terms and conditions of any asset purchase and sale agreement or lease agreement, as well as industry, business and economic conditions. We cannot provide any assurance that we will be able to sell non-strategic businesses on terms that are acceptable to us, or at all. In addition, if the sale of any non-strategic business cannot be consummated or is not practical, alternative courses of action, including relocation of product lines or closure, may not be available to us or may be more costly than anticipated.

Natural and man-made disasters could adversely affect our business, results of operations and financial condition.

Several of our facilities, as a result of their locations, could be subject to a catastrophic loss caused by earthquakes, hurricanes, tornados, floods, ice storms or other natural disasters. Many of our production facilities and our headquarters are located in California and thus are in areas with above average seismic activity and may also be at risk of damage due to wildfires. In November 2018, wildfires impacted areas near our headquarters and principal research and development center in Thousand Oaks, California, resulting in temporary disruptions and evacuations of employees who lived nearby. Local utilities may impose blackouts during high fire risk weather conditions, which could result in disruptions to our businesses located in California, including our headquarters. Teledyne DALSA's semiconductor facilities in Quebec, Canada have been impacted by loss of electrical power caused by severe ice storms. In addition, we have manufacturing facilities in the southeastern United States and Texas that have been threatened or struck by major hurricanes. In 2017, our businesses located in Houston, Texas were impacted by Hurricane Harvey and our business in Florida was threatened by Hurricanes Irma and Matthew. Our facilities in Alabama, Florida, Nebraska, Tennessee and Virginia have also been threatened by tornados. If any of our California facilities, including our California headquarters, were to experience a catastrophic earthquake or wildfire loss or if any of our Alabama, Florida, Nebraska, Tennessee or Texas facilities were to experience a catastrophic hurricane, storm, tornado or other natural disaster, or if DALSA's facilities in Quebec experience long-term loss of electrical power, such event could disrupt our operations, delay production, shipments and revenue, and result in large expenses to repair or replace the facility or facilities. While Teledyne has property insurance to partially reimburse it for losses caused by windstorm and earth movement, such insurance would not cover all possible losses. In addition, our existing disaster recovery and business continuity plans (including those relating to our information technology systems) may not be fully responsive to, or minimize losses associated with, catastrophic events.

Disasters also have an indirect adverse impact on our business. For example, in 2018, a fire at a Netherlands-based facility of a key supplier of printed circuit boards resulted in delivery disruptions to the electronics industry, including to businesses in our Digital Imaging segment.

Teledyne Brown Engineering, Inc. has developed, built, and launched a multiuser system for earth sensing that is affixed to the International Space Station ("ISS"). For the program to continue to be financially successful, the 20-year-old ISS must continue to fly in a safe and human tended condition. While certain spaceflight risks, such as a high-velocity debris impact to the station causing significant structural damage or necessitating the evacuation of the ISS, have been regarded as small, if such event were to occur, the ISS program continuation could be threatened, jeopardizing our investment and potential revenue generation from ISS-based Earth imaging.

We may not be able to enforce or protect our intellectual property rights, or third parties may claim we infringe their intellectual rights, each which may harm our ability to compete and thus harm our business.

Our ability to enforce and protect our patents, copyrights, software licenses, trade secrets, know-how, and other intellectual property rights is subject to general litigation risks, as well as uncertainty as to the enforceability of our intellectual property rights in various countries. When we seek to enforce our rights, we have found that various claims may be asserted against us, including claims that our intellectual property right is invalid, is otherwise not enforceable or is licensed to the party against whom we are asserting a claim. In addition, we may be the target of aggressive and opportunistic enforcement of patents by third parties. If we are not ultimately successful in defending ourselves against these claims in litigation, we may not be able to sell a product or family of products due to an injunction, or we may have to pay damages that could, in turn, harm our results of operations. Our inability to enforce our intellectual property rights under these circumstances may harm our competitive position and our business.

Higher tax rates may harm our results of operations and cash flow.

Our effective tax rate for 2019 was 15.1%, compared with 15.3% for 2018 and 20.8% for 2017. While in December 2017, the Tax Cuts and Jobs Act of 2017 was signed into law, which in general lowered corporate tax rates in the United States, a number of factors may impact our effective tax rates, which could reduce our net income and increase our tax payments, including:

- the relative amount of income we earn in other jurisdictions;
- changes in tax laws or their interpretation, including changes in the United States to the taxation of foreign income and expenses, changes in tax laws in foreign jurisdictions, and changes in U.S. generally accepted accounting principles and governing body pronouncements and interpretations;
- the resolution of issues arising from tax audits;
- changes in valuation of our deferred tax assets and liabilities, including deferred tax valuation allowances;
- adjustments to income taxes upon finalization of tax returns;
- increases in expense not deductible for tax purposes;
- changes in available tax credits; and
- any decision to repatriate non-U.S. earnings for which we have not made provision for U.S. taxes.

Our financial statements are based on estimates required by Generally Accepted Accounting Principles in the United States ("GAAP"), and actual results may differ materially from those estimated under different assumptions or conditions.

Our financial statements are prepared in conformity with GAAP. These principles require our management to make estimates and assumptions that affect the reported amounts of assets and liabilities at the date of the financial statements and the reported amounts of revenue and expenses during the reporting period. For example, estimates are used when accounting for items such as revenue, asset valuations, allowances for doubtful accounts, allowance for excess and obsolete inventory, depreciation and amortization, impairment assessments, employee benefits, taxes, recall and warranty costs, product and general liability and contingencies. While we base our estimates on historical experience and on various assumptions that we believe to be reasonable under the circumstances at the time made, actual results may differ materially from those estimated. Our most critical accounting estimates are described in "Item 7. Management Discussion and Analysis of Financial Condition and Results of Operations" in this Form 10-K under "Critical Accounting Estimates."

There are inherent limitations in internal control systems, and misstatements resulting from error or fraud may occur and may not be detected.

We continue to act to assure compliance with the internal controls, disclosure controls and other requirements of the Sarbanes-Oxley Act of 2002. Our management, including our Chief Executive Officer and Chief Financial Officer, cannot guarantee that our internal controls and disclosure controls will prevent all possible errors or all fraud. A control system, no matter how well conceived and operated, can provide only reasonable, not absolute, assurance that the objectives of the control system are met. In addition, the design of a control system must reflect the fact that there are resource constraints and the benefit of controls must be relative to their costs. Because of the inherent limitations in all control systems, no system of controls can provide absolute assurance that all control issues and instances of fraud, if any, within the Company have been detected. These inherent limitations include the realities that judgments in decision-making can be faulty and that breakdowns can occur because of simple error or mistake. Further, controls can be circumvented by individual acts of some persons, by collusion of two or more persons, or by management override of the controls. The design of any system of controls is also based, in part, upon certain assumptions about the likelihood of future events, and there can be no assurance that any design will succeed in achieving its stated goals under all potential future conditions. Over time, a control may become inadequate because of changes in conditions or the degree of compliance with the policies or procedures may deteriorate. Because of inherent limitations in a cost-effective control system, misstatements resulting from error or fraud may occur and may not be detected.

Provisions of our governing documents, applicable law, and our Change in Control Severance Agreements could make an acquisition of Teledyne more difficult.

Our Restated Certificate of Incorporation, our Amended and Restated Bylaws and the General Corporation Law of the State of Delaware contain several provisions that could make the acquisition of control of Teledyne, in a transaction not approved by our Board of Directors, more difficult. We have also entered into Change in Control Severance Agreements with ten members of our current management, which could have an anti-takeover effect. These provisions may prevent or discourage attempts to acquire our company.

The market price of our Common Stock has fluctuated significantly since we became a public company, and could continue to do so.

The market price of our Common Stock has fluctuated substantially and fluctuations in our stock price could continue. In 2019, the price of our Common Stock ranged from $198.15 to $351.53. Subsequent to year-end 2019, our Common Stock hit a high of $398.99 on January 22, 2020. On February 21, 2020, the closing price of our Common Stock was $385.66.

Among the factors that could affect our stock price are:

- quarterly variations in our operating results;
- strategic actions by us or our competitors;
- acquisitions;
- divestitures;
- stock repurchases;
- adverse business developments;
- war in the Middle East or elsewhere;
- terrorists' activities;
- military or homeland defense activities;
- changes to the U.S. Federal budget or other government budgets;
- changes in the energy exploration or production, semiconductor, digital imaging, telecommunications, commercial aviation, and electronic manufacturing services markets;
- general market conditions;
- changes in tax laws;
- general economic factors unrelated to our performance;
- changes from analysts' expectations in revenues, earnings or other financial results; and
- one or more of the risk factors described in this report.

Stock markets in general, and the markets for high-technology companies in particular, have experienced a high degree of volatility that is not necessarily related to the operating performance of these companies. We cannot provide assurances as to our stock price. We have in the past repurchased shares of our stock pursuant to board-approved stock repurchase programs. We cannot provide assurances that we will continue to repurchase shares under those programs, or that our board will authorize new repurchase programs.

Item 1B. Unresolved Staff Comments

None.

Item 2. Properties

The Company has 70 principal operating facilities in 17 states and six foreign countries. The Company's executive offices are located in Thousand Oaks, California. Its principal research and development center is also located in Thousand Oaks, California. We maintain our facilities in good operating condition, and we believe they are suitable and adequate for the purposes for which they are intended and overall have sufficient capacity to conduct business as currently conducted.

Information on the number, ownership and location of principal operating facilities by segment was as follows at February 21, 2020:

			Location of Facilities	
Segment	Owned	Leased	States	Countries
Instrumentation	16	13	California, Colorado, Florida, Massachusetts, Nebraska, New Hampshire, New York, Ohio, Pennsylvania, Texas and Virginia	United States, Canada, Denmark, France and United Kingdom
Digital Imaging	13	7	California, Massachusetts, New Jersey and North Carolina	United States, Belgium, Canada, France, The Netherlands and United Kingdom
Aerospace and Defense Electronics	6	8	California, Illinois, Pennsylvania and Texas	United States and United Kingdom
Engineered Systems	2	5	Alabama, Maryland, Ohio and Tennessee	United States
Total	37	33		

Item 3. Legal Proceedings

From time to time, we become involved in various lawsuits, claims and proceedings arising out of, or incident to, our ordinary course of business including lawsuits, claims or proceedings pertaining to product liability, patent infringement, commercial contracts, employment and employee benefits. While we cannot predict the outcome of any lawsuit, claim or proceeding, our management does not believe that the disposition of any pending matters is likely to have a material adverse effect on our business, financial condition or liquidity.

Item 4. Mine Safety Disclosures

No information is required in response to this item.

PART II

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

Our Common Stock is listed on the New York Stock Exchange and traded under the symbol "TDY". The following table sets forth, for the periods indicated, the high and low sale prices for the Common Stock as reported by the New York Stock Exchange.

As of February 18, 2020, there were 2,791 holders of record of the Common Stock. Because many of our shares of common stock are held by brokers and institutions on behalf of stockholders, we are unable to estimate the total number of beneficial owners of our stock represented by these stockholders of record.

We intend to use future earnings to fund the development and growth of our businesses, including through potential acquisitions. We may also deploy cash to fund share repurchases. Therefore, we do not anticipate paying any cash dividends in the foreseeable future.

We have stock repurchase programs authorized by our Board of Directors to repurchase up to approximately three million shares. No repurchases were made since 2015. See Note 8 of the Notes to Consolidated Financial Statements for additional information about our stock repurchase program.

Information relating to compensation plans under which our equity securities are outstanding for issuance is set forth in Part III, Item 12 of this Annual Report on Form 10-K.

In each of December 2019, December 2018 and December 2017, we withheld shares upon the vesting of restricted stock unit awards to satisfy tax withholding obligations in the amounts of 2,651 shares, 2,651 shares and 2,960 shares, respectively

Item 6. Selected Financial Data

The following table presents our summary consolidated financial data. We derived the following historical selected financial data from our audited consolidated financial statements. Our fiscal year is determined based on a 52- or 53-week convention ending on the Sunday nearest to December 31. Each fiscal year presented below contained 52 weeks except for fiscal year 2015 which contained 53 weeks. The five-year summary of selected financial data should be read in conjunction with the discussion under "Item 7-Management's Discussion and Analysis of Financial Condition and Results of Operation" and the Notes to Consolidated Financial Statements.

Five-Year Summary of Selected Financial Data

	2019	2018	2017	2016	2015
	(In millions, except per-share amounts)				
Net sales	**$ 3,163.6**	$ 2,901.8	$ 2,603.8	$ 2,149.9	$ 2,298.1
Net income	**$ 402.3**	$ 333.8	$ 227.2	$ 190.9	$ 195.5
Net income attributable to Teledyne	**$ 402.3**	$ 333.8	$ 227.2	$ 190.9	$ 195.8
Basic earnings per common share	**$ 11.08**	$ 9.32	$ 6.45	$ 5.52	$ 5.55
Diluted earnings per common share	**$ 10.73**	$ 9.01	$ 6.26	$ 5.37	$ 5.44
Weighted average diluted common shares outstanding	**37.5**	37.0	36.3	35.5	36.0
Total assets	**$ 4,579.8**	$ 3,809.3	$ 3,846.4	$ 2,774.4	$ 2,717.1
Long-term debt, less current portion	**$ 750.0**	$ 610.1	$ 1,063.9	$ 509.7	$ 754.1
Total stockholders' equity	**$ 2,714.7**	$ 2,229.7	$ 1,947.3	$ 1,554.4	$ 1,344.1

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

Teledyne Technologies Incorporated provides enabling technologies for industrial growth markets that require advanced technology and high reliability. These markets include aerospace and defense, factory automation, air and water quality environmental monitoring, oceanographic research, deepwater oil and gas exploration and production, medical imaging and pharmaceutical research. Our products include digital imaging sensors, cameras and systems within the visible, infrared and X-ray spectra, monitoring instrumentation for marine and environmental applications, harsh environment interconnects, electronic test and measurement equipment, aircraft information management systems, and defense electronics and satellite communication subsystems. We also supply engineered systems for defense, space, environmental and energy applications. We differentiate ourselves from many of our direct competitors by having a customer- and company-sponsored applied research center that augments our product development expertise.

Strategy/Overview

Our strategy continues to emphasize growth in our core markets of instrumentation, digital imaging, aerospace and defense electronics and engineered systems. Our core markets are characterized by high barriers to entry and include specialized products and services not likely to be commoditized. We intend to strengthen and expand our core businesses with targeted acquisitions and through product development. We continue to focus on balanced and disciplined capital deployment among capital expenditures, acquisitions, product development and share repurchases. We aggressively pursue operational excellence to continually improve our margins and earnings by emphasizing cost containment and cost reductions in all aspects of our business. At Teledyne, operational excellence includes the rapid integration of the businesses we acquire. Using complementary technology across our businesses and internal research and development, we seek to create new products to grow our company and expand our addressable markets. We continue to evaluate our businesses to ensure that they are aligned with our strategy.

Consistent with this strategy, we made three acquisitions in 2019 and in March 2017, we made our largest acquisition to date, e2v technologies plc ("e2v"). See the Recent Acquisitions section following this section.

In the third quarter of 2019, we realigned the segment reporting structure for certain business units, primarily related to certain refinements of our management reporting structure. This change primarily related to moving certain electronic manufacturing services products from the Aerospace and Defense Electronics segment to the Engineered Systems segment. Total net sales for these products were $76.2 million for fiscal year 2018. Other immaterial changes included moving certain United Kingdom ("U.K.") microwave product lines (previously within the Digital Imaging segment) and certain U.K. manufactured composite parts (previously within the Engineered Systems segment) into the Aerospace and Defense Electronics segment. Total net sales for these U.K. product lines was less than $20.0 million for fiscal year 2018. The realignment had no impact on the Instrumentation segment or the Consolidated Financial Statements. See Note 12 of the Notes to Consolidated Financial Statements for additional information on the realignment. Previously reported segment data has been adjusted to reflect these changes.

As part of a continuing effort to reduce costs and improve operating performance, we may take and have taken actions to consolidate and relocate certain facilities and reduce headcount across various businesses, reducing our exposure to weak end markets and high cost locations. We continue to seek cost reductions in our businesses. At December 29, 2019, $1.5 million remains to be paid related to these actions.

The following pre-tax charges were incurred related to severance and facility consolidations (in millions):

	2019	2018	2017
Instrumentation	**$ 1.5**	$ 5.6	$ 2.1
Digital Imaging	**1.1**	0.7	—
Aerospace and Defense Electronics	**0.5**	1.3	2.1
Engineered Systems	**0.1**	0.2	—
Total	**$ 3.2**	$ 7.8	$ 4.2

	2019	2018	2017
Severance	**$ 3.5**	$ 5.6	$ 3.8
Facility consolidations (a)	**(0.3)**	2.2	0.4
Total	**$ 3.2**	$ 7.8	$ 4.2

(a) 2019 includes the reversal of certain amounts recorded in 2018 no longer needed.

	2019	2018	2017
Cost of sales	**$ 0.8**	$ 4.9	$ 2.8
Selling, general and administrative expenses	**2.4**	2.9	1.4
Total	**$ 3.2**	$ 7.8	$ 4.2

Recent Acquisitions

The Company spent $484.0 million, $3.1 million and $774.1 million on acquisitions and other investments, net of cash acquired in 2019, 2018 and 2017, respectively.

2019 Acquisitions

On February 5, 2019, we acquired the scientific imaging businesses of Roper Technologies, Inc. for $224.8 million in cash. The acquired businesses include Princeton Instruments, Photometrics and Lumenera. The acquired businesses provide a range of imaging solutions, primarily for life sciences, academic research and customized OEM industrial imaging solutions. Princeton Instruments and Photometrics manufacture state-of-the-art cameras, spectrographs and optics for advanced research in physical sciences, life sciences research and spectroscopy imaging. Applications and markets include materials analysis, quantum technology and cell biology imaging using fluorescence and chemiluminescence. Lumenera primarily provides rugged USB-based customized cameras for markets such as traffic management, as well as life sciences applications. Principally located in the United States and Canada, the acquired businesses are part of the Digital Imaging segment.

On August 1, 2019, we acquired the gas and flame detection businesses of 3M Company for $233.5 million in cash. The gas and flame detection businesses includes Oldham, Simtronics, Gas Measurement Instruments, Detcon and select Scott Safety products. The gas and flame detection businesses provides a portfolio of fixed and portable industrial gas and flame detection instruments used in a variety of industries including petrochemical, power generation, oil and gas, food and beverage, mining and waste water treatment. Principally located in France, the United Kingdom and the United States, the acquired businesses are part of the Environmental Instrumentation product line of the Instrumentation segment.

On August 30, 2019, we acquired Micralyne Inc. (“Micralyne”) for $25.7 million in cash. Micralyne provides micro electromechanical systems (“MEMS”) devices. In particular, Micralyne possesses unique microfluidic technology for biotech applications, as well as capabilities in non-silicon-based MEMS (e.g. gold, polymers) often required for human body compatibility. Based in Edmonton, Alberta, Canada, the acquired business is part of the Digital Imaging segment.

2017 Acquisitions

On March 28, 2017, we completed the acquisition of all of the outstanding common stock of e2v for $770.7 million, including stock options and assumed debt, net of $24.4 million of cash acquired. Most of e2v’s operations are included in the Digital Imaging and Aerospace and Defense Electronics segments. The Instrumentation segment includes a small portion of e2v’s operations. Principally located in Chelmsford, United Kingdom and Grenoble, France, e2v’s results have been included since the date of the acquisition and include $273.7 million in net sales and operating income of $37.3 million, which included $8.3 million in acquisition-related costs and $11.2 million in additional intangible asset amortization expense for fiscal year 2017.

Fiscal year 2017 includes pretax charges of $27.0 million related to the acquisition of e2v, which included $13.0 million in transaction costs, including stamp duty, advisory, legal and other consulting fees and other costs recorded to selling, general and administrative expenses, $5.7 million in inventory fair value step-up amortization expense recorded to cost of sales, $6.0 million related to a foreign currency option contract expense to hedge the e2v purchase price recorded as other expense and $2.3 million in bank bridge facility commitment expense recorded to interest expense. Of these amounts, $8.3 million impacted segment operating income.

On July 20, 2017, Teledyne Instruments, Inc. completed the acquisition of assets of Scientific Systems, Inc. (“SSI”) for $31.0 million in cash. Headquartered in State College, Pa., SSI is a manufacturer of precision components and specialized subassemblies used primarily in analytical and diagnostic instrumentation, such as high performance liquid chromatography systems and specific medical devices. SSI designs and manufactures high pressure positive-displacement piston pumps for a wide variety of analytical, clinical, sample prep and fluid-metering applications and is part of the Environmental Instrumentation product line of the Instrumentation segment.

See Note 3 of the Notes to Consolidated Financial Statements for additional information about our recent acquisitions.

Consolidated Operating Results

Our fiscal year is determined based on a 52- or 53-week convention ending on the Sunday nearest to December 31. Fiscal years 2019, 2018 and 2017 each contained 52 weeks. The following are selected financial highlights for 2019, 2018 and 2017 (in millions, except per-share amounts):

	2019	2018	2017
Net sales	**$ 3,163.6**	$ 2,901.8	$ 2,603.8
Costs and expenses			
Cost of sales	**1,920.3**	1,791.0	1,624.0
Selling, general and administrative expenses	**751.6**	694.2	658.1
Total costs and expenses	**2,671.9**	2,485.2	2,282.1
Operating income	**491.7**	416.6	321.7
Interest and debt expense, net	**(21.0)**	(25.5)	(33.1)
Non-service retirement benefit income	**8.0**	13.5	13.9
Other expense, net	**(5.0)**	(10.7)	(15.5)
Income before income taxes	**473.7**	393.9	287.0
Provision for income taxes	**71.4**	60.1	59.8
Net income	**$ 402.3**	$ 333.8	$ 227.2
Basic earnings per common share	**$ 11.08**	$ 9.32	$ 6.45
Diluted earnings per common share	**$ 10.73**	$ 9.01	$ 6.26

Our businesses are aligned in four business segments: Instrumentation, Digital Imaging, Aerospace and Defense Electronics and Engineered Systems. Our four business segments and their respective percentage contributions to our total sales in 2019, 2018 and 2017 are summarized in the following table:

	Percentage of Total Net Sales		
Segment contribution to total net sales:	**2019**	**2018**	**2017**
Instrumentation	**35 %**	35 %	37 %
Digital Imaging	**31 %**	30 %	27 %
Aerospace and Defense Electronics	**22 %**	22 %	23 %
Engineered Systems	**12 %**	13 %	13 %
	100 %	100 %	100 %

Results of Operations

2019 compared with 2018

Net sales (dollars in millions)	2019	2018	% Change
Instrumentation	**$ 1,105.1**	$1,021.2	8.2 %
Digital Imaging	**992.9**	875.3	13.4 %
Aerospace and Defense Electronics	**690.1**	640.2	7.8 %
Engineered Systems	**375.5**	365.1	2.8 %
Total net sales	**$ 3,163.6**	$2,901.8	9.0 %

Results of operations (dollars in millions)	2019	2018	% Change
Instrumentation	**$ 200.4**	$ 147.4	36.0 %
Digital Imaging	**176.5**	155.5	13.5 %
Aerospace and Defense Electronics	**143.4**	131.8	8.8 %
Engineered Systems	**36.5**	37.9	(3.7)%
Corporate expense	**(65.1)**	(56.0)	16.3 %
Operating income	**491.7**	416.6	18.0 %
Interest and debt expense, net	**(21.0)**	(25.5)	(17.6)%
Non-service retirement benefit income	**8.0**	13.5	(40.7)%
Other expense, net	**(5.0)**	(10.7)	(53.3)%
Income before income taxes	**473.7**	393.9	20.3 %
Provision for income taxes	**71.4**	60.1	18.8 %
Net income	**$ 402.3**	$ 333.8	20.5 %

Sales and cost of sales by segment and total company (dollars in millions):

	2019	2018	Change
Instrumentation			
Net sales	**$ 1,105.1**	$ 1,021.2	$ 83.9
Cost of sales	**$ 612.8**	$ 575.2	$ 37.6
Cost of sales % of net sales	**55.5 %**	56.3 %	
Digital Imaging			
Net sales	**$ 992.9**	$ 875.3	$ 117.6
Cost of sales	**$ 580.6**	$ 529.4	$ 51.2
Cost of sales % of net sales	**58.5 %**	60.5 %	
Aerospace and Defense Electronics			
Net sales	**$ 690.1**	$ 640.2	$ 49.9
Cost of sales	**$ 414.7**	$ 385.9	$ 28.8
Cost of sales % of net sales	**60.1 %**	60.3 %	
Engineered Systems			
Net sales	**$ 375.5**	$ 365.1	$ 10.4
Cost of sales	**$ 312.2**	$ 300.5	$ 11.7
Cost of sales % of net sales	**83.1 %**	82.3 %	
Total Company			
Net sales	**$ 3,163.6**	$ 2,901.8	$ 261.8
Cost of sales	**$ 1,920.3**	$ 1,791.0	$ 129.3
Cost of sales % of net sales	**60.7 %**	61.7 %	

We reported net sales of $3,163.6 million in 2019, compared with net sales of $2,901.8 million for 2018, an increase of 9.0%. Net income was $402.3 million ($10.73 per diluted share) in 2019, compared with net income of $333.8 million ($9.01 per diluted share) in 2018, an increase of 20.5%.

Total year 2019 and 2018 reflected pretax charges totaling $3.2 million and $7.8 million, respectively, for severance and facility consolidation charges. Net income for 2019 and 2018 also included net discrete tax benefits of $26.1 million and $23.8 million, respectively.

Net sales

The increase in net sales in 2019, compared with 2018, reflected higher net sales in each segment. Net sales in 2019 included revenue growth of $128.7 million plus $133.1 million in incremental net sales from recent acquisitions.

Sales under contracts with the U.S. Government were approximately 24% of net sales in 2019 and 23% of net sales in 2018. Sales to international customers represented approximately 44% of net sales in 2019 and 47% of net sales in 2018.

Cost of Sales

Total cost of sales increased by $129.3 million in 2019, compared with 2018, which primarily reflected the impact of higher net sales. The total company cost of sales as a percentage of net sales for 2019 was 60.7%, compared with 61.7% for 2018.

Selling, general and administrative expenses

Selling, general and administrative expenses, including research and development and bid and proposal expense, were higher in 2019, compared with 2018. The increase primarily reflected the impact of higher sales and higher research and development and bid and proposal expense. Corporate administrative expense in 2019 was $65.1 million, compared with $56.0 million in 2018. The higher 2019 amount reflected higher compensation expense including higher stock option expense. For 2019, we recorded a total of $26.1 million in stock option expense, of which $9.7 million was recorded within corporate expense and $16.4 million was recorded in the operating segment results. For 2018, we recorded a total of $19.8 million in stock option expense, of which $6.3 million was recorded within corporate expense and $13.5 million was recorded in the operating segment results. Selling, general and administrative expenses as a percentage of sales was 23.8% for 2019, compared with 23.9% for 2018.

Pension Service Expense

Pension service expense is included in both cost of sales and selling, general and administrative expense. Pension service expense in 2019 was $9.4 million compared with $10.8 million in 2018.

Operating Income

Operating income for 2019 was $491.7 million, compared with $416.6 million for 2018, an increase of 18.0%. The increase in operating income primarily reflected higher operating income in each segment, except the Engineered Systems segment. Operating income in 2019 and 2018 reflected $3.2 million and $7.8 million in severance and facility consolidation costs, respectively. The incremental operating income included in the results for 2019 from recent acquisitions was $16.2 million.

Interest Expense, Interest Income, Non-Service Retirement Benefit Income and Other Expense

Total interest expense, including credit facility fees and other bank charges, was $22.0 million in 2019 compared with $29.2 million in 2018 and reflected the impact of lower average debt levels in 2019. Interest income was $1.0 million in 2019 and $3.7 million in 2018. Non-service retirement benefit income was $8.0 million in 2019, compared with $13.5 million in 2018. Other expense was $5.0 million for 2019, compared with expense of $10.7 million and reflected lower foreign currency expense in 2019.

Income Taxes

The Company's effective tax rate for 2019 was 15.1%, compared with 15.3% for 2018. For 2019 net discrete income tax benefits were $26.1 million, which included a $15.4 million income tax benefit related to share-based accounting, $13.1 million in income tax benefit as a result of the remeasurement of uncertain tax positions due to expiration of statute of limitations, a favorable tax settlement and a tax benefit related to U.S. export sales. For 2018 net discrete income tax benefits were $23.8 million, which included a $12.9 million income tax benefit related to share-based accounting, $5.1 million in income tax benefit as a result of the remeasurement of uncertain tax positions due to expiration of statute of limitations and a $4.8 million income tax benefit related to the release of a valuation allowance for which the deferred tax assets are now determined more-likely-than-not to be realizable. Excluding the net discrete income tax benefits in both years, the effective tax rates would have been 20.6% for 2019 and 21.3% for 2018.

2018 compared with 2017

Sales (dollars in millions)	**2018**	**2017**	**% Change**
Instrumentation	**$ 1,021.2**	$ 953.9	7.1 %
Digital Imaging	**875.3**	710.4	23.2 %
Aerospace and Defense Electronics	**640.2**	591.2	8.3 %
Engineered Systems	**365.1**	348.3	4.8 %
Total sales	**$ 2,901.8**	$ 2,603.8	11.4 %

Results of operations (dollars in millions)	**2018**	**2017**	**% Change**
Instrumentation	**$ 147.4**	$ 126.0	17.0 %
Digital Imaging	**155.5**	110.2	41.1 %
Aerospace and Defense Electronics	**131.8**	113.0	16.6 %
Engineered Systems	**37.9**	35.5	6.8 %
Corporate expense	**(56.0)**	(63.0)	(11.1)%
Operating income	**416.6**	321.7	29.5 %
Interest and debt expense, net	**(25.5)**	(33.1)	(23.0)%
Non-service retirement benefit income	**13.5**	13.9	(2.9)%
Other expense, net	**(10.7)**	(15.5)	(31.0)%
Income before income taxes	**393.9**	287.0	37.2 %
Provision for income taxes	**60.1**	59.8	0.5 %
Net income	**$ 333.8**	$ 227.2	46.9 %

Sales and cost of sales by segment and total company (dollars in millions):

	2018	**2017**	**Change**
Instrumentation			
Net sales	**$ 1,021.2**	$ 953.9	$ 67.3
Cost of sales	**$ 575.2**	$ 547.2	$ 28.0
Cost of sales % of net sales	**56.3 %**	57.4 %	
Digital Imaging			
Net sales	**$ 875.3**	$ 710.4	$ 164.9
Cost of sales	**$ 529.4**	$ 442.8	$ 86.6
Cost of sales % of net sales	**60.5 %**	62.3 %	
Aerospace and Defense Electronics			
Net sales	**$ 640.2**	$ 591.2	$ 49.0
Cost of sales	**$ 385.9**	$ 348.9	$ 37.0
Cost of sales % of net sales	**60.3 %**	59.0 %	
Engineered Systems			
Net sales	**$ 365.1**	$ 348.3	$ 16.8
Cost of sales	**$ 300.5**	$ 285.1	$ 15.4
Cost of sales % of net sales	**82.3 %**	81.9 %	
Total Company			
Net sales	**$ 2,901.8**	$ 2,603.8	$ 298.0
Cost of sales	**$ 1,791.0**	$ 1,624.0	$ 167.0
Cost of sales % of net sales	**61.7 %**	62.4 %	

We reported net sales of $2,901.8 million in 2018, compared with net sales of $2,603.8 million for 2017, an increase of 11.4%. Net income was $333.8 million ($9.01 per diluted share) in 2018, compared with net income of $227.2 million ($6.26 per diluted share) in 2017, an increase of 46.9%.

Total year 2018 and 2017 reflected pretax charges totaling $7.8 million and $4.2 million, respectively, for severance and facility consolidation charges. Net income for 2018 and 2017 also included net discrete tax benefits of $23.8 million and $17.2 million, respectively. The total year 2017 amount included provisional charges of $4.7 million for the estimated impact of the Tax Cuts and Jobs Act ("Tax Act"). Net income for 2017 included pretax charges totaling $27.0 million related to e2v acquisition related expenses, of which, $5.7 million was recorded to cost of sales, $13.0 million was recorded to selling, general and administrative expenses, $2.3 million was recorded to interest expense and $6.0 million was recorded as other expense. The amount recorded to cost of sales related to the inventory fair value step-up amortization expense. The amount recorded to selling, general and administrative expenses related to transaction costs, including stamp duty, advisory, legal and other consulting fees and other costs. The amount recorded to interest expense related to funds-certain bank bridge facility commitment expense. The amount recorded to other expense related to a foreign currency option contract.

Net sales

The increase in net sales in 2018, compared with 2017, reflected higher net sales in each segment. Net sales in 2018 included revenue growth of $182.9 million plus $115.1 million in incremental net sales from recent acquisitions, primarily e2v. The incremental net sales from the March 2017 e2v acquisition in 2018 was $103.0 million.

Sales under contracts with the U.S. Government were approximately 23% of net sales in 2018 and 24% of net sales in 2017. Sales to international customers represented approximately 47% of net sales in 2018 and 46% of net sales in 2017.

Cost of Sales

Total company cost of sales increased by $167.0 million in 2018, compared with 2017, which primarily reflected the impact of higher net sales. The total company cost of sales as a percentage of sales for 2018 was 61.7%, compared with 62.4% for 2017.

Selling, general and administrative expenses

Selling, general and administrative expenses, including Company-funded research and development and bid and proposal expense, were higher in 2018, compared with 2017. The increase primarily reflected the impact of higher sales and higher research and development and bid and proposal expense. The 2017 amount included $13.0 million in acquisition related expenses for the e2v acquisition. Corporate administrative expense in 2018 was $56.0 million, compared with $63.0 million in 2017. The 2017 amount included $10.4 million in acquisition related expenses for the e2v acquisition. For 2018, we recorded a total of $19.8 million in stock option expense, of which $6.3 million was recorded within corporate expense and $13.5 million was recorded in the operating segment results. For 2017, we recorded a total of $14.2 million in stock option expense, of which $4.5 million was recorded within corporate expense and $9.7 million was recorded in the operating segment results. Selling, general and administrative expenses as a percentage of sales was 23.9% for 2018, compared with 25.3% for 2017. The higher percentage in 2017 reflected the impact of acquisition related expenses for the e2v acquisition.

Pension Service Expense

Pension service expense is included in both cost of sales and selling, general and administrative expense. Pension service expense in 2018 was $10.8 million compared with pension service expense of $11.2 million in 2017.

Operating Income

Operating income for 2018 was $416.6 million, compared with $321.7 million for 2017, an increase of 29.5%. The increase in operating income primarily reflected higher operating income in each segment, as well as lower corporate expense. Operating income in 2018 and 2017 reflected $7.8 million and $4.2 million in severance and facility consolidation costs, respectively. The incremental operating income included in the results for 2018 from recent acquisitions was $43.3 million.

Interest Expense, Interest Income, Non-Service Retirement Benefit Income and Other Expense

Total interest expense, including credit facility fees and other bank charges, was $29.2 million in 2018 compared with $35.5 million in 2017 and reflected the impact of lower debt levels in 2018. Interest expense in 2017 included $2.3 million in fees related to the terminated bridge facility in connection with the acquisition of e2v. Interest income was $3.7 million in 2018 and $2.4 million in 2017. Non-service retirement benefit income was $13.5 million in 2018, compared with $13.9 million in 2017. Other expense was $10.7 million for 2018, compared with expense of $15.5 million. Other expense in 2017 included $6.0 million of expense for a foreign currency option contract related to the e2v acquisition.

Income Taxes

On December 22, 2017, the Tax Act was enacted, which significantly revised the U.S. corporate income tax by, among other things, lowering corporate income tax rates, implementing the territorial tax system and imposing a tax on deemed repatriation of non-U.S. earnings. The repatriation tax resulted in a net tax expense of $26.2 million and the remeasurement of U.S. deferred tax assets and liabilities resulted in a net tax benefit of $21.5 million, for a net provisional charge of $4.7 million recorded in the fourth quarter of 2017. The Company finalized its assessment of the Tax Act during the fourth quarter of 2018, resulting in a decrease of $0.8 million to the provisional charge and the repatriation tax.

The Company's effective tax rate for 2018 was 15.3%, compared with 20.8% for 2017. For 2018 net discrete income tax benefits were $23.8 million, which included a $12.9 million income tax benefit related to share-based accounting, $5.1 million in income tax benefit as a result of the remeasurement of uncertain tax positions due to expiration of statute of limitations and a $4.8 million income tax benefit related to the release of a valuation allowance for which the deferred tax assets are now determined to be more-likely-than-not realizable. For 2017, net discrete income tax benefits were $17.2 million, which included an $8.5 million income tax benefit related to the release of valuation allowance for which the deferred tax assets are now determined more-likely-than-not to be realizable, $8.5 million income tax benefit as a result of the remeasurement of uncertain tax positions due to expiration of statute of limitation, and $8.8 million in net discrete tax benefits related to share-based accounting, partially offset by $4.6 million related to adjustments for uncertain tax positions and the $4.7 million provisional charge, related to the Tax Act.

Excluding the net discrete income tax benefits in both years, the effective tax rates would have been 21.3% for 2018 and 26.8% for 2017. The decrease in the effective tax rate in 2018, primarily reflects the lower corporate income tax rates as part of the Tax Act.

Segments

The following discussion of our four segments should be read in conjunction with Note 12 of the Notes to Consolidated Financial Statements.

Instrumentation

(Dollars in millions)	2019	2018	2017
Net sales	**$ 1,105.1**	$ 1,021.2	$ 953.9
Cost of sales	**$ 612.8**	$ 575.2	$ 547.2
Selling, general and administrative expenses	**$ 291.9**	$ 298.6	$ 280.7
Operating income	**$ 200.4**	$ 147.4	$ 126.0
Cost of sales % of net sales	**55.5 %**	56.3 %	57.4 %
Selling, general and administrative expenses % of net sales	**26.4 %**	29.3 %	29.4 %
Operating income % of net sales	**18.1 %**	14.4 %	13.2 %
International sales % of net sales	**54.8 %**	51.0 %	53.7 %
U.S. Government sales % of net sales	**7.3 %**	6.7 %	6.8 %

Our Instrumentation segment provides monitoring and control instruments for marine, environmental, industrial and other applications, as well as electronic test and measurement equipment. We also provide power and communications connectivity devices for distributed instrumentation systems and sensor networks deployed in mission critical, harsh environments.

2019 compared with 2018

Our Instrumentation segment net sales for 2019 increased 8.2%, compared with 2018. Operating income for 2019 increased 36.0%, compared with 2018.

The 2019 net sales increase primarily resulted from higher sales of environmental instrumentation, marine instrumentation and test and measurement instrumentation, as well as the contribution from the gas and flame detection business acquisition. Sales of environmental instrumentation increased $51.8 million and included $45.3 million in incremental sales from the gas and flame detection business acquisition. Sales of marine instrumentation increased by $17.2 million. Sales of test and measurement instrumentation increased $14.9 million. The increase in operating income reflected the impact of higher sales and higher margins across most product lines. The incremental operating income included in the results for 2019 from the gas and flame detection business acquisition was $4.1 million. Operating income in 2019 included $1.5 million in severance and facility consolidation costs compared with $5.6 million in severance and facility consolidation costs for 2018.

Cost of sales increased by $37.6 million in 2019, compared with 2018, and primarily reflected the impact of higher net sales. The cost of sales percentage decreased slightly to 55.5% in 2019 from 56.3% in 2018. Selling, general and administrative expenses, including research and development and bid and proposal expense, in 2019, decreased by $6.7 million, compared with 2018, and reflected the impact of cost control efforts, lower severance and facility consolidation costs and lower research and development and bid and proposal expense of $3.2 million. Selling, general and administrative expenses for 2019, as a percentage of sales, decreased to 26.4%, compared with 29.3% for 2018, and reflected the impact of cost control efforts, lower severance and facility consolidation costs and lower research and development and bid and proposal expense.

2018 compared with 2017

Our Instrumentation segment net sales for 2018 increased 7.1%, compared with 2017. Operating income increased 17.0%, compared with 2017.

The 2018 net sales increase primarily resulted from higher sales of test and measurement instrumentation, environmental instrumentation and marine instrumentation, as well as the contribution from the SSI acquisition. Sales of test and measurement instrumentation increased $39.7 million. Sales of environmental instrumentation increased $25.3 million and included $12.1 million in incremental sales from the SSI acquisition. Sales of marine instrumentation increased by $2.3 million. The increase in operating income was primarily due to higher sales and improved margins for test and measurement instrumentation. Operating income in 2017 included a $2.6 million reversal of a previously reserved receivable that was collected during 2017. The incremental operating income included in the results for 2018 from recent acquisitions was $3.5 million.

Cost of sales increased by $28.0 million in 2018, compared with 2017, and primarily reflected the impact of higher net sales. The cost of sales percentage decreased to 56.3% in 2018 from 57.4% in 2017. Selling, general and administrative expenses, including research and development and bid and proposal expense, in 2018, increased by $17.9 million, compared with 2017, and primarily reflected the impact of higher net sales. Selling, general and administrative expenses for 2018, as a percentage of net sales, decreased slightly to 29.3%, compared with 29.4% for 2017.

Digital Imaging

(Dollars in millions)	2019	2018 (a)	2017 (a)
Net sales	**$ 992.9**	$ 875.3	$ 710.4
Cost of sales	**$ 580.6**	$ 529.4	$ 442.8
Selling, general and administrative expenses	**$ 235.8**	$ 190.4	$ 157.4
Operating income	**$ 176.5**	$ 155.5	$ 110.2
Cost of sales % of net sales	**58.5 %**	60.5 %	62.3 %
Selling, general and administrative expenses % of net sales	**23.7 %**	21.7 %	22.2 %
Operating income % of net sales	**17.8 %**	17.8 %	15.5 %
International sales % of net sales	**59.7 %**	66.0 %	61.2 %
U.S. Government sales % of net sales	**10.8 %**	10.3 %	12.1 %

(a) Previously reported segment data for 2018 and 2017 has been adjusted to reflect the third quarter 2019 segment realignment.

Our Digital Imaging segment includes high-performance sensors, cameras and systems, within the visible, infrared and X-ray spectra for use in industrial, government and medical applications, as well as MEMS and high-performance, high-reliability semiconductors including analog-to-digital and digital-to-analog converters. It also includes our sponsored and centralized research laboratories which benefit government programs and commercial businesses.

2019 compared with 2018

Our Digital Imaging segment net sales for 2019 increased 13.4%, compared with 2018. Operating income for 2019 increased 13.5%, compared with 2018.

Total year 2019 net sales primarily reflected higher sales of X-ray detectors for life sciences applications and aerospace, defense and MEMS products, as well as $87.8 million in sales from recent acquisitions, partially offset by lower sales of industrial machine vision products. The increase in operating income for 2019 reflected the impact of higher sales and incremental operating profit from recent acquisitions. The incremental operating income reflected in the results for 2019 from recent acquisitions was $12.1 million which included $4.7 million in additional intangible asset amortization expense.

Cost of sales for 2019 increased by $51.2 million, compared with 2018, and reflected the impact of higher net sales. The cost of sales percentage in 2019 decreased to 58.5% compared with 60.5% in 2018 and reflected product mix differences. Selling, general and administrative expenses for 2019 increased to $235.8 million, compared with $190.4 million in 2018 and reflected the impact of higher net sales, higher research and development and bid and proposal expense and intangible amortization expense from recent acquisitions. The selling, general and administrative expense percentage increased to 23.7% in 2019 from 21.7% in 2018 and reflected the impact of higher research and development and bid and proposal expense and intangible amortization expense from recent acquisitions.

2018 compared with 2017

Our Digital Imaging segment net sales for 2018 increased 23.2%, compared with 2017. Operating income for 2018 increased 41.1%, compared with 2017.

The 2018 net sales included organic growth of $77.4 million and $87.5 million in incremental net sales from the e2v acquisition. Total year 2018 also reflected higher sales of X-ray detectors for life sciences applications, machine vision cameras for industrial applications, infrared detectors, geospatial hardware and software and MEMS products. The increase in operating income for 2018 reflected the impact of higher sales, favorable product mix and incremental operating profit from e2v. Operating income in 2017 reflected $8.0 million in acquisition-related costs related to the e2v acquisition. The incremental operating income reflected in the results for 2018 from the e2v acquisition was $31.3 million which included $1.1 million in additional intangible asset amortization expense.

Cost of sales for 2018 increased by $86.6 million, compared with 2017, and reflected the impact of higher net sales. The cost of sales percentage in 2018 decreased to 60.5% compared with 62.3% in 2017 and reflected product mix differences, as well as the inclusion in 2017 of $5.4 million of inventory fair value step-up amortization expense related to the e2v acquisition. Selling, general and administrative expenses for 2018 increased to $190.4 million, compared with $157.4 million in 2017 and reflected the impact of higher net sales. The selling, general and administrative expense percentage decreased slightly to 21.7% in 2018 from 22.2% in 2017.

Aerospace and Defense Electronics

(Dollars in millions)	2019	2018 (a)	2017 (a)
Net sales	**$ 690.1**	$ 640.2	$ 591.2
Cost of sales	**$ 414.7**	$ 385.9	$ 348.9
Selling, general and administrative expenses	**$ 132.0**	$ 122.5	$ 129.3
Operating income	**$ 143.4**	$ 131.8	$ 113.0
Cost of sales % of net sales	**60.1 %**	60.3 %	59.0 %
Selling, general and administrative expenses % of net sales	**19.1 %**	19.1 %	21.9 %
Operating income % of net sales	**20.8 %**	20.6 %	19.1 %
International sales % of net sales	**27.4 %**	34.1 %	40.8 %
U.S. Government sales % of net sales	**32.6 %**	27.7 %	26.6 %

(a) Previously reported segment data for 2018 and 2017 has been adjusted to reflect the third quarter 2019 segment realignment.

Our Aerospace and Defense Electronics segment provides sophisticated electronic components and subsystems and communications products, including defense electronics, harsh environment interconnects, data acquisition and communications equipment for aircraft, and components and subsystems for wireless and satellite communications, as well as general aviation batteries.

2019 compared with 2018

Our Aerospace and Defense Electronics segment net sales for 2019 increased 7.8%, compared with 2018. Operating income for 2019 increased 8.8%, compared with 2018.

The 2019 net sales increase reflected $57.9 million of higher sales of defense electronics, partially offset by $8.0 million of lower sales of aerospace electronics. The higher sales of defense electronics reflected greater sales in most product categories. Operating income in 2019 reflected the impact of higher net sales.

Cost of sales for 2019 increased by $28.8 million, compared with 2018, and reflected the impact of higher net sales. Cost of sales as a percentage of net sales for 2019 decreased slightly to 60.1% from 60.3% in 2018. Selling, general and administrative expenses, including research and development and bid and proposal expense, increased to $132.0 million in 2019, from $122.5 million in 2018 and reflected higher research and development and bid and proposal expense of $10.5 million. The selling, general and administrative expense percentage was 19.1% for both 2019 and 2018.

2018 compared with 2017

Our Aerospace and Defense Electronics segment net sales for 2018 increased 8.3%, compared with 2017. Operating income for 2018 increased 16.6%, compared with 2017.

The 2018 net sales increase reflected $59.5 million of higher sales of defense electronics, partially offset by $10.5 million of lower sales of aerospace electronics. The higher sales of defense electronics reflected higher sales in most product categories and included $14.9 million in incremental sales from the e2v acquisition. Operating income in 2018 reflected the impact of higher net sales, overall improved margins and favorable product mix. The incremental operating income included in the results for 2018 from the e2v acquisition was $8.5 million.

Cost of sales for 2018 increased by $37.0 million, compared with 2017, and reflected the impact of higher net sales. Cost of sales as a percentage of net sales for 2018 increased to 60.3% from 59.0% in 2017. Selling, general and administrative expenses, including research and development and bid and proposal expense, decreased to $122.5 million in 2018, from $129.3 million in 2017 and reflected lower research and development and bid and proposal expense of $9.8 million. The selling, general and administrative expense percentage in 2018 decreased to 19.1% from 21.9% for 2017 and reflected the impact of lower research and development and bid and proposal expense.

Engineered Systems

(Dollars in millions)	2019	2018 (a)	2017 (a)
Net sales	**$ 375.5**	$ 365.1	$ 348.3
Cost of sales	**$ 312.2**	$ 300.5	$ 285.1
Selling, general and administrative expenses	**$ 26.8**	$ 26.7	$ 27.7
Operating income	**$ 36.5**	$ 37.9	$ 35.5
Cost of sales % of net sales	**83.1 %**	82.3 %	81.9 %
Selling, general and administrative expenses % of net sales	**7.2 %**	7.3 %	7.9 %
Operating income % of net sales	**9.7 %**	10.4 %	10.2 %
International sales % of net sales	**1.1 %**	2.9 %	2.8 %
U.S. Government sales % of net sales	**92.3 %**	87.5 %	89.5 %

(a) Previously reported segment data for 2018 and 2017 has been adjusted to reflect the third quarter 2019 segment realignment.

Our Engineered Systems segment provides innovative systems engineering and integration, advanced technology development, and manufacturing solutions for defense, space, environmental and energy applications. This segment also designs and manufactures electrochemical energy systems and small turbine engines.

2019 compared with 2018

Our Engineered Systems segment net sales for 2019 increased 2.8%, compared with 2018. Operating income for 2019 decreased 3.7%, compared with 2018.

The 2019 sales increase of $10.4 million reflected higher sales of $14.3 million of engineered products and services, partially offset by lower sales of $2.6 million of energy systems products and $1.3 million of turbine engines. The higher sales of engineered products and services primarily reflected increased sales for nuclear manufacturing and space programs. Operating income in 2019 decreased due to product mix differences.

Cost of sales for 2019 increased by $11.7 million, compared with 2018, and primarily reflected the impact of higher net sales. Cost of sales as a percentage of net sales for 2019 increased slightly 83.1%, compared with 82.3% in 2018. Selling, general and administrative expenses, including research and development and bid and proposal expense, increased slightly to $26.8 million in 2019, compared with $26.7 million in 2018. The selling, general and administrative expense percentage decreased slightly to 7.2% for 2019, compared with 7.3% in 2018.

2018 compared with 2017

Our Engineered Systems segment net sales for 2018 increased 4.8%, compared with 2017. Operating income for 2018 increased 6.8%, compared with 2017.

The 2018 sales increase of $16.8 million reflected higher sales of $28.8 million of engineered products and services, partially offset by lower sales of $12.0 million of turbine engines. The higher sales of engineered products and services, primarily reflected increased nuclear and aviation manufacturing programs and increased sales related to missile defense. Sales of turbine engines reflected lower sales of cruise missile engines. Operating income in 2018 increased due to higher sales of engineered products and services, partially offset by lower sales of turbine engines.

Cost of sales for 2018 increased by $15.4 million, compared with 2017, and reflected the impact of higher net sales. Cost of sales as a percentage of net sales for 2018 increased slightly to 82.3%, compared with 81.9% in 2017. Selling, general and administrative expenses, including research and development and bid and proposal expense, decreased to $26.7 million in 2018, compared with $27.7 million in 2017, and reflected the impact of lower research and development and bid and proposal expense of $1.8 million. The selling, general and administrative expense percentage decreased to 7.3% for 2018, compared with 7.9% in 2017, and reflected the impact of lower research and development and bid and proposal expense.

Financial Condition, Liquidity and Capital Resources

Principal Cash and Capital Requirements

Our principal cash and capital requirements are to fund working capital needs, capital expenditures, income tax payments and debt service requirements, as well as acquisitions. We may deploy cash for stock repurchases. It is anticipated that operating cash flow, together with available borrowings under the credit facility described below, will be sufficient to meet these requirements and could be used to fund acquisitions in 2020. To support acquisitions, we may need to raise additional capital. Our liquidity is not dependent upon the use of off-balance sheet financial arrangements. We have no off-balance sheet financing arrangements that incorporate the use of special purpose or unconsolidated entities.

Credit Facility, Senior Notes and Term Loans

Long-term debt (in millions):	**December 29, 2019**	**December 30, 2018**
$750.0 million credit facility, due March 2024, weighted average rate of 2.80% at December 29, 2019 and 5.50% at December 30, 2018	**$ 125.0**	$ 29.0
Term loan repaid October 2019, variable rate of 3.63% at December 30, 2018, swapped to a Euro fixed rate of 0.7055%	**—**	100.0
Term loan due October 2024, variable rate of 2.702% at December 29, 2019, swapped to a Euro fixed rate of 0.612%	**150.0**	**—**
2.61% Fixed Rate Senior Notes repaid December 2019	**—**	30.0
5.30% Fixed Rate Senior Notes due September 2020	**75.0**	75.0
2.81% Fixed Rate Senior Notes due November 2020	**25.0**	25.0
3.09% Fixed Rate Senior Notes due December 2021	**95.0**	95.0
3.28% Fixed Rate Senior Notes due November 2022	**100.0**	100.0
0.70% €50 Million Fixed Rate Senior Notes due April 2022	**56.0**	57.2
0.92% €100 Million Fixed Rate Senior Notes due April 2023	**111.9**	114.4
1.09% €100 Million Fixed Rate Senior Notes due April 2024	**111.9**	114.4
Other debt	**2.0**	8.8
Debt issuance costs	**(1.2)**	(1.3)
Total long-term debt	**850.6**	747.5
Current portion of long-term debt	**(100.6)**	(137.4)
Total long-term debt, net of current portion	**$ 750.0**	$ 610.1

At December 29, 2019, we had $29.2 million in outstanding letters of credit.

On March 15, 2019, Teledyne amended its $750.0 million credit agreement to extend the maturity date from December 2020 to March 2024. While the borrowing capacity remains at $750.0 million, the amendment permits Teledyne to increase the aggregate amount of the borrowing capacity by up to $250.0 million subject to certain conditions. Excluding interest and fees, no payments are due under the $750.0 million unsecured credit facility ("credit facility") until it matures. Borrowings under our credit facility and term loans are at variable rates which are, at our option, tied to a Eurocurrency rate equal to LIBOR (London Interbank Offered Rate) plus an applicable rate or a base rate as defined in our credit agreements. Eurocurrency rate loans may be denominated in U.S. dollars or an alternative currency as defined in the agreement. Eurocurrency or LIBOR based loans under the facility typically have terms of one, two, three or six months and the interest rate for each such loan is subject to change if the loan is continued or converted following the applicable maturity date. The Company has not drawn any loans with a term longer than three months under the credit facility. Base rate loans have interest rates that primarily fluctuate with changes in the prime rate. Interest rates are also subject to change based on our consolidated leverage ratio as defined in the credit agreement. The credit facility also provides for facility fees that vary between 0.12% and 0.25% of the credit line, depending on our consolidated leverage ratio.

In October 2019, Teledyne and its subsidiary, Teledyne Netherlands B.V., as borrowers, entered into an Amended and Restated Term Loan Credit Agreement (the "Amended Term Loan Credit Agreement") that amends and restates the Term Loan Credit Agreement dated as of March 17, 2017. Pursuant to the Amended Term Loan Credit Agreement, the lenders thereunder made unsecured term loans in an aggregate principal amount of $150.0 million, denominated in US dollars, $100.0 million of which was used to repay outstanding loans, which had a maturity date of October 30, 2019. Also, on October 30, 2019,

Teledyne entered into a cross currency swap to effectively convert the $150.0 million term loan to a €135.2 million denominated instrument with a fixed euro interest rate of 0.612%.

Our credit facility, senior notes and term loans agreements require the Company to comply with various financial and operating covenants, including maintaining certain consolidated leverage and interest coverage ratios, as well as minimum net worth levels and limits on acquired debt. At December 29, 2019, the Company was in compliance with these covenants and we had a significant amount of margin between required financial covenant ratios and our actual ratios. Currently, we do not believe our ability to undertake additional debt financing, if needed, is reasonably likely to be materially impacted by debt restrictions under our credit agreements subject to our complying with required financial covenants listed in the table below.

Financial covenant ratios and the actual ratios at December 29, 2019:

$750.0 million Credit Facility expires March 2024 and $150.0 million term loan due October 2024 (issued October 2019)

Financial Covenant	Requirement	Actual Measure
Consolidated Leverage Ratio (Net Debt/EBITDA) (a)	No more than 3.25 to 1	1.4 to 1
Consolidated Interest Coverage Ratio (EBITDA/Interest) (b)	No less than 3.0 to 1	22.6 to 1

$574.8 million Private Placement Senior Notes due from 2020 to 2024

Financial Covenant	Requirement	Actual Measure
Consolidated Leverage Ratio (Net Debt/EBITDA) (a)	No more than 3.25 to 1	1.4 to 1
Consolidated Interest Coverage Ratio (EBITDA/Interest) (b)	No less than 3.0 to 1	22.6 to 1

(a) The Consolidated Leverage Ratio is equal to Net Debt/EBITDA as defined in our private placement note purchase agreement and our $750.0 million credit agreement.

(b) The Consolidated Interest Coverage Ratio is equal to EBITDA/Interest as defined in our private placement note purchase agreement and our $750.0 million credit agreement.

In the event of an acquisition, our credit agreements permit us, at our option, to exceed the Consolidated Leverage Ratio of 3.25 to 1 for up to four quarters following the fiscal quarter in which the acquisition event occurs, provided that the Consolidated Leverage Ratio does not exceed 3.5 to 1.

Available borrowing capacity under the $750.0 million credit facility, which is reduced by borrowings and outstanding letters of credit, was $598.3 million at December 29, 2019.

Contractual Obligations

The following table summarizes our expected cash outflows resulting from financial contracts and commitments at December 29, 2019:

Contractual obligations (in millions):	2020	2021	2022	2023	2024	After 2024	Total
Debt obligations	$100.6	$ 95.4	$156.0	$111.9	$386.9	$ 1.0	$ 851.8
Interest expense(a)	20.1	17.0	13.6	10.0	4.7	—	65.4
Operating lease obligations (b)	24.5	23.0	19.7	16.9	15.1	70.1	169.3
Purchase obligations (c)	184.5	22.6	18.4	8.3	0.6	0.7	235.1
Total	$329.7	$158.0	$207.7	$147.1	$407.3	$ 71.8	$ 1,321.6

(a) Interest expense related to the credit facility, including facility fees, is assumed to accrue at the rates in effect at year-end 2019 and is assumed to be paid at the end of each quarter with the final payment in March 2024 when the credit facility expires.

(b) Includes imputed interest and the short-term portion of lease obligations.

(c) Purchase obligations generally include contractual obligations for the purchase of goods and services and capital commitments that are enforceable and legally binding on us and that specifies all significant terms, including: fixed or minimum quantities to be purchased; fixed, minimum, or variable price provisions; and the approximate timing of the transaction.

Unrecognized tax benefits of $24.5 million are not included in the table above because $10.6 million is offset by deferred tax assets, and the remainder cannot be reasonably estimated to be settled in cash due to a lack of prior settlement history and offsetting credits.

At December 29, 2019, we were not required, and accordingly are not planning, to make any cash contributions to the domestic qualified pension plan for 2020. Our minimum funding requirements after 2020 as set forth by ERISA, are dependent on several factors as discussed under “Accounting for Pension Plans” in the Critical Accounting Policies section of this Management’s Discussion and Analysis of Financial Condition and Results of Operation. Estimates beyond 2020 have not been provided due to the significant uncertainty of these amounts, which are subject to change until the Company’s pension assumptions can be updated at the appropriate times. In addition, certain pension contributions are eligible for future recovery

through the pricing of products and services to the U.S. government under certain government contracts, therefore, future cash contributions are not necessarily indicative of the impact these contributions may have on our liquidity. We also have payments due under our other postretirement benefit plans. These plans are not required to be funded in advance, but are pay as you go. See further discussion in Note 11 of the Notes to Consolidated Financial Statements. Teledyne intends to continue to monitor and manage its defined benefit pension plans obligation and may take additional actions to manage risk in the future.

Operating Activities

In 2019, net cash provided by operating activities was $482.1 million, compared with $446.9 million in 2018 and $374.7 million in 2017. The higher cash provided by operating activities in 2019, compared with 2018, was driven by higher operating income, cash flow from recent acquisitions, partially offset by $45.4 million of higher income tax payments. The higher cash provided by operating activities in 2018, compared with 2017, was driven by higher operating income, partially offset by $28.0 million of higher income tax payments.

Free cash flow (cash provided by operating activities less capital expenditures) was $393.7 million in 2019, compared with $360.1 million in 2018 and $316.2 million in 2017.

Free Cash Flow(a) (in millions, brackets indicate use of funds)	**2019**	**2018**	**2017**
Cash provided by operating activities	**$482.1**	$446.9	$374.7
Capital expenditures for property, plant and equipment	**(88.4)**	(86.8)	(58.5)
Free cash flow	**$393.7**	$360.1	$316.2

a) We define free cash flow as cash provided by operating activities (a measure prescribed by generally accepted accounting principles) less capital expenditures for property, plant and equipment. The company believes that this supplemental non-GAAP information is useful to assist management and the investment community in analyzing the company's ability to generate cash flow.

Investing Activities

Net cash used in investing activities was $571.9 million, $88.6 million and $831.2 million for 2019, 2018 and 2017, respectively. Cash flows relating to investing activities consists primarily of cash used for acquisitions and other investments and capital expenditures.

Capital expenditures (in millions):	**2019**	**2018**	**2017**
Instrumentation	**$ 18.9**	$ 14.8	$ 13.7
Digital Imaging	**45.2**	35.8	23.4
Aerospace and Defense Electronics	**19.0**	18.7	9.3
Engineered Systems	**3.6**	13.6	7.4
Corporate	**1.7**	3.9	4.7
	$ 88.4	$ 86.8	$ 58.5

During 2020, we plan to invest approximately $100.0 million in capital expenditures, principally to upgrade facilities and manufacturing equipment to reduce costs and introduce new products. The increase in capital spending in 2018 compared with 2017, primarily reflects facility upgrades and expansions.

Acquisitions

Investing activities used cash for acquisitions and other investments of $484.0 million, $3.1 million and $774.1 million, in 2019, 2018 and 2017, respectively (see "Recent Acquisitions"). Teledyne funded the acquisitions primarily from borrowings under its credit facilities, issuance of senior notes and term loans and cash on hand. On January 3, 2020, we acquired OakGate Technology, Inc. for $28.0 million in cash.

For all acquisitions, the results of operations and cash flows are included in our consolidated financial statements from the date of each respective acquisition.

The following table shows the purchase price (net of cash acquired), goodwill acquired and intangible assets acquired for the acquisitions and other investments made in 2019 and 2017 (in millions):

		2019		
Acquisition	**Acquisition date**	**Cash Paid (a)**	**Goodwill Acquired**	**Acquired Intangible Assets**
Scientific imaging businesses	February 5, 2019	**$ 224.8**	**$ 149.9**	**$ 52.4**
Gas and flame detection business	August 1, 2019	**233.5**	**147.7**	**69.0**
Micralyne Inc.	August 30, 2019	**25.7**	**7.3**	**0.9**
Total		**$ 484.0**	**$ 304.9**	**$ 122.3**

(a) Net of any cash acquired and any purchase price adjustments.

The majority of the goodwill resulting from the acquisition of the scientific imaging businesses will be deductible for tax purposes. Goodwill resulting from the acquisition of the gas and flame detection business and Micralyne will not be deductible for tax purposes.

		2017		
Acquisition	Acquisition date	Cash Paid (a)	Goodwill Acquired	Acquired Intangible Assets
e2v	March 28, 2017	$ 740.6	$ 494.3	$ 172.3
SSI	July 20, 2017	31.3	18.6	4.8
Other investments	Various	2.2	0.6	0.4
Total		$ 774.1	$ 513.5	$ 177.5

(a) Net of any cash acquired and any purchase price adjustments.

Goodwill resulting from the e2v acquisition is not deductible for tax purposes. Goodwill resulting from the SSI acquisition is deductible for tax purposes.

Financing Activities

Financing activities for 2019 reflected net proceeds from debt of $108.8 million, compared with net payments on debt of $306.5 million in 2018 and net proceeds from debt of $393.7 million for 2017. Fiscal years 2019, 2018 and 2017 reflect proceeds from the exercise of stock options of $34.6 million, $37.2 million and $24.9 million, respectively.

Other Matters

Pension Plans

Teledyne has a domestic qualified defined benefit pension plan covering substantially all U.S. employees hired before January 1, 2004, or approximately 10% of Teledyne's active employees as of December 29, 2019. As of January 1, 2004, new U.S. hires participate in a domestic defined contribution plan. In 2019, 2018 and 2017, Teledyne's domestic pension plan was over 100% funded, thus no cash contributions were made. For the Company's qualified defined benefit pension plans, the discount rate for 2020 will decrease to an average of 3.41% from 4.59% in 2019. The company also has several small non-qualified domestic and foreign-based defined benefit pension plans.

Income Taxes

Our income tax expense, deferred tax assets and liabilities, and reserves for unrecognized tax benefits reflect management's best assessment of estimated current and future taxes to be paid. We are subject to income taxes in both the United States and numerous foreign jurisdictions. Significant judgments and estimates are required in determining the consolidated income tax expense.

We intend to reinvest indefinitely the earnings of our material foreign subsidiaries in our operations outside of the United States. The cash that the Company's foreign subsidiaries hold for indefinite reinvestment is generally used to finance foreign operations and investments, including foreign acquisitions. We estimate that future domestic cash generation will be sufficient to meet future domestic cash requirements. Due to the Tax Act, U.S. federal and applicable state income taxes have been accrued for the deemed repatriation. At December 29, 2019, the amount of undistributed foreign earnings was $309.5 million, for which we have not recorded a deferred tax liability of approximately $1.4 million for corporate income taxes which would be due if reinvested foreign earnings were repatriated. Should we decide to repatriate the foreign earnings, we would need to adjust our income tax provision in the period we determined that we would no longer indefinitely reinvest the earnings outside the United States.

Deferred income taxes arise from temporary differences between the tax basis of assets and liabilities and their reported amount in the financial statements, which will result in taxable or deductible amounts in the future. In evaluating our ability to recover our deferred tax assets within the jurisdiction from which they arise, we consider all available positive and negative evidence, including scheduled reversals of deferred tax liabilities, projected future taxable income, tax-planning strategies, and results of recent operations. In projecting future taxable income, we begin with historical results adjusted for the results of discontinued operations and incorporate assumptions about the amount of future state, federal and foreign pretax operating income adjusted for items that do not have tax consequences. The assumptions about future taxable income require significant judgment and are consistent with the plans and estimates we are using to manage the underlying businesses. In evaluating the objective evidence that historical results provide, we consider three years of cumulative operating income. Based on the Company's history of operating earnings, expectations of future operating earnings and potential tax planning strategies, management believes that it is possible that some portion of deferred taxes will not be realized as a future tax benefit and therefore has recorded a valuation allowance.

We file income tax returns in the United States federal jurisdiction and in various states and foreign jurisdictions. The Company has substantially concluded on all U.S. federal income tax matters for all years through 2015, United Kingdom income tax matters for all years through 2017, France income tax matters for all years through 2016 and Canadian income tax matters for all years through 2011.

Costs and Pricing

Inflationary trends in recent years have been moderate. Current inventory costs, the increasing costs of equipment and other costs are considered in establishing sales pricing policies. The Company emphasizes cost containment and cost reductions in all aspects of its business.

Hedging Activities and Market Risk Disclosures

Teledyne transacts business in various foreign currencies and has international sales and expenses denominated in foreign currencies, subjecting the Company to foreign currency risk. The Company's primary objective is to protect the United States dollar value of future cash flows and minimize the volatility of reported earnings. The Company utilizes foreign currency forward contracts to reduce the volatility of cash flows primarily related to forecasted revenue and expenses denominated in Canadian dollars for our Canadian companies, and in British pounds for our U.K. companies. These contracts are designated and qualify as cash flow hedges. The Company has converted U.S. dollar denominated, variable rate and fixed rate debt obligations of a European subsidiary, into euro fixed rate obligations using a receive float, pay fixed cross currency swap, and a received fixed pay, fixed cross currency swap. These cross currency swaps are designated as cash flow hedges. In addition, the Company has converted domestic U.S. variable rate debt to fixed rate debt using a receive variable, pay fixed interest rate swap. The interest rate swap is also designated as a cash flow hedge.

The effectiveness of the cash flow hedge forward contracts, the cross currency swap hedges, and the interest rate swap cash flow hedge is assessed prospectively and retrospectively on a monthly basis using regression analysis, as well as using other timing and probability criteria. To receive hedge accounting treatment, all hedging relationships are formally documented at the inception of the hedges and must be highly effective in offsetting changes to future cash flows on hedged transactions. The effective portion of the cash flow hedge forward contracts' gains or losses resulting from changes in the fair value of these hedges is initially reported, net of tax, as a component of accumulated other comprehensive income/(loss) ("AOCI") in stockholders' equity until the underlying hedged item is reflected in our consolidated statements of income, at which time the effective amount in AOCI is reclassified to revenue in our consolidated statements of income. For the cross currency swap and interest rate cash flow hedges, effective amounts are recorded in AOCI, and reclassified into interest expense in the consolidated statements of income. In addition, for the cross currency swaps an amount is reclassified from AOCI to other income and expense each reporting period, to offset the earnings impact of the remeasurement of the hedged liabilities. Net deferred gains recorded in AOCI, net of tax, for forward contracts that will mature in the next 12 months total $0.8 million. These gains are expected to be offset by anticipated losses in the value of the forecasted underlying hedged item. Amounts related to the cross currency swaps and interest rate swap expected to be reclassified from AOCI into income in the coming 12 months total $5.9 million.

In the event that the underlying forecasted transactions do not occur, or it becomes remote that they will occur, within the defined hedge period, the gains or losses on the related cash flow hedges will be reclassified from AOCI to other income and expense. During the current reporting period, all forecasted transactions occurred and, therefore, there were no such gains or losses reclassified to other income and expense, due to missed forecasts.

As of December 29, 2019, Teledyne had foreign currency forward contracts designated as cash flow hedges to buy Canadian dollars and to sell U.S. dollars totaling $75.7 million. These foreign currency forward contracts have maturities ranging from March 2020 to February 2021. Teledyne had foreign currency forward contracts designated as cash flow hedges to buy British pounds and to sell U.S. dollars totaling $17.1 million. These foreign currency forward contracts have maturities ranging from March 2020 to February 2021. Together these contracts had a negative fair value of $1.1 million.

The cross currency swaps have notional amounts of €113.0 million and $125.0 million, and €135.0 million and $150.0 million, and mature in March 2023 and October 2024, respectively. The interest rate swap has a notional amount of $125.0 million and matures in March 2023.

In addition, the Company utilizes foreign currency forward contracts to mitigate foreign exchange rate risk associated with foreign currency denominated monetary assets and liabilities, including intercompany receivables and payables. As of December 29, 2019, Teledyne primarily had foreign currency contracts of this type in the following currency pairs (in millions):

Contracts to Buy			Contracts to Sell		
Currency	Amount		Currency	Amount	
Canadian Dollars	$	7.9	U.S. Dollars	US$	6.2
Euros	€	35.8	U.S. Dollars	US$	39.2
Great Britain Pounds	£	44.9	U.S. Dollars	US$	55.5
Canadian Dollars	$	11.9	Euros	€	8.2
Danish Krone	Kr.	66.2	U.S. Dollars	US$	9.7
Great Britain Pounds	£	9.1	Euros	€	10.3

These contracts had a negative fair value of $0.3 million at December 29, 2019. The gains and losses on these derivatives which are not designated as hedging instruments, are intended to, at a minimum, partially offset the transaction gains and losses recognized in earnings.

All derivatives are recorded on the balance sheet at fair value. As discussed below, the accounting for gains and losses resulting from changes in fair value depends on the use of the derivative and whether it is designated and qualifies for hedge accounting. Teledyne does not use foreign currency forward contracts for speculative or trading purposes.

Notwithstanding our efforts to mitigate portions of our foreign currency exchange rate risks, there can be no assurance that our hedging activities will adequately protect us against the risks associated with foreign currency fluctuations. A hypothetical 10 percent price change of the U.S. dollar from its value at December 29, 2019, would result in a decrease or increase in the fair value of our foreign currency forward contracts designated as cash flow hedges to buy Canadian dollars and to sell U.S. dollars by approximately $7.6 million. A hypothetical 10 percent price change in the U.S. dollar from its value at December 29, 2019 would result in a decrease or increase in the fair value of our foreign currency forward contracts designated as cash flow hedges to buy British Pounds and to sell U.S. dollars by approximately $1.7 million. A hypothetical 10 percent price change in the U.S. dollar from its value at December 29, 2019 would result in a decrease or increase in the fair value of our Euro/U.S. Dollar cross currency swaps designated as cash flow hedges by approximately $28.7 million. A hypothetical 100 basis point increase in U.S. interest rates at December 29, 2019 would result in an increase in the fair value of our U.S. Dollar interest rate swap designated as a cash flow hedge by approximately $3.7 million, while a 100 basis point decrease would result in a decrease in its fair value of $3.5 million.

Borrowings under our credit facility are at fixed rates that vary with the term and timing of each loan under the facility. Loans under the facility typically have terms of one, two, three or six months and the interest rate for each such loan is subject to change if the loan is continued or converted following the applicable maturity date. Interest rates are also subject to change based on our debt to earnings before interest, taxes, depreciation and amortization ratio. As of December 29, 2019, we had $125.0 million outstanding under our $750.0 million credit facility. Any borrowings under the Company's credit facility are based on a fluctuating market interest rate and, consequently, the fair value of any outstanding debt should not be affected materially by changes in market interest rates.

Our primary exposure to market risk relates to changes in interest rates and foreign currency exchange rates. We periodically evaluate these risks and have taken measures to mitigate these risks. We own assets and operate facilities in countries that have been politically stable.

Environmental

We are subject to various federal, state, local and international environmental laws and regulations which require that we investigate and remediate the effects of the release or disposal of materials at sites associated with past and present operations. These include sites at which Teledyne has been identified as a potentially responsible party under the Comprehensive Environmental Response, Compensation and Liability Act, commonly known as Superfund, and comparable state laws. We are currently involved in the investigation and remediation of a number of sites. Reserves for environmental investigation and remediation totaled $6.0 million at both December 29, 2019 and December 30, 2018. As investigation and remediation of these sites proceed and new information is received, the Company will adjust accruals to reflect new information. Based on current information, we do not believe that future environmental costs, in excess of those already accrued, will materially and adversely affect our financial condition or liquidity. See also our environmental risk factor disclosure beginning on page 24 and Notes 2 and 14 of the Notes to Consolidated Financial Statements.

Government Contracts

We perform work on a number of contracts with the U.S. Department of Defense and other agencies and departments of the U.S. Government including sub-contracts with government prime contractors. Sales under these contracts with the U.S. Government, which included contracts with the U.S. Department of Defense, were approximately 24% of total net sales in 2019, 23% of total net sales in 2018 and 24% of total sales in 2017. For a summary of sales to the U.S. Government by segment, see Note 12 of the Notes to Consolidated Financial Statements. Sales to the U.S. Department of Defense represented approximately 17%, 17% and 18% of total net sales for 2019, 2018 and 2017, respectively.

Performance under government contracts has certain inherent risks that could have a material adverse effect on the Company's business, results of operations and financial condition. Government contracts are conditioned upon the continuing availability of Congressional appropriations, which usually occurs on a fiscal year basis even though contract performance may take more than one year. See also our government contracts risks factor disclosure beginning on page 18.

For information on accounts receivable from the U.S. Government, see Note 5 of the Notes to Consolidated Financial Statements.

Estimates and Reserves

Our discussion and analysis of financial condition and results of operations are based upon our consolidated financial statements, which have been prepared in accordance with accounting principles generally accepted in the United States. The preparation of these financial statements requires us to make estimates and judgments that affect the reported amounts of assets, liabilities, revenues and expenses, and related disclosure of contingent liabilities. On an ongoing basis, we evaluate our estimates, including those related to product returns and replacements, allowance for doubtful accounts, inventories, intangible assets, income taxes, warranty obligations, pension and other postretirement benefits, long-term contracts, environmental, workers' compensation and general liability, employee benefits and other contingencies and litigation. We base our estimates on historical experience and on various other assumptions that are believed to be reasonable under the circumstances at the time, the results of which form the basis for making our judgments. Actual results may differ materially from these estimates under different assumptions or conditions. In some cases, such differences may be material. See also Critical Accounting Policies.

The following table reflects significant reserves and valuation accounts, which are estimates and based on judgments as described above, at December 29, 2019, and December 30, 2018:

Reserves and Valuation Accounts (in millions): (a)	**2019**	**2018**
Allowance for doubtful accounts	**$ 10.2**	$ 6.8
Reduction to LIFO cost basis	**$ 7.8**	$ 9.4
Workers' compensation and general liability reserves (b)	**$ 6.5**	$ 8.9
Environmental reserves (b)	**$ 6.0**	$ 6.0
Other accrued liability reserves (b)	**$ 16.0**	$ 26.5

(a) This table should be read in conjunction with the Notes to Consolidated Financial Statements.
(b) Includes both long-term and short-term reserves.

Some of the Company's products are subject to standard warranties and the Company provides for the estimated cost of product warranties. We regularly assess the adequacy of our pre-existing warranty liabilities and adjust amounts as necessary based on a review of historic warranty experience with respect to the applicable business or products, as well as the length and actual terms of the warranties, which are typically one year. The product warranty reserve is included in current accrued liabilities and other long-term liabilities on the balance sheet.

Warranty Reserve (in millions):	**2019**	**2018**	**2017**
Balance at beginning of year	**$ 21.0**	$ 21.1	$ 18.4
Product warranty expense	**13.1**	10.0	6.0
Deductions	**(14.2)**	(10.1)	(6.4)
Acquisitions	**4.9**	—	3.1
Balance at year-end	**$ 24.8**	$ 21.0	$ 21.1

Critical Accounting Policies

The preparation of our consolidated financial statements in conformity with United States generally accepted accounting principles requires management to make estimates and assumptions that affect the amounts reported in the financial statements and the notes to the financial statements. Some of those judgments can be subjective and complex, and therefore, actual results could differ materially from those estimates under different assumptions or conditions. Our critical accounting policies are those that are reflective of significant judgment, complexity and uncertainty, and may potentially result in materially different results under different assumptions and conditions. We have identified the following as critical accounting policies: revenue recognition; accounting for pension plans; accounting for business combinations, goodwill and acquired intangible assets; and accounting for income taxes. For additional discussion of the application of these and other accounting policies, see Note 2 of the Notes to Consolidated Financial Statements.

Revenue Recognition

Approximately 40% of our revenue is recognized over time with the remaining 60% of our revenue recognized at a point in time.

Revenue recognized over time relates primarily to contracts to design, develop and/or manufacture highly engineered products used in both defense and commercial applications. The transaction price in these arrangements may include estimated amounts of variable consideration, including award fees, incentive fees, contract amounts not yet funded, or other provisions that can either increase or decrease the transaction price. We estimate variable consideration at the amount to which we expect to be entitled, and we include estimated amounts in the transaction price to the extent it is probable that a significant reversal of cumulative revenue recognized will not occur when the estimation uncertainty is resolved. The estimation of this variable consideration and determination of whether to include estimated amounts in the transaction price are based largely on an assessment of our anticipated performance and all information (historical, current and forecasted) that is reasonably available to us. As control transfers continuously over time on these contracts, revenue is recognized based on the extent of progress towards completion of the performance obligation. The selection of the method to measure progress towards completion requires judgment and is based on the nature of the products or services to be provided. We generally use the cost-to-cost measure of progress as this measure best depicts the transfer of control to the customer which occurs as we incur costs on our contracts. Under the cost-to-cost method, the extent of progress towards completion is measured based on the ratio of costs incurred to date to the total estimated costs at completion of the performance obligation.

For over time contracts using cost-to-cost, we have an Estimate at Completion ("EAC") process in which management reviews the progress and execution of our performance obligations. This EAC process requires management judgment relative to assessing risks, estimating contract revenue, determining reasonably dependable cost estimates, and making assumptions for schedule and technical issues. Since certain contracts extend over a longer period of time, the impact of revisions in cost and revenue estimates during the progress of work may adjust the current period earnings through a cumulative catch-up basis. This method recognizes, in the current period, the cumulative effect of the changes on current and prior quarters. Additionally, if the current contract estimate indicates a loss, a provision is made for the total anticipated loss in the period that it becomes evident. Contract cost and revenue estimates for significant contracts are generally reviewed and reassessed quarterly.

We do not believe that any discrete event or adjustment to an individual contract within the aggregate changes in contract estimates for 2019, 2018 or 2017 was material to the consolidated statements of income for such annual periods.

Revenue recognized at a point in time relates primarily to the sale of standard or minimally customized products, with control transferring to the customer generally upon the transfer of title. See Note 2 of the Notes to Consolidated Financial Statements for additional revenue recognition disclosures.

Pension Plans

The Company's accounting for its defined benefit pension plans requires that amounts recognized in financial statements be determined on an actuarial basis, rather than as contributions are made to the plan. In consultation with our actuaries, we determine the appropriate assumptions for use in determining the liability for future pension benefits. Net actuarial gains or losses are amortized to expense on a plan-by-plan basis when they exceed the accounting corridor. The accounting corridor is a defined range within which amortization of net gains and losses is not required and is equal to 10 percent of the greater of the market related value of assets or benefit obligations. Gains or losses outside of the corridor are subject to amortization over our average employee future service period of approximately nine years. Significant assumptions used in determining the Company's pension income or expense is the expected long-term rate of return on plan assets, participant mortality estimates, expected rates of increase in future compensation levels, employee turnover, as well as the assumed discount rate on pension obligations.

Differences in the discount rate and expected long-term rate of return on assets within the indicated range would have had the following impact on 2019 pension expense (in millions):

	0.25 Percentage Point Increase	0.25 Percentage Point Decrease
Increase (decrease) to pension expense resulting from:		
Change in discount rate	$ (1.2)	$ 1.3
Change in long-term rate of return on plan assets	$ (2.1)	$ 2.1

See Note 11 of the Notes to Consolidated Financial Statements for additional pension disclosures.

Business Combinations, Goodwill and Acquired Intangible Assets

The results for all acquisitions are included in the Company's consolidated financial statements from the date of each respective acquisition. Business acquisitions are accounted for under the acquisition method by assigning the purchase price to tangible and intangible assets acquired and liabilities assumed. Assets acquired and liabilities assumed are recorded at their fair values and the excess of the purchase price over the amounts assigned is recorded as goodwill. We determine the fair value of such assets and liabilities, often in consultation with third-party valuation advisors. Acquired intangible assets with finite lives are amortized over their estimated useful lives. Adjustments to fair value assessments are recorded to goodwill over the purchase price allocation period.

Goodwill and acquired intangible assets with indefinite lives are not amortized. We review goodwill and acquired indefinite-lived intangible assets for impairment whenever events or changes in circumstances indicate that the carrying amount of these assets may not be recoverable. The Company also performs an annual impairment test in the fourth quarter of each year. We test goodwill and acquired indefinite-lived intangible assets for impairment between annual tests if events occur or circumstances change that would more likely than not reduce our enterprise fair value below its book value. These events or circumstances could include a significant change in the business climate, including a significant sustained decline in an entity's market value, legal factors, operating performance indicators, competition, sale or disposition of a significant portion of the business, or other factors.

We may use either a qualitative or quantitative approach when testing a reporting unit's goodwill for impairment. For selected reporting units where we use the qualitative approach, we perform a qualitative evaluation of events and circumstances impacting the reporting unit to determine the likelihood of goodwill impairment. Based on that qualitative evaluation, if we determine it is more likely than not that the fair value of a reporting unit exceeds its carrying amount, no further evaluation is necessary. Otherwise we perform a quantitative impairment test. We perform a quantitative test for each reporting unit at least once every three years.

For goodwill impairment testing using the quantitative approach, the Company estimates the fair value of the selected reporting units primarily through the use of a discounted cash flow model based on our best estimate of amounts and timing of future revenues and cash flows and our most recent business and strategic plans, and compares the estimated fair value to the carrying value of the reporting unit, including goodwill. The discounted cash flow model requires judgmental assumptions about projected revenue growth, future operating margins, discount rates and terminal values over a multi-year period. There are inherent uncertainties related to these assumptions and management's judgment in applying them to the analysis of goodwill impairment. While the Company believes it has made reasonable estimates and assumptions to calculate the fair value of its reporting units, it is possible a material change could occur. If actual results are not consistent with management's estimates and assumptions, goodwill may be overstated and a charge would need to be taken against net earnings.

Changes in our projections used in the discounted cash flow model could affect the estimated fair value of certain of the Company's reporting units and could result in a goodwill impairment charge in a future period. In order to evaluate the sensitivity of the fair value calculations used in the quantitative goodwill impairment test, the Company applied a hypothetical 10% decrease to the fair values of each reporting unit subject to a quantitative impairment test and compared those values to the reporting unit carrying values. Based on this sensitivity analysis, the Company did not identify any goodwill impairment. Due to the many variables inherent in the estimation of a reporting unit's fair value and the relative size of our recorded goodwill, differences in assumptions may have a material effect on the results of our impairment analysis.

As of December 29, 2019, the Company had nine reporting units for goodwill impairment testing. The carrying value of goodwill included in the Company's individual reporting units ranged from $1.2 million to $870.2 million. The Company's analysis in 2019 indicated that in all instances, the fair value of the Company's reporting units exceeded their carrying values and consequently did not result in an impairment charge. The excess of the estimated fair value over the carrying value (expressed as a percentage of carrying value of the respective reporting unit) for the Company's reporting units subject to a quantitative test as of the fourth quarter of 2019, the annual testing date, exceeded at least 77%.

Income Taxes

Income tax expense and deferred tax assets and liabilities reflect management's assessment of actual future taxes to be paid on items reflected in the financial statements. Significant judgment is required in evaluating our tax positions and determining our provision for income taxes. Uncertainty exists regarding tax positions taken in previously filed tax returns still under examination and positions expected to be taken in the current year and future returns. Deferred tax assets and liabilities arise due to differences between the consolidated financial statement carrying amounts of existing assets and liabilities and their respective tax bases and tax carryforwards. Although we believe our income tax expense and deferred tax assets and liabilities are reasonable, no assurance can be given that the final tax outcome will not be different from that which is reflected in our historical income tax provisions and accruals. To the extent that the final tax outcome is different than the amounts recorded, such differences will impact the provision for income taxes in the period in which such determination is made. The provision for income taxes includes the impact of uncertain tax benefits that are considered appropriate, as well as the related net interest.

Significant judgment is required in determining any valuation allowance recorded against deferred tax assets. In assessing the need for a valuation allowance, we consider all available evidence including past operating results, estimates of future taxable income and the feasibility of tax planning strategies. In the event that we change our determination as to the amount of deferred tax assets that can be realized, we will adjust our valuation allowance with a corresponding impact to the provision for income taxes in the period in which such determination is made.

An increase of 100 basis points in our nominal tax rate would have resulted in additional income tax provision for the fiscal year ended December 29, 2019, of $4.7 million. For a description of the Company's tax accounting policies, refer to Note 2 and Note 10 of the Notes to Consolidated Financial Statements.

Recent Accounting Standards

For a discussion of recent accounting standards see Note 2 of the Notes to Consolidated Financial Statements.

Safe Harbor Cautionary Statement Regarding Forward-Looking Information

This Management's Discussion and Analysis of Financial Condition and Results of Operation contains forward-looking statements, as defined in the Private Securities Litigation Reform Act of 1995, directly and indirectly relating to earnings, growth opportunities, acquisitions and divestitures, product sales, capital expenditures, pension matters, stock option compensation expense, the credit facility, interest expense, severance and relocation costs, environmental remediation cost, stock repurchases, taxes, exchange rate fluctuations and strategic plans. All statements made in this Management's Discussion and Analysis of Financial Condition and Results of Operation that are not historical in nature should be considered forward-looking. Actual results could differ materially from these forward-looking statements.

Many factors could change the anticipated results, including: disruptions in the global economy; changes in demand for products sold to the defense electronics, instrumentation, digital imaging, energy exploration and production, commercial aviation, semiconductor and communications markets; funding, continuation and award of government programs; cuts to defense spending resulting from existing and future deficit reduction measures; impacts from the United Kingdom's pending exit from the European Union; uncertainties related to the policies of the U.S. Presidential administration; the imposition and expansion of, and responses to, trade sanctions and tariffs; and threats to the security of our confidential and proprietary information, including cyber security threats. Lower oil and natural gas prices, as well as instability in the Middle East or other oil producing regions, and new regulations or restrictions relating to energy production, including with respect to hydraulic fracturing could further negatively affect our businesses that supply the oil and gas industry. Disruptions from the production delay of Boeing's 737 Max aircraft and increasing fuel costs will negatively affect the markets of our commercial aviation businesses. If the Coronavirus outbreak continues and results in a prolonged period of travel, commercial and other similar restrictions, we could experience lower demand for our products and global supply disruptions. In addition, financial market fluctuations affect the value of our pension assets.

Changes in the policies of U.S. and foreign governments, including economic sanctions, could result, over time, in reductions or realignment in defense or other government spending and further changes in programs in which the Company participates.

While Teledyne's growth strategy includes possible acquisitions, we cannot provide any assurance as to when, if or on what terms any acquisitions will be made. Acquisitions involve various inherent risks, such as, among others, our ability to integrate acquired businesses, retain customers and achieve identified financial and operating synergies. There are additional risks associated with acquiring, owning and operating businesses outside of the United States, including those arising from U.S. and foreign government policy changes or actions and exchange rate fluctuations.

We continue to take action to assure compliance with the internal controls, disclosure controls and other requirements of the Sarbanes-Oxley Act of 2002. While we believe our control systems are effective, there are inherent limitations in all control systems, and misstatements due to error or fraud may occur and may not be detected.

Additional information concerning factors that could cause actual results to differ materially from those projected in the forward-looking statements is contained beginning on page 14 of this Form 10-K under the caption "Risk Factors; Cautionary Statement as to Forward-Looking Statements." Forward-looking statements are generally accompanied by words such as "estimate", "project", "predict", "believes" or "expect", that convey the uncertainty of future events or outcomes. We assume no obligation to publicly update or revise any forward-looking statements, whether as a result of new information or otherwise.

Item 7A. Quantitative and Qualitative Disclosures About Market Risk

The information required by this item is included in this Report on page 45 under the caption "Other Matters - Hedging Activities; Market Risk Disclosures" of "Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operation."

Item 8. Financial Statements and Supplementary Data

The information required by this item is included in this Report on pages 55 through 98. See the "Index to Financial Statements and Related Information" on page 55.

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

None.

Item 9A. Controls and Procedures

Disclosure Controls

Teledyne's disclosure controls and procedures are designed to ensure that information required to be disclosed in reports that it files or submits, under the Securities Exchange Act of 1934, was recorded, processed, summarized and reported within the time periods specified in the rules and forms of the Securities and Exchange Commission and to provide reasonable assurance that information required to be disclosed by us in such reports is accumulated and communicated to the company's management, including its principal executive officer and principal financial officer, as appropriate to allow timely decisions regarding required disclosure. The company's President and Chief Executive Officer and Senior Vice President and Chief Financial Officer, with the participation and assistance of other members of management, have evaluated the effectiveness, as of December 29, 2019, of the company's "disclosure controls and procedures," as that term is defined in Rule 13a-15(e) under the Securities and Exchange Act of 1934, as amended ("the Exchange Act"). Based upon that evaluation, our Chief Executive Officer and our Chief Financial Officer concluded that the disclosure controls and procedures as of December 29, 2019, are effective.

Internal Controls

See Management Statement on page 56 for management's annual report on internal control over financial reporting. See Report of Independent Registered Public Accounting Firm on page 57 for Deloitte & Touche LLP's attestation report on the Report of Management on Teledyne Technologies Incorporated's Internal Control over Financial Reporting.

There was no change in the company's "internal control over financial reporting" (as such term is defined in Rule 13a-15(f) under the Exchange Act) that occurred during the quarter ended December 29, 2019, that has materially affected, or is reasonably likely to materially affect, the company's internal control over financial reporting. There also were no material weaknesses identified for which corrective action needed to be taken.

Sarbanes-Oxley Disclosure Committee

The Company's Sarbanes-Oxley Disclosure Committee includes the following members:

Carl W. Adams, Vice President, Business Risk Assurance
Cynthia Belak, Vice President and Controller
Stephen F. Blackwood, Senior Vice President, Strategic Sourcing, Tax and Treasurer
Melanie S. Cibik, Senior Vice President, General Counsel, Chief Compliance Officer and Secretary
Duncan Forsythe, Associate Vice President, Taxation
Michael C. Lee, Director, Global Income Tax Accounting
Brian A. Levan, Senior Director of Financial Reporting and Assistant Controller
Susan L. Main, Senior Vice President and Chief Financial Officer
S. Paul Sassalos, Associate Vice President, Associate General Counsel and Assistant Secretary
Jason VanWees, Executive Vice President
Tyler D. Vernon, Senior Director, SEC/GAAP Compliance and External Reporting

Among its tasks, the Sarbanes-Oxley Disclosure Committee discusses and reviews disclosure issues to help us fulfill our disclosure obligations on a timely basis in accordance with SEC rules and regulations and is intended to be used as an additional resource for employees to raise questions regarding accounting, auditing, internal controls and disclosure matters. Our toll-free Ethics Help Line (1-877-666-6968) continues to be an alternative means to communicate concerns to the Company's management.

Item 9B. Other Information

None.

PART III

Item 10. Directors, Executive Officers and Corporate Governance.

In addition to the information set forth under the caption "Executive Management" beginning on page 10 in Part I of this Report, the information required by this item is set forth in the 2020 Proxy Statement under the captions "Item 1 on Proxy Card - Election of Directors," "Board Composition and Practices," "Corporate Governance," "Committees of Our Board of Directors - Audit Committee" and "Report of the Audit Committee" and "Stock Ownership - Sections 16(a) Beneficial Ownership Reporting Compliance." This information is incorporated herein by reference.

Item 11. Executive Compensation.

The information required by this item is set forth in the 2020 Proxy Statement under the captions "Executive and Director Compensation" "Compensation Committee Interlocks and Insider Participation" and "Personnel and Compensation Committee Report." This information is incorporated herein by reference.

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

Except for the table below, the information required by this item is set forth in the 2020 Proxy Statement under the caption "Stock Ownership Information" and is incorporated herein by reference. The following table summarizes information about our common stock that may be issued upon the exercise of options, warrant and rights under all of our equity compensation plans, as of December 29, 2019:

Plan Category	Number of Securities to be issued upon Exercise of Outstanding Options, Warrants and Rights (a)		Weighted-Average Exercise Price of Outstanding Options, Warrants or Rights (b)		Number of Securities Remaining Available for Future Issuance under Equity Compensation Plans [excluding securities reflected in column (a)]	
Equity compensation plans approved by security holders:						
Amended and Restated 2008 Incentive Award Plan[1]	390,192		$ 62.77		—	
Amended and Restated 2014 Incentive Award Plan[2]	1,598,384	(3)	$ 147.24	(4)	2,885,771	(5)
Equity Compensation plans not approved by security holders:						
Employee Stock Purchase Plan[6]	—		—		1,000,000	
Total	1,988,576		$ 130.67		3,885,771	

1) No additional awards may be granted under the Amended and Restated 2008 Incentive Award Plan (2008 Plan). Any shares available under the 2008 Plan on the effective date of the 2014 Plan or that were subject to awards under the 2008 Plan that were forfeited or lapsed following the effective date of the 2014 Plan are automatically transferred to the Amended and Restated 2014 Plan.

2) On April 26, 2017, the stockholders of Teledyne approved the amendment and restatement of the 2014 Incentive Award Plan, which increased the shares available by 2,500,000.

3) Does not include (i) 15,430 shares of stock reserved for issuance under the 2015-2017 cycle of our PSP, of which 7,673 shares were issued as part of the final installment payment in February 2020; (ii) 13,551 shares subject to restricted stock unit awards issued to employees and directors; and (iii) 51,123 shares reserved for issuance under the 2018-2020 cycle of our PSP.

4) Does not include the securities described in footnote (3) above, which do not have an exercise price

5) The number of shares available for future issuance (i) includes shares transferred from the 2008 Plan (see footnote (1) above); and (ii) assumes the issuance of (a) 15,430 shares of stock reserved for issuance under the 2015-2017 cycle of our PSP, of which 7,673 shares were issued as part of the final installment payment in February 2020;(b) 13,551 shares subject to restricted stock unit awards issued to employees and directors; and (c) 51,123 shares reserved for issuance under the 2018-2020 cycle of our PSP.

6) We maintain an Employee Stock Purchase Plan (commonly known as The Stock Advantage Plan) for eligible employees. It enables employees to invest in our common stock through automatic, after-tax payroll deductions, within specified limits. We add a 25% matching Company contribution up to $1,200 annually. Our contribution is currently paid in cash and the plan administrator purchases shares of our common stock in the open market. Historically, all shares used to fund the Employee Stock Purchase Plan have been purchased on the open market and no new shares have been issued.

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

The information required by this item is set forth in the 2020 Proxy Statement under the captions "Corporate Governance" and "Certain Transactions" and is incorporated herein by reference.

Item 14. Principal Accountant Fees and Services.

The information required by this item is set forth in the 2020 Proxy Statement under the captions "Fees Billed by Independent Registered Public Accounting Firm" and "Audit Committee Pre-Approval Policies" under "Item 2 on Proxy Card - Ratification of Appointment of Independent Registered Public Accounting Firm" and is incorporated herein by reference.

PART IV

Item 15. Exhibits and Financial Statement Schedules

(a) Exhibits and Financial Statement Schedules:

(1) Financial Statements

See the "Index to Financial Statements and Related Information" on page 55 of this Report, which is incorporated herein by reference.

(2) Financial Statement Schedules

See Schedule II captioned "Valuation and Qualifying Accounts" on page 98 of this Report, which is incorporated herein by reference.

(3) Exhibits

A list of exhibits filed with this Form 10-K or incorporated by reference is found in the Exhibit Index immediately following the certifications of this Report and incorporated herein by reference.

(b) Exhibits:

See Item 15(a)(3) above.

(c) Financial Schedules:

See Item 15(a)(2) above.

INDEX TO FINANCIAL STATEMENTS AND RELATED INFORMATION

MANAGEMENT STATEMENT

RESPONSIBILITY FOR PREPARATION OF THE FINANCIAL STATEMENTS AND ESTABLISHING AND MAINTAINING ADEQUATE INTERNAL CONTROL OVER FINANCIAL REPORTING

We are responsible for the preparation of the financial statements included in this Annual Report. The financial statements were prepared in accordance with accounting principles generally accepted in the United States of America and include amounts that are based on the best estimates and judgments of management. The other financial information contained in this Annual Report is consistent with the financial statements.

Our internal control system is designed to provide reasonable assurance concerning the reliability of the financial data used in the preparation of Teledyne financial statements, as well as to safeguard the Company's assets from unauthorized use or disposition.

All internal control systems, no matter how well designed, have inherent limitations. Therefore, even those systems determined to be effective can provide only reasonable assurance with respect to financial statement presentation.

REPORT OF MANAGEMENT ON TELEDYNE TECHNOLOGIES INCORPORATED'S INTERNAL CONTROL OVER FINANCIAL REPORTING

We are also responsible for establishing and maintaining adequate internal control over financial reporting. We conducted an evaluation of the effectiveness of the Company's internal control over financial reporting as of December 29, 2019. In making this evaluation, we used the criteria set forth by the Committee of Sponsoring Organizations of the Treadway Commission (2013 Framework) (the COSO criteria) in *Internal Control - Integrated Framework*. Our evaluation included reviewing the documentation of our controls, evaluating the design effectiveness of our controls and testing their operating effectiveness. Our evaluation did not include assessing the effectiveness of internal control over financial reporting for the scientific imaging businesses of Roper Technologies, Inc., the gas and flame detection businesses of 3M Company or the Micralyne acquisitions in 2019. These acquisitions, which are included in the 2019 consolidated financial statements of the Company, constituted approximately 12% of total assets, 4% of total revenues and 3% of net income of the Company as of and for the fiscal year ended December 29, 2019. We did not assess the effectiveness of internal control over financial reporting at these newly acquired entities due to the insufficient time between the date acquired and year-end and the complexity associated with assessing internal controls during integration efforts making the process impractical. Based on this evaluation we believe that, as of December 29, 2019, the Company's internal controls over financial reporting were effective.

Deloitte and Touche LLP, our independent registered public accounting firm, has issued its report on the effectiveness of Teledyne's internal control over financial reporting. Their report appears on page 57 of this Annual Report.

Date: February 21, 2020

/s/ ALDO PICHELLI
Aldo Pichelli
President and Chief Executive Officer

Date: February 21, 2020

/s/ SUSAN L. MAIN
Susan L. Main
Senior Vice President and Chief Financial Officer

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Board of Directors and Stockholders of Teledyne Technologies Incorporated
Thousand Oaks, California

Opinion on Internal Control over Financial Reporting

We have audited the internal control over financial reporting of Teledyne Technologies Incorporated and subsidiaries (the "Company") as of December 29, 2019, based on criteria established in *Internal Control — Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO). In our opinion, the Company maintained, in all material respects, effective internal control over financial reporting as of December 29, 2019, based on criteria established in *Internal Control — Integrated Framework (2013)* issued by COSO.

We have also audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the consolidated financial statements as of and for the year ended December 29, 2019, of the Company and our report dated February 21, 2020, expressed an unqualified opinion on those financial statements and financial statement schedule.

As described in Report of Management on Teledyne Technologies Incorporated's Internal Control over Financial Reporting, management excluded from its assessment the internal control over financial reporting for the scientific imaging businesses of Roper Technologies, Inc., the gas and flame detection businesses of 3M Company, and the Micralyne acquisition, which were acquired on February 5, 2019, August 1, 2019 and August 30, 2019, respectively, and whose financial statements constitute approximately 12% of total assets, 4% of total revenues, and 3% of net income of the consolidated financial statement amounts as of and for the year ended December 29, 2019. Accordingly, our audit did not include the internal control over financial reporting for the 2019 acquisitions.

Basis for Opinion

The Company's management is responsible for maintaining effective internal control over financial reporting and for its assessment of the effectiveness of internal control over financial reporting, included in the accompanying Report of Management on Teledyne Technologies Incorporated's Internal Control over Financial Reporting. Our responsibility is to express an opinion on the Company's internal control over financial reporting based on our audit. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audit in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether effective internal control over financial reporting was maintained in all material respects. Our audit included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, testing and evaluating the design and operating effectiveness of internal control based on the assessed risk, and performing such other procedures as we considered necessary in the circumstances. We believe that our audit provides a reasonable basis for our opinion.

Definition and Limitations of Internal Control over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

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

/s/ Deloitte & Touche LLP
Los Angeles, California
February 21, 2020

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Board of Directors and Stockholders of Teledyne Technologies Incorporated
Thousand Oaks, California

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of Teledyne Technologies Incorporated and subsidiaries (the "Company") as of December 29, 2019 and December 30, 2018, the related consolidated statements of income, comprehensive income, shareholders' equity, and cash flows, for each of the three years in the period ended December 29, 2019, and the related notes and the schedule listed in the Index at Item 15 (collectively referred to as the "financial statements"). In our opinion, the financial statements present fairly, in all material respects, the financial position of the Company as of December 29, 2019 and December 30, 2018, and the results of its operations and its cash flows for each of the three years in the period ended December 29, 2019, in conformity with accounting principles generally accepted in the United States of America.

We have also audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the Company's internal control over financial reporting as of December 29, 2019, based on criteria established in *Internal Control — Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission and our report dated February 21, 2020, expressed an unqualified opinion on the Company's internal control over financial reporting.

Change in Accounting Principle

As discussed in Note 2 to the consolidated financial statements, the Company has changed its method of accounting for revenue recognition, effective January 1, 2018, due to adoption of FASB ASC Topic 606, *Revenue from Contracts with Customers*.

Also as discussed in Note 2 to the consolidated financial statements, effective December 31, 2018, the Company adopted FASB ASC Topic 842, *Leases*, using the modified retrospective approach.

Basis for Opinion

These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's financial statements based on our audits. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

Critical Audit Matter

The critical audit matter communicated below is a matter arising from the current-period audit of the financial statements that was communicated or required to be communicated to the audit committee and that (1) relates to accounts or disclosures that are material to the financial statements and (2) involved our especially challenging, subjective, or complex judgments. The communication of critical audit matters does not alter in any way our opinion on the financial statements, taken as a whole, and we are not, by communicating the critical audit matter below, providing a separate opinion on the critical audit matter or on the accounts or disclosures to which it relates.

Acquisitions — The Scientific Imaging Businesses of Roper Technologies, Inc. and the Gas and Flame Detection Businesses of 3M Company – Intangible Assets – Refer to Notes 2 and 3 to the financial statements

Critical Audit Matter Description

During 2019, the Company completed three acquisitions for net consideration of $484.0 million. The most significant of these were (1) the acquisition of the scientific imaging businesses of Roper Technologies, Inc. for net consideration of $224.8 million and (2) the acquisition of the gas and flame detection businesses of 3M Company for net consideration of $233.5 million. Auditing the Company's 2019 acquisitions involved a high degree of auditor judgment and complexity to test management's identification and preliminary valuation of acquired intangibles, specifically revenue projections used within the fair valuation of certain intangible assets assumed.

How the Critical Audit Matter Was Addressed in the Audit

Our audit procedures related to (1) the identification of acquired intangibles and (2) revenue projections used to estimate the fair value of the intangible assets acquired included the following, among others:

- We tested the effectiveness of controls over the identification of acquired intangibles and management's controls over the revenue projections used to estimate the fair value of the intangible assets acquired.
- With the assistance of our fair value specialists, we read each of the purchase agreements and evaluated and challenged management's identification of the acquired intangible assets.
- We evaluated the reasonableness of the revenue projections by comparing them to (1) third-party historical financial data, (2) current economic factors and analyst reports of the Company and companies in its peer group, (3) evidence obtained in other areas of the audit, such as assumptions used by the Company in its budgeting process, and (4) the Company's similar historical acquisitions.
- We performed a sensitivity analysis by varying projected revenue assumptions.
- With the assistance of our fair value specialists, we performed an analysis comparing the projected revenues of comparable companies within the acquired companies' industries to management's projected revenues used within the valuation models.
- With the assistance of our fair value specialists, we tested the underlying source information and mathematical accuracy of the calculations.

/s/ Deloitte & Touche LLP
Los Angeles, California
February 21, 2020

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

TELEDYNE TECHNOLOGIES INCORPORATED
CONSOLIDATED STATEMENTS OF INCOME
(In millions, except per-share amounts)

	For the Fiscal Year		
	2019	**2018**	**2017**
Net Sales	**$ 3,163.6**	$ 2,901.8	$ 2,603.8
Costs and expenses			
Cost of sales	**1,920.3**	1,791.0	1,624.0
Selling, general and administrative expenses	**751.6**	694.2	658.1
Total costs and expenses	**2,671.9**	2,485.2	2,282.1
Operating income	**491.7**	416.6	321.7
Interest and debt expense, net	**(21.0)**	(25.5)	(33.1)
Non-service retirement benefit income	**8.0**	13.5	13.9
Other expense, net	**(5.0)**	(10.7)	(15.5)
Income before income taxes	**473.7**	393.9	287.0
Provision for income taxes	**71.4**	60.1	59.8
Net income	**$ 402.3**	$ 333.8	$ 227.2
Basic earnings per common share	**$ 11.08**	$ 9.32	$ 6.45
Weighted average common shares outstanding	**36.3**	35.8	35.2
Diluted earnings per common share	**$ 10.73**	$ 9.01	$ 6.26
Weighted average diluted common shares outstanding	**37.5**	37.0	36.3

The accompanying notes are an integral part of these financial statements.

TELEDYNE TECHNOLOGIES INCORPORATED
CONSOLIDATED STATEMENTS OF COMPREHENSIVE INCOME
(In millions)

	For the Fiscal Year		
	2019	**2018**	**2017**
Net income	**$ 402.3**	$ 333.8	$ 227.2
Other comprehensive income (loss):			
Foreign exchange translation adjustment	**31.1**	(79.5)	96.8
Hedge activity, net of tax	**2.6**	(5.4)	3.3
Pension and postretirement benefit adjustments, net of tax	**(16.3)**	(31.4)	21.8
Other comprehensive income (loss)(a)	**17.4**	(116.3)	121.9
Comprehensive income	**$ 419.7**	$ 217.5	$ 349.1

(a) Net of income tax benefit of $6.6 million in 2019, income tax benefit of $10.6 million for 2018 and income tax expense of $12.7 million for 2017.

The accompanying notes are an integral part of these financial statements.

TELEDYNE TECHNOLOGIES INCORPORATED
CONSOLIDATED BALANCE SHEETS
For the Fiscal Years Ended December 29, 2019 and December 30, 2018
(In millions, except share amounts)

	2019	2018
Assets		
Current Assets		
Cash	**$ 199.5**	$ 142.5
Accounts receivable, net	**460.4**	416.5
Unbilled receivables, net	**200.5**	145.3
Inventories, net	**393.4**	364.3
Prepaid expenses and other current assets	**59.9**	45.8
Total Current Assets	**1,313.7**	1,114.4
Property, plant and equipment, net	**487.9**	442.6
Goodwill	**2,050.5**	1,735.2
Acquired intangible assets, net	**430.8**	344.3
Prepaid pension assets	**71.8**	88.2
Operating lease right-of-use assets	**127.1**	—
Other assets, net	**98.0**	84.6
Total Assets	**$ 4,579.8**	$ 3,809.3
Liabilities and Stockholders' Equity		
Current Liabilities		
Accounts payable	**$ 271.1**	$ 227.8
Accrued liabilities	**391.5**	355.6
Current portion of long-term debt and other debt	**100.6**	137.4
Total Current Liabilities	**763.2**	720.8
Long-term debt	**750.0**	610.1
Long-term operating lease liabilities	**119.3**	—
Other long-term liabilities	**232.6**	248.7
Total Liabilities	**1,865.1**	1,579.6
Commitments and Contingencies		
Stockholders' Equity		
Preferred stock, $0.01 par value; authorized 15,000,000 shares; outstanding shares-none	**—**	—
Common stock, $0.01 par value; authorized 125,000,000 shares; Issued shares: 37,697,865 at December 29, 2019, and December 30, 2018; outstanding shares: 36,547,966 at December 29, 2019, and 36,087,297 at December 30, 2018	**0.4**	0.4
Additional paid-in capital	**360.5**	343.7
Retained earnings	**2,926.0**	2,523.7
Treasury stock, 1,149,899 at December 29, 2019 and 1,610,568 at December 30, 2018	**(96.4)**	(144.9)
Accumulated other comprehensive loss	**(475.8)**	(493.2)
Total Stockholders' Equity	**2,714.7**	2,229.7
Total Liabilities and Stockholders' Equity	**$ 4,579.8**	$ 3,809.3

The accompanying notes are an integral part of these financial statements.

TELEDYNE TECHNOLOGIES INCORPORATED
CONSOLIDATED STATEMENTS OF STOCKHOLDERS' EQUITY
(In millions)

	Common Stock	Additional Paid-in Capital	Treasury Stock	Retained Earnings	Accumulated Other Comprehensive Income (Loss)	Total
Balance, January 1, 2017	$ 0.4	$ 335.7	$ (242.9)	$ 1,912.4	$ (451.2)	$ 1,554.4
Net income	—	—	—	227.2	—	227.2
Other comprehensive income, net of tax	—	—	—	—	121.9	121.9
Treasury stock issued	—	(42.2)	42.2	—	—	—
Stock-based compensation	—	24.9	—	—	—	24.9
Exercise of stock options	—	18.9	—	—	—	18.9
Balance, December 31, 2017	0.4	337.3	(200.7)	2,139.6	(329.3)	1,947.3
Net income	—	—	—	333.8	—	333.8
Other comprehensive loss, net of tax	—	—	—	—	(116.3)	(116.3)
Treasury stock issued	—	(55.8)	55.8	—	—	—
Stock-based compensation	—	37.2	—	—	—	37.2
Exercise of stock options and other	—	25.0	—	(0.6)	—	24.4
Cumulative effect of new accounting standards	—	—	—	50.9	(47.6)	3.3
Balance, December 30, 2018	**0.4**	**343.7**	**(144.9)**	**2,523.7**	**(493.2)**	**2,229.7**
Net income	**—**	**—**	**—**	**402.3**	**—**	**402.3**
Other comprehensive income, net of tax	**—**	**—**	**—**	**—**	**17.4**	**17.4**
Treasury stock issued	**—**	**(48.5)**	**48.5**	**—**	**—**	**—**
Stock-based compensation	**—**	**30.7**	**—**	**—**	**—**	**30.7**
Exercise of stock options	**—**	**34.6**	**—**	**—**	**—**	**34.6**
Balance, December 29, 2019	**$ 0.4**	**$ 360.5**	**$ (96.4)**	**$ 2,926.0**	**$ (475.8)**	**$ 2,714.7**

The accompanying notes are an integral part of these financial statements.

TELEDYNE TECHNOLOGIES INCORPORATED AND SUBSIDIARIES
CONSOLIDATED STATEMENTS OF CASH FLOWS
(In millions)

	For the Fiscal Year		
	2019	**2018**	**2017**
Operating Activities			
Net income	**$ 402.3**	$ 333.8	$ 227.2
Adjustments to reconcile net income to net cash provided by operating activities:			
Depreciation and amortization	**111.9**	113.0	113.0
Stock-based compensation	**30.7**	25.1	18.8
Changes in operating assets and liabilities, excluding the effect of businesses acquired:			
Accounts receivable	**(58.8)**	(66.7)	(19.6)
Inventories	**12.2**	(1.7)	(7.4)
Prepaid expenses and other assets	**2.8**	7.6	(3.6)
Accounts payable	**29.6**	39.9	12.4
Accrued liabilities	**5.9**	17.8	16.2
Deferred and income taxes payable, net	**(53.8)**	(26.4)	28.1
Long-term assets	**(8.1)**	4.9	(13.8)
Other long-term liabilities	**11.9**	(13.7)	(2.2)
Other, net	**(4.5)**	13.3	5.6
Net cash provided by operating activities	**482.1**	446.9	374.7
Investing Activities			
Purchases of property, plant and equipment	**(88.4)**	(86.8)	(58.5)
Purchase of businesses and other investments, net of cash acquired	**(484.0)**	(3.1)	(774.1)
Other, net	**0.5**	1.3	1.4
Net cash used in investing activities	**(571.9)**	(88.6)	(831.2)
Financing Activities			
Net proceeds (payments) on credit facility	**96.0**	(136.0)	165.0
Proceeds from other debt	**—**	11.5	100.0
Payments on other debt	**(137.2)**	(182.0)	(139.3)
Proceeds from issuance of term loans and senior notes	**150.0**	—	268.0
Proceeds from stock options exercised	**34.6**	37.2	24.9
Other, net	**(1.7)**	(2.0)	(4.5)
Net cash provided by (used in) financing activities	**141.7**	(271.3)	414.1
Effect of exchange rate changes on cash	**5.1**	(15.4)	14.7
Change in cash	**57.0**	71.6	(27.7)
Cash—beginning of period	**142.5**	70.9	98.6
Cash—end of period	**$ 199.5**	$ 142.5	$ 70.9

The accompanying notes are an integral part of these financial statements.

Note 1. Description of Business

Teledyne Technologies Incorporated ("Teledyne" or the "Company") became an independent, public company effective November 29, 1999. Teledyne provides enabling technologies for industrial growth markets that require advanced technology and high reliability. These markets include aerospace and defense, factory automation, air and water quality environmental monitoring, electronics design and development, oceanographic research, deepwater oil and gas exploration and production, medical imaging and pharmaceutical research. The products include digital imaging sensors, cameras and systems within the visible, infrared and X-ray spectra, monitoring and control instrumentation for marine and environmental applications, harsh environment interconnects, electronic test and measurement equipment, aircraft information management systems, and defense electronics and satellite communication subsystems. Teledyne also supplies engineered systems for defense, space, environmental and energy applications. Teledyne differentiates itself from many of its direct competitors by having a customer and company-sponsored applied research center that augments our product development expertise.

Teledyne consists of the Instrumentation segment with principal operations in the United States, the United Kingdom and Denmark; the Digital Imaging segment with principal operations in the United States, Canada, France, the Netherlands and the United Kingdom: the Aerospace and Defense Electronics segment with principal operations in the United States and the United Kingdom; and the Engineered Systems segment with principal operations in the United States.

In the third quarter of 2019, we realigned the segment reporting structure for certain business units, primarily related to certain refinements of our management reporting structure. This change primarily related to moving certain electronic manufacturing services products from the Aerospace and Defense Electronics segment to the Engineered Systems segment. The realignment had no impact on the Instrumentation Segment or the Consolidated Financial Statements. See Note 12 to these Consolidated Financial Statements for additional information on the realignment. Previously reported segment data has been adjusted to reflect these changes.

Note 2. Summary of Significant Accounting Policies

Principles of Consolidation

The consolidated financial statements include the accounts of Teledyne and its majority-owned subsidiaries. Intercompany accounts and transactions have been eliminated.

Fiscal Year

The Company operates on a 52- or 53-week fiscal year convention ending on the Sunday nearest to December 31. Fiscal year 2019 was a 52-week fiscal year and ended on December 29, 2019. Fiscal year 2018 was a 52-week fiscal year and ended on December 30, 2018. Fiscal year 2017 was a 52-week fiscal year and ended on December 31, 2017. References to the years 2019, 2018 and 2017 are intended to refer to the respective fiscal year unless otherwise noted.

Estimates

The preparation of financial statements in conformity with U.S. generally accepted accounting principles ("GAAP") requires management to make estimates and assumptions that affect reported amounts of assets, liabilities, revenues and expenses, and related disclosure of contingent liabilities. On an ongoing basis, the Company evaluates its estimates, including those related to sales returns and allowances, allowance for doubtful accounts, inventories, goodwill, intangible assets, asset valuations, income taxes, warranty obligations, pension and other postretirement benefits, long-term contracts, environmental, workers' compensation and general liability, employee benefits and other contingencies and litigation. The Company bases its estimates on historical experience and on various other assumptions that are believed to be reasonable under the circumstances at the time, the results of which form the basis for making its judgments. Actual results may differ materially from these estimates under different assumptions or conditions. Management believes that the estimates are reasonable.

Accumulated Other Comprehensive Income/(Loss)

The following table summarizes the changes in accumulated balances of other comprehensive income/(loss) ("AOCI") for the fiscal years ended December 29, 2019, and December 30, 2018 (in millions):

	Foreign Currency Translation	Cash Flow Hedges and other	Pension and Postretirement Benefits	Total
Balance as of December 31, 2017	$ (102.0)	$ 0.5	$ (227.8)	$ (329.3)
Other comprehensive income (loss) before reclassifications	(79.5)	1.0	—	(78.5)
Amounts reclassified from AOCI	—	(6.4)	(31.4)	(37.8)
Net other comprehensive loss	(79.5)	(5.4)	(31.4)	(116.3)
Reclassification of stranded income tax effects	—	—	(47.6)	(47.6)
Balance as of December 30, 2018	**(181.5)**	**(4.9)**	**(306.8)**	**(493.2)**
Other comprehensive income before reclassifications	**31.1**	**7.6**	—	**38.7**
Amounts reclassified from AOCI	**—**	**(5.0)**	**(16.3)**	**(21.3)**
Net other comprehensive income (loss)	**31.1**	**2.6**	**(16.3)**	**17.4**
Balance as of December 29, 2019	**$ (150.4)**	**$ (2.3)**	**$ (323.1)**	**$ (475.8)**

The reclassification out of AOCI for the fiscal years ended December 29, 2019, and December 30, 2018, are as follows (in millions):

	December 29, 2019	December 30, 2018	
	Amount reclassified from AOCI	Amount reclassified from AOCI	Financial Statement Presentation
Gain on cash flow hedges:			
Gain recognized in income on derivatives	**$ (6.9)**	$ (8.7)	See Note 2
Income tax impact	**1.9**	2.3	Provision for income taxes
Total	**$ (5.0)**	$ (6.4)	
Amortization of defined benefit pension and postretirement plan items:			
Amortization of prior service cost	**$ (5.9)**	$ (6.1)	See Note 11
Amortization of net actuarial loss	**30.9**	31.5	See Note 11
Pension adjustments	**(47.1)**	(66.6)	See Note 11
Total before tax	**(22.1)**	(41.2)	
Income tax impact	**5.8**	9.8	
Net of tax	**$ (16.3)**	$ (31.4)	

Revenue Recognition

We determine the appropriate method by which we recognize revenue by analyzing the nature of the products or services being provided as well as the terms and conditions of contracts or arrangements entered into with our customers. We account for a contract when it has approval and commitment from both parties, the rights of the parties are identified, payment terms are identified, the contract has commercial substance and collectability of consideration is probable. A contract's transaction price is allocated to each distinct good or service (i.e., performance obligation) identified in the contract, and each performance obligation is valued based on its estimated relative standalone selling price. For standard products or services, list prices generally represent the standalone selling price. For performance obligations where list price is not available, we typically use the expected cost plus a margin approach to estimate the standalone selling price for that performance obligation. Approximately 60% of our revenue is recognized at a point in time, with the remaining 40% recognized over time.

Revenue recognized at a point in time relates primarily to the sale of standard or minimally customized products, with control transferring to the customer generally upon the transfer of title. This type of revenue arrangement is typical for our commercial contracts within the Instrumentation, Digital Imaging, and Aerospace and Defense Electronics segments, and to a lesser extent for certain commercial contracts within the Engineered Systems segment relating to the sale of standard hydrogen/oxygen gas generators. In limited circumstances, customer specified acceptance criteria exist. If we cannot objectively demonstrate that the product meets those specifications prior to the shipment, the revenue is deferred until customer acceptance is obtained. The transaction price in these arrangements can include variable consideration, such as product returns and sales allowances. The estimation of this variable consideration and determination of whether to include estimated amounts as a

reduction in the transaction price is based largely on an assessment of our anticipated performance and all information (historical, current and forecasted) that is reasonably available to us.

Revenue recognized over time relates primarily to contracts to design, develop and/or manufacture highly engineered products used in both defense and commercial applications. This type of revenue arrangement is typical of our U.S. government contracts and to a lesser extent for certain commercial contracts, with both contract types occurring across all segments. The customer typically controls the work in process as evidenced either by contractual termination clauses or by our right to payment for costs incurred to date plus a reasonable profit for products or services that do not have an alternative use. As control transfers continuously over time on these contracts, revenue is recognized based on the extent of progress towards completion of the performance obligation. The selection of the method to measure progress towards completion requires judgment and is based on the nature of the products or services to be provided. We generally use the cost-to-cost measure of progress as this measure best depicts the transfer of control to the customer which occurs as we incur costs on our contracts. Under the cost-to-cost method, the extent of progress towards completion is measured based on the ratio of costs incurred to date to the total estimated costs at completion of the performance obligation. The transaction price in these arrangements may include estimated amounts of variable consideration, including award fees, incentive fees, contract amounts not yet funded, or other provisions that can either increase or decrease the transaction price. We estimate variable consideration at the amount to which we expect to be entitled, and we include estimated amounts in the transaction price to the extent it is probable that a significant reversal of cumulative revenue recognized will not occur when the estimation uncertainty is resolved. The estimation of this variable consideration and determination of whether to include estimated amounts in the transaction price are based largely on an assessment of our anticipated performance and all information (historical, current and forecasted) that is reasonably available to us.

The majority of our over time contracts have a single performance obligation as the promise to transfer the individual goods or services is not separately identifiable from other promises in the contracts and, therefore, not distinct. Over time contracts are often modified to account for changes in contract specifications and requirements. We consider contract modifications to exist when the modification either creates new or changes the existing enforceable rights and obligations. Most of our contract modifications on over time contracts are for goods or services that are not distinct from the existing contract due to the significant integration service provided in the context of the contract and are accounted for as if they were part of that existing contract. The effect of a contract modification on the transaction price and our measure of progress for the performance obligation to which it relates, is recognized as an adjustment to revenue (either as an increase in or a reduction of revenue) on a cumulative catch-up basis.

For over time contracts using cost-to-cost, we have an Estimate at Completion ("EAC") process in which management reviews the progress and execution of our performance obligations. This EAC process requires management judgment relative to assessing risks, estimating contract revenue, determining reasonably dependable cost estimates, and making assumptions for schedule and technical issues. Since certain contracts extend over a longer period of time, the impact of revisions in cost and revenue estimates during the progress of work may adjust the current period earnings through a cumulative catch-up basis. This method recognizes, in the current period, the cumulative effect of the changes on current and prior quarters. Additionally, if the current contract estimate indicates a loss, a provision is made for the total anticipated loss in the period that it becomes evident. Contract cost and revenue estimates for significant contracts are generally reviewed and reassessed quarterly. The majority of revenue recognized over time uses an EAC process. The net aggregate effects of these changes in estimates on contracts accounted for under the cost-to-cost method in 2019 was approximately $20.2 million of favorable operating income, primarily related to favorable changes in estimates that impacted revenue, and, to a lesser degree, cost of sales, within the Digital Imaging operating segment. The net aggregate effects of these changes in estimates on contracts accounted for under the cost-to-cost method in 2018 was approximately $4.4 million of favorable operating income, primarily related to changes in estimates that favorably impacted revenue. None of the effects of changes in estimates on any individual contract were material to the consolidated statements of income for any period presented.

While extended or non-customary warranties do not represent a significant portion of our revenue, we recognize warranty services as a separate performance obligations when it is material to the contract. When extended or non-customary warranties represents a separate performance obligation, the revenue is deferred and recognized ratably over the extended warranty period.

Remaining performance obligations represent the transaction price of firm orders for which work has not been performed as of the period end date and excludes unexercised contract options and potential orders under ordering-type contracts (e.g., indefinite-delivery, indefinite-quantity). As of December 29, 2019, the aggregate amount of the transaction price allocated to remaining performance obligations was $1,834.8 million. The Company expects approximately 75% of remaining performance obligations to be recognized into revenue within the next twelve months, with the remaining 25% recognized thereafter.

Shipping and Handling

Shipping and handling fees reimbursed by customers are classified as revenue while shipping and handling costs incurred by Teledyne are classified as cost of sales in the accompanying consolidated statements of income.

Product Warranty Costs

Some of the Company's products are subject to standard warranties and the Company reserves for the estimated cost of product warranties on a product-specific basis. Facts and circumstances related to a product warranty matter and cost estimates to return, repair and/or replace the product are considered when establishing a product warranty reserve. The adequacy of the preexisting warranty liabilities is assessed regularly and the reserve is adjusted as necessary based on a review of historic warranty experience with respect to the applicable business or products, as well as the length and actual terms of the warranties, which are typically one year. The product warranty reserve is included in current accrued liabilities and long-term liabilities on the balance sheet.

Warranty Reserve (in millions):	**2019**	**2018**	**2017**
Balance at beginning of year	**$ 21.0**	$ 21.1	$ 18.4
Product warranty expense	**13.1**	10.0	6.0
Deductions	**(14.2)**	(10.1)	(6.4)
Acquisitions	**4.9**	—	3.1
Balance at end of year	**$ 24.8**	$ 21.0	$ 21.1

Research and Development and Bid and Proposal Costs

Selling, general and administrative expenses include Company-funded research and development and bid and proposal costs which are expensed as incurred and were $209.6 million in 2019, $185.6 million in 2018 and $177.7 million in 2017.

Income Taxes

We compute the provision for income taxes using the asset and liability method, under which deferred tax assets and liabilities are recognized for temporary differences between the tax basis of assets and liabilities and their reported amount in the financial statements, which will result in taxable or deductible amounts in the future. In evaluating our ability to recover our deferred tax assets within the jurisdiction from which they arise, we consider all available positive and negative evidence, including scheduled reversals of deferred tax liabilities, projected future taxable income, tax-planning strategies, and results of recent operations. In projecting future taxable income, we begin with historical results adjusted for the results of discontinued operations and incorporate assumptions about the amount of future state, federal and foreign pretax operating income adjusted for items that do not have tax consequences. The assumptions about future taxable income require significant judgment and are consistent with the plans and estimates we are using to manage the underlying businesses. In evaluating the objective evidence that historical results provide, we consider three years of cumulative operating income. A valuation allowance is recorded when it is more likely than not that some of the deferred tax assets will not be realized.

Income tax positions must meet a more-likely-than-not recognition in order to be recognized in the financial statements. We recognize potential accrued interest and penalties related to unrecognized tax benefits within operations as income tax expense. As new information becomes available, the assessment of the recognition threshold and the measurement of the associated tax benefit of uncertain tax positions may result in financial statement recognition or derecognition.

Net Income Per Common Share

Basic and diluted earnings per share were computed based on net income. The weighted average number of common shares outstanding during the period was used in the calculation of basic earnings per share. This number of shares was increased by contingent shares that could be issued under various compensation plans as well as by the dilutive effect of stock options based on the treasury stock method in the calculation of diluted earnings per share.

The following table sets forth the computations of basic and diluted earnings per share (amounts in millions, except per share data):

Net Income Per Common Share:	**2019**	**2018**	**2017**
Net income	**$ 402.3**	$ 333.8	$ 227.2
Basic earnings per common share:			
Weighted average common shares outstanding	**36.3**	35.8	35.2
Basic earnings per common share	**$ 11.08**	$ 9.32	$ 6.45
Diluted earnings per share:			
Weighted average common shares outstanding	**36.3**	35.8	35.2
Effect of diluted securities (primarily stock options)	**1.2**	1.2	1.1
Weighted average diluted common shares outstanding	**37.5**	37.0	36.3
Diluted earnings per common share	**$ 10.73**	$ 9.01	$ 6.26

For 2019, 1,620 stock options were excluded in the computation of diluted earnings per share because they had exercise prices that were greater than the weighted average market price of the Company's common stock during the year. For 2018, 2,580 stock options were excluded in the computation of diluted earnings per share because they had exercise prices that were greater than the weighted average market price of the Company's common stock during the year. For 2017, no stock options were excluded in the computation of diluted earnings per share.

For 2019, 2018 and 2017, stock options to purchase 2.0 million, 2.1 million and 2.3 million shares of common stock, respectively, had exercise prices that were less than the average market price of the Company's common stock during the respective periods and are included in the computation of diluted earnings per share.

No contingent shares under the restricted stock or performance share compensation plans were excluded from fully diluted shares outstanding for 2019, 2018 or 2017.

Cash

Cash totaled $199.5 million at December 29, 2019, of which $139.7 million was held by foreign subsidiaries.

Accounts Receivable, Unbilled Receivables and Contract Liabilities

The timing of revenue recognition, billings and cash collections results in billed accounts receivable, unbilled receivables (contract assets), and customer advances and deposits (contract liabilities, which are included in accrued liabilities and other long-term liabilities) on the Consolidated Balance Sheet. Under the typical payment terms of our over time contracts, the customer pays us either performance-based payments or progress payments. Amounts billed and due from our customers are classified as receivables on the Consolidated Balance Sheet. We may receive interim payments as work progresses, although for some contracts, we may be entitled to receive an advance payment. We recognize a liability for these interim and advance payments in excess of revenue recognized and present it as a contract liability which is included within accrued liabilities and other long-term liabilities on the Consolidated Balance Sheet, which represented $126.8 million and $17.9 million as of December 29, 2019 and $111.5 million and $15.3 million as of December 30, 2018, respectively. Contract liabilities typically are not considered a significant financing component because these cash advances are used to meet working capital demands that can be higher in the early stages of a contract, and these cash advances protect us from the other party failing to adequately complete some or all of its obligations under the contract. When revenue recognized exceeds the amount billed to the customer, we record an unbilled receivable (contract asset) for the amount we are entitled to receive based on our enforceable right to payment. The unbilled receivable balance increased from the beginning of the year by $55.2 million, or 38.0%, primarily due to work performed ahead of billings on certain over time revenue contracts primarily in our Aerospace and Defense Electronics. Contract liabilities increased from the beginning of the year by $17.9 million, or 14.1%. The Company recognized revenue of $75.7 million during the year ended December 29, 2019 from contract liabilities that existed at the beginning of year. The Company recognizes the incremental costs of obtaining or fulfilling a contract as expense when incurred if the amortization period of the asset is one year or less. Incremental costs to obtain or fulfill contracts with an amortization period greater than one year were not material.

Accounts receivable is presented net of an allowance for doubtful accounts of $10.2 million at December 29, 2019, and $6.8 million at December 30, 2018. Expense recorded for the allowance for doubtful accounts was $1.3 million, $0.6 million and $4.2 million for 2019, 2018 and 2017, respectively. An allowance for doubtful accounts is established for losses expected to be incurred on accounts receivable balances. Judgment is required in the estimation of the allowance and is based upon specific identification, collection history and creditworthiness of the debtor. Trade credit is extended based upon evaluations of each customer's ability to perform its obligations, which are updated periodically.

Inventories

Inventories are stated at the lower of cost or net realizable value. The majority of inventory values are valued on an average cost or first-in, first-out method, while the remainder are stated at cost based on the last-in, first-out method. Costs include direct material, direct labor, applicable manufacturing and engineering overhead, and other direct costs. Judgment is required when establishing reserves to reduce the carrying amount of inventory to market or net realizable value. Inventory reserves are recorded when inventory is considered to be excess or obsolete based upon an analysis of actual on-hand quantities on a part-level basis to forecasted product demand and historical usage.

Property, Plant and Equipment

Property, plant and equipment is capitalized at cost. Property, plant and equipment is stated at cost less accumulated depreciation and amortization. Depreciation and amortization are determined using a combination of accelerated and straight-line methods over the estimated useful lives of the various asset classes. Buildings and building improvements are depreciated over periods not exceeding 45 years, equipment over 5 to 18 years, computer hardware and software over 3 to 7 years and leasehold improvements over the shorter of the estimated remaining lives or lease terms. Significant improvements are capitalized while maintenance and repairs are charged to expense as incurred. Depreciation expense on property, plant and equipment was $74.5 million in 2019, $73.5 million in 2018 and $65.9 million in 2017.

Goodwill, Acquired Intangible Assets and Other Long-lived Assets

Business acquisitions are accounted for under the acquisition method by assigning the purchase price to tangible and intangible assets acquired and liabilities assumed. Assets acquired and liabilities assumed are recorded at their fair values and the excess of the purchase price over the amounts assigned is recorded as goodwill.

Goodwill and acquired intangible assets with indefinite lives are not amortized, but tested at least annually for impairment. The Company performs an annual impairment test for goodwill and other indefinite-lived intangible assets in the fourth quarter of each year, or more often as circumstances require. The Company uses qualitative and quantitative approaches when testing goodwill for impairment. For selected reporting units under the qualitative approach, the Company performs a qualitative evaluation of events and circumstances impacting the reporting unit to determine the likelihood of goodwill impairment. Based on that qualitative evaluation, if the Company determines it is more likely than not that the fair value of a reporting unit exceeds its carrying amount, no further evaluation is necessary. Otherwise the Company performs a quantitative impairment test. The Company performs quantitative tests for reporting units at least once every three years. However, for certain reporting units the Company may perform a quantitative impairment test every year.

The two-step quantitative impairment test is used to first identify potential goodwill impairment and then measure the amount of goodwill impairment loss, if any. When it is determined that an impairment has occurred, an appropriate charge to operations is recorded. The results of our annual impairment tests of goodwill indicated that no impairment existed in 2019, 2018 or 2017.

The Company reviews intangible and other long-lived assets subject to depreciation or amortization for impairment whenever events or circumstances indicate that the carrying value of the asset may not be recoverable. Acquired intangible assets with finite lives are amortized and reflected in the segment's operating income over their estimated useful lives. The Company assesses the recoverability of the carrying value of assets held for use based on a review of projected undiscounted cash flows. Impairment losses, where identified, are determined as the excess of the carrying value over the estimated fair value of the long-lived asset. Recorded impairment charges to intangible or other long-lived assets were not material in 2019, 2018 or 2017.

Deferred Compensation Plan

The Company has a non-qualified executive deferred compensation plan that provides supplemental retirement income benefits for a select group of management. This plan permits eligible employees to make salary and bonus deferrals that are 100% vested. We have an unsecured obligation to pay in the future the value of the deferred compensation adjusted to reflect the performance, whether positive or negative, of selected investment measurement options chosen by each participant during the deferral period. As of December 29, 2019 and December 30, 2018, $63.0 million and $52.4 million, respectively, is included in other long-term liabilities related to these deferred compensation liabilities. Additionally, the Company purchased life insurance policies on certain participants to potentially offset these unsecured obligations. These policies are recorded at their cash surrender value as determined by the insurance carrier. The cash surrender value of these policies was $65.6 million and $56.1 million, as of December 29, 2019 and December 30, 2018, respectively, and are recorded in other non-current assets.

Environmental

Costs that mitigate or prevent future environmental contamination or extend the life, increase the capacity or improve the safety or efficiency of property utilized in current operations are capitalized. Other costs that relate to current operations or an existing condition caused by past operations are expensed in the period incurred. Environmental liabilities are recorded when the Company's liability is probable and the costs are reasonably estimable, which is generally not later than the completion of the feasibility study or the Company's recommendation of a remedy or commitment to an appropriate plan of action. The accruals are reviewed periodically and, as investigations and remediations proceed, adjustments are made as necessary. Accruals for losses from environmental remediation obligations do not consider the effects of inflation, and anticipated expenditures are not discounted to their present value. The accruals are not reduced by possible recoveries from insurance carriers or other third parties, but do reflect anticipated allocations among potentially responsible parties at federal Superfund sites or similar state-managed sites and an assessment of the likelihood that such parties will fulfill their obligations at such sites. The measurement of environmental liabilities by the Company is based on currently available facts, present laws and regulations, and current technology. Such estimates take into consideration the Company's prior experience in site investigation and remediation, the data concerning cleanup costs available from other companies and regulatory authorities, and the professional judgment of the Company's environmental personnel in consultation with outside environmental specialists, when necessary. The Company's reserves for environmental remediation obligations totaled $6.0 million at both December 29, 2019 and December 30, 2018. The short term amount is included in current accrued liabilities and the long-term amount is included in long-term accrued liabilities.

Foreign Currency Translation

The Company's foreign entities' accounts are generally measured using local currency as the functional currency. Assets and liabilities of these entities are translated at the exchange rate in effect at year-end. Revenues and expenses are translated at average month end rates of exchange prevailing during the year. Unrealized translation gains and losses arising from differences in exchange rates from period to period are included as a component of AOCI.

Derivative Instruments and Hedging Activities

Teledyne transacts business in various foreign currencies and has international sales and expenses denominated in foreign currencies, subjecting the Company to foreign currency risk. The Company's primary foreign currency risk objective is to protect the U.S. dollar value of future cash flows and minimize the volatility of reported earnings. The Company utilizes foreign currency forward contracts to reduce the volatility of cash flows primarily related to forecasted revenue and expenses denominated in Canadian dollars for our Canadian companies, and in British pounds for our U.K. companies. These contracts are designated and qualify as cash flow hedges. The Company has also converted a U.S. dollar denominated, variable rate debt obligation into a euro fixed rate obligation using a receive-float, pay fixed cross currency swap. These cross currency swaps are designated as cash flow hedges. In addition, the Company has converted domestic U.S. variable rate debt to fixed rate debt using a receive variable, pay fixed interest rate swap. The interest rate swap is also designated as a cash flow hedge.

The effectiveness of the cash flow hedge forward contracts, is assessed prospectively and retrospectively on a monthly basis using regression analysis, as well as using other timing and probability criteria. To receive hedge accounting treatment, all hedging relationships are formally documented at the inception of the hedges and must be highly effective in offsetting changes to future cash flows on hedged transactions. The effective portion of the cash flow hedge contracts' gains or losses resulting from changes in the fair value of these hedges is initially reported, net of tax, as a component of AOCI in stockholders' equity until the underlying hedged item is reflected in our consolidated statements of income, at which time the effective amount in AOCI is reclassified to revenue in our consolidated statements of income. Net deferred gains recorded in AOCI, net of tax, for forward contracts that will mature in the next 12 months total $0.8 million. These gains are expected to be offset by anticipated losses in the value of the forecasted underlying hedged item. Amounts related to the cross currency swaps and interests rate swap expected to be reclassified from AOCI into income in the next 12 months total $5.9 million.

In the event that the underlying forecasted transactions do not occur, or it becomes remote that they will occur, within the defined hedge period, the gains or losses on the related cash flow hedges will be reclassified from AOCI to other income and expense. During the current reporting period, all forecasted transactions occurred and, therefore, there were no such gains or losses reclassified to other income and expense, due to missed forecasts.

As of December 29, 2019, Teledyne had foreign currency forward contracts designated as cash flow hedges to buy Canadian dollars and to sell U.S. dollars totaling $75.7 million. These foreign currency forward contracts have maturities ranging from March 2020 to February 2021. Teledyne had foreign currency forward contracts designated as cash flow hedges to buy British pounds and to sell U.S. dollars totaling $17.1 million. These foreign currency forward contracts have maturities ranging from March 2020 to February 2021. Together these contracts had a fair value of $1.1 million.

The cross currency swaps have notional amounts of €113.0 million and $125.0 million, and €135.0 million and $150.0 million, and mature in March 2023 and October 2024, respectively. The interest rate swap has a notional amount of $125.0 million U.S. dollars and matures in March 2023.

In addition, the Company utilizes foreign currency forward contracts which are not designated as hedging instruments for accounting purposes to mitigate foreign exchange rate risk associated with foreign currency denominated monetary assets and liabilities, including intercompany receivables and payables. As of December 29, 2019, Teledyne primarily had foreign currency contracts of this type in the following pairs (in millions):

Contracts to Buy			Contracts to Sell		
Currency	**Amount**		**Currency**	**Amount**	
Canadian Dollars	$	7.9	U.S. Dollars	US$	6.2
Euros	€	35.8	U.S. Dollars	US$	39.2
Great Britain Pounds	£	44.9	U.S. Dollars	US$	55.5
Canadian Dollars	$	11.9	Euros	€	8.2
Danish Krone	Kr.	66.2	U.S. Dollars	US$	9.7
Great Britain Pounds	£	9.1	Euros	€	10.3

The above table includes non-designated hedges derived from terms contained in triggered or previously designated cash flow hedges. The gains and losses on these derivatives which are not designated as hedging instruments, are intended to, at a minimum, partially offset the transaction gains and losses recognized in earnings.

All derivatives are recorded on the balance sheet at fair value. As discussed below, the accounting for gains and losses resulting from changes in fair value depends on the use of the derivative and whether it is designated and qualifies for hedge accounting. Teledyne does not use foreign currency forward contracts for speculative or trading purposes.

The effect of derivative instruments designated as cash flow hedges for 2019 and 2018 was as follows (in millions):

	2019	**2018**
Net gain recognized in AOCI - foreign exchange contracts (a)	**$ 9.3**	$ 1.2
Net gain recognized in AOCI - interest rate contracts	**$ 0.8**	$ —
Net gain (loss) reclassified from AOCI into revenue/cost of sales - foreign exchange contracts	**$ (1.8)**	$ 2.1
Net gain reclassified from AOCI into interest expense - foreign exchange contracts	**$ 2.4**	$ 2.4
Net gain reclassified from AOCI into interest expense -interest rate contracts	**$ 0.2**	$ —
Net gain reclassified from AOCI into other income and expense, net - foreign exchange contracts (b)	**$ 6.0**	$ 4.2
Net foreign exchange loss recognized in revenue, net - foreign exchange contracts (c)	**$ (0.5)**	$ (0.5)

(a) Effective portion
(b) Amount reclassified to offset earnings impact of liability hedged by cross currency swap
(c) Amount excluded from effectiveness testing (recorded in other income and expense in 2018)

The effect of derivative instruments not designated as cash flow hedges recognized in other income and expense for 2019 and 2018 was a gain of $4.9 million and a loss of $24.8 million, respectively.

The Company has elected to use the income approach to value the derivatives, using observable Level 2 market expectations at measurement date and standard valuation techniques to convert future amounts to a single present amount. Level 2 inputs for the valuations are limited to quoted prices for similar assets or liabilities in active markets (specifically futures contracts on LIBOR and EURIBOR) and inputs other than quoted prices that are observable for the asset or liability (specifically LIBOR and EURIBOR cash and swap rates, foreign currency forward rates and cross currency basis spreads). Mid-market pricing is used as a practical expedient for fair value measurements. The fair value measurement of an asset or liability must reflect the nonperformance risk of the entity and the counterparty. Therefore, the impact of the counterparty's creditworthiness when in an asset position and the Company's creditworthiness when in a liability position has also been factored into the fair value measurement of the derivative instruments and did not have a material impact on the fair value of these derivative instruments. Both the counterparty and the Company are expected to continue to perform under the contractual terms of the instruments.

The fair values of the Company's derivative financial instruments are presented below. All fair values for these derivatives were measured using Level 2 information as defined by the accounting standard hierarchy (in millions):

Asset/(Liability) Derivatives	Balance sheet location	December 29, 2019	December 30, 2018
Derivatives designated as hedging instruments:			
Cash flow forward contracts	Other assets	**$ 1.3**	$ —
Interest rate contracts	Other current assets	**0.2**	—
Interest rate contracts	Other non-current assets	**0.3**	—
Cash flow forward contracts	Accrued liabilities	**(0.1)**	(4.2)
Cash flow cross currency swaps	Other current assets	**5.4**	—
Cash flow cross currency swaps	Other non-current liabilities	**(7.8)**	—
Cash flow cross currency swaps	Accrued liabilities	**0.3**	(6.3)
Total derivatives designated as hedging instruments		**(0.4)**	(10.5)
Derivatives not designated as hedging instruments:			
Non-designated forward contracts	Other current assets	**0.1**	—
Non-designated forward contracts	Accrued liabilities	**(0.4)**	(0.6)
Total derivatives not designated as hedging instruments		**(0.3)**	(0.6)
Total liability derivatives		**$ (0.7)**	$ (11.1)

Supplemental Cash Flow Information

Cash payments for federal, foreign and state income taxes were $110.1 million for 2019, which are net of $7.1 million in tax refunds. Cash payments for federal, foreign and state income taxes were $64.7 million for 2018, which are net of $7.6 million in tax refunds. Cash payments for federal, foreign and state income taxes were $36.7 million for 2017, which are net of $8.5 million in tax refunds. Cash payments for interest and credit facility fees totaled $23.4 million, $28.1 million and $32.4 million for 2019, 2018 and 2017, respectively.

Fair Value Measurements

Fair value is defined as the price that would be received for an asset or the exit price that would be paid to transfer a liability in the principal or most advantageous market in an orderly transaction between market participants on the measurement date. The Company considers assumptions that market participants would use when pricing the asset or liability, such as inherent risk, transfer restrictions, and risk of nonperformance. The Company uses the following three levels of inputs in determining the fair value, focusing on the most observable inputs when available:

- Level 1-Quoted prices in active markets for identical assets or liabilities.
- Level 2-Observable inputs other than Level 1 prices such as quoted prices for similar assets or liabilities; quoted prices in markets with insufficient volume or infrequent transactions (less active markets); or model-derived valuations in which all significant inputs are observable or can be derived principally from or corroborated by observable market data for substantially the full term of the assets or liabilities.
- Level 3-Unobservable inputs to the valuation methodology that are significant to the measurement of fair value of assets or liabilities.

To the extent that valuation is based on models or inputs that are less observable or unobservable in the market, the determination of fair value requires more judgment. In certain cases, the inputs used to measure fair value may fall into different levels of the fair value hierarchy. In such cases, for disclosure purposes, the level in the fair value hierarchy within which the fair value measurement is disclosed is determined based on the lowest level input that is significant to the fair value measurement.

Related Party Transactions

For all periods presented, the Company had no material related party transactions that required disclosure.

Recent Accounting Standards

In February 2016, the Financial Accounting Standards Board ("FASB") issued Accounting Standards Update ("ASU") No. 2016-02, Leases (Topic 842). The guidance requires lessees to recognize most leases on their balance sheet as a right-of-use asset and a lease liability, other than leases that meet the definition of a short-term lease. For income statement purposes, the FASB retained a dual model, requiring leases to be classified as either operating or finance. We adopted the guidance on December 31, 2018, the beginning of our 2019 fiscal year, using the modified retrospective transition method. Prior period comparative information was not adjusted. In addition, we elected the package of practical expedients permitted under the transition guidance, which among other things, allowed us to carry forward the historical lease classification. The adoption of this guidance did not have a material impact related to existing leases and as a result, a cumulative-effect adjustment was not recorded. Also, the adoption of the guidance did not have a material impact on our results of operations or cash flows. Upon adoption, on December 31, 2018, we recognized right-of-use assets of $128.4 million and a total lease liability of $139.8 million for operating leases. For additional discussion of the application of this guidance, see Note 13 of the Notes to Consolidated Financial Statements.

In February 2018, the FASB issued ASU No. 2018-02, "Income Statement-Reporting Comprehensive Income (Topic 220) Reclassification of Certain Tax Effects from Accumulated Other Comprehensive Income", to address a specific consequence of the Tax Cuts and Jobs Act ("Tax Act") by allowing a reclassification from AOCI to retained earnings for stranded tax effects resulting from the Tax Act reduction of the U.S. federal corporate income tax rate. The guidance is effective for all entities for annual periods beginning after December 15, 2018, with early adoption permitted, and is to be applied either in the period of adoption or retrospectively to each period in which the effect of the change in the U.S. federal corporate income tax rate in the Tax Act is recognized. In the third quarter of 2018, Teledyne elected to early adopt this ASU and elected to reclassify, in the period of enactment, stranded tax effects totaling $47.6 million from AOCI to retained earnings in its consolidated balance sheet. The reclassification amount primarily included income tax effects related to our pension and postretirement benefit plans. Income tax effects remaining in AOCI will be released into earnings as the related pretax amounts are reclassified to earnings.

In August 2017, the FASB issued ASU No. 2017-12, "Derivatives and Hedging (Topic 815) Targeted Improvements to Accounting for Hedging Activities." This guidance better aligns an entity's risk management activities and financial reporting for hedging relationships and expands and refines hedge accounting for both nonfinancial and financial risk components. This guidance also simplifies and aligns the recognition and presentation of the effects of the hedging instrument and the hedged item in the financial statements. We adopted the guidance as of December 31, 2018, the beginning of our 2019 fiscal year using the modified retrospective approach, there was no cumulative adjustment to retained earnings related to hedge ineffectiveness for the year ended December 31, 2018. Additionally, as a result of the adoption, we no longer disclose the ineffective portion of the change in fair value of our derivative financial instruments. The entire change in the fair value of the cash flow hedging instruments aside from components excluded from the assessment of hedge effectiveness will now be recorded in other comprehensive income and subsequently reclassified to earnings in the period the hedged item impacts earnings. The adoption of this guidance did not have a material impact on our consolidated financial statements.

In January 2017, the FASB issued ASU 2017-04, "Simplifying the Test for Goodwill Impairment", which eliminates the computation of the implied fair value of goodwill to measure a goodwill impairment charge. Instead, entities will record a goodwill impairment charge based on the excess of a reporting unit's carrying amount over its fair value. The new standard, will be effective for the Company prospectively for interim and annual reporting periods beginning after December 15, 2019, with early adoption permitted for interim or annual goodwill impairment tests performed on testing dates after January 1, 2017. We expect the adoption of this standard will reduce the complexity surrounding the evaluation of goodwill for impairment. The impact of this new standard for the Company will depend on the outcomes of future goodwill impairment tests.

In June 2016, the FASB issued ASU 2016-13, Financial Instruments - Credit Losses (Topic 326). The new guidance is effective for reporting periods beginning after December 15, 2019. The standard replaces the incurred loss impairment methodology under current GAAP with a methodology that reflects expected credit losses and requires the use of a forward-looking expected credit loss model for accounts receivables, loans, and other financial instruments. The standard requires a modified retrospective approach through a cumulative-effect adjustment to retained earnings as of the beginning of the first reporting period in which the guidance is effective. We plan to adopt the new credit loss standard effective December 30, 2019, the beginning of our 2020 fiscal year. We do not expect the new guidance to have a material effect on our financial position, results of operations or cash flows.

In May 2014, the FASB issued ASU No. 2014-09 (Topic 606), Revenue from Contracts with Customers, which provides a single comprehensive model for entities to use in accounting for revenue arising from contracts with customers and superseded most current revenue recognition guidance under Topic 605, Revenue Recognition. The Company adopted the requirements of Topic 606 as of January 1, 2018, using the modified retrospective transition method which required a cumulative-effect adjustment as of the date of adoption. Comparative disclosures with periods prior to adoption (i.e., fiscal year 2017) are not required due to our use of the modified retrospective transition method.

Note 3. Business Acquisitions, Goodwill and Acquired Intangible Assets

The Company spent $484.0 million, $3.1 million and $774.1 million on acquisitions and other investments, net of cash acquired, in 2019, 2018 and 2017, respectively.

2019 Acquisitions

On February 5, 2019, we acquired the scientific imaging businesses of Roper Technologies, Inc. for $224.8 million in cash. The acquired businesses include Princeton Instruments, Photometrics and Lumenera. The acquired businesses provide a range of imaging solutions, primarily for life sciences, academic research and customized original equipment manufacturer industrial imaging solutions. Princeton Instruments and Photometrics manufacture state-of-the-art cameras, spectrographs and optics for advanced research in physical sciences, life sciences research and spectroscopy imaging. Applications and markets include materials analysis, quantum technology and cell biology imaging using fluorescence and chemiluminescence. Lumenera primarily provides rugged USB-based customized cameras for markets such as traffic management, as well as life sciences applications. Principally located in the United States and Canada, the acquired businesses are part of the Digital Imaging segment.

On August 1, 2019, we acquired the gas and flame detection businesses of 3M Company for $233.5 million in cash. The gas and flame detection businesses includes Oldham, Simtronics, Gas Measurement Instruments, Detcon and select Scott Safety products. The gas and flame detection businesses provides a portfolio of fixed and portable industrial gas and flame detection instruments used in a variety of industries including petrochemical, power generation, oil and gas, food and beverage, mining and waste water treatment. Principally located in France, the United Kingdom and the United States, the acquired businesses are part of the Environmental Instrumentation product line of the Instrumentation segment.

On August 30, 2019, we acquired Micralyne Inc. (“Micralyne”) for $25.7 million in cash. Micralyne is a foundry providing MEMS devices. In particular, Micralyne possesses unique microfluidic technology for biotech applications, as well as capabilities in non-silicon-based MEMS (e.g. gold, polymers) often required for human body compatibility. Based in Edmonton, Alberta, Canada, the acquired business is part of the Digital Imaging segment.

2017 Acquisitions

On March 28, 2017, Teledyne completed the acquisition of all of the outstanding common stock of e2v technologies plc (“e2v”) for $770.7 million, including stock options and assumed debt, net of $24.4 million of cash acquired. e2v provides high performance image sensors and custom camera solutions and application specific standard products for the machine vision market. In addition, e2v provides high performance space qualified imaging sensors and arrays for space science and astronomy. e2v also produces components and subsystems that deliver high reliability radio frequency power generation for healthcare, industrial and defense applications. Finally, e2v provides high reliability semiconductors and board-level solutions for use in aerospace, space and communications applications. Teledyne funded the acquisition of e2v with borrowings under its credit facility and cash on hand as well as $100.0 million in a newly issued term loan.

Most of e2v’s operations are included in the Digital Imaging and Aerospace and Defense Electronics segments. The Instrumentation segment includes a small portion of e2v’s operations. Principally located in Chelmsford, United Kingdom and Grenoble, France, e2v had sales of approximately £236 million for its fiscal year ended March 31, 2016. e2v’s results have been included since the date of the acquisition and include $274.2 million in net sales and operating income of $37.3 million, which included $8.3 million in acquisition-related costs and $11.2 million in additional intangible asset amortization expense for 2017.

Fiscal year 2017 includes pretax charges of $27.0 million related to the acquisition of e2v, which included $13.0 million in transaction costs, including stamp duty, advisory, legal and other consulting fees and other costs recorded to selling, general and administrative expenses, $5.7 million in inventory fair value step-up amortization expense recorded to cost of sales, $2.3 million in bank bridge facility commitment expense recorded to interest expense and $6.0 million related to a foreign currency option contract expense to hedge the e2v purchase price recorded as other expense. Of these amounts, $8.0 million impacted the Digital Imaging segment and $0.3 million impacted the Aerospace and Defense segment operating results. Fiscal year 2016 includes pretax charges of $7.9 million related to the acquisition of e2v, of which, $1.9 million was recorded to selling, general and administrative expenses, $0.5 million was recorded to interest expense and $5.5 million was recorded as other expense.

The following table presents proforma net sales, net income and earnings per share data assuming e2v was acquired at the beginning of the 2017 fiscal year:

	Fiscal Year (a)
(Unaudited - in millions, except per share amounts)	2017
Net sales	$ 2,696.8
Net income	$ 209.8
Basic earnings per common share	$ 5.96
Diluted earnings per common share	$ 5.78

(a) The above unaudited proforma information is presented for the e2v acquisition as it is considered a material acquisition.

On July 20, 2017, a subsidiary of Teledyne acquired assets of Scientific Systems, Inc. ("SSI") for an initial cash payment of $31.0 million. A subsequent cash payment of $0.3 million related to a purchase price adjustment was made in 2017. Headquartered in State College, PA, SSI manufactures precision components and specialized subassemblies used primarily in analytical and diagnostic instrumentation, such as High Performance Liquid Chromatography systems and specific medical devices and is part of the Instrumentation segment.

The results of these acquisitions have been included in Teledyne's results since the dates of their respective acquisition.

Other

The primary reasons for the above acquisitions were to strengthen and expand our core businesses through adding complementary product and service offerings, allowing greater integrated products and services, enhancing our technical capabilities or increasing our addressable markets. The significant factors that resulted in recognition of goodwill were: (a) the purchase price was based on cash flow and return on capital projections assuming integration with our businesses and (b) the calculation of the fair value of tangible and intangible assets acquired that qualified for recognition. Teledyne funded the acquisitions primarily from borrowings under its credit facilities, issuance of senior notes and term loans and cash on hand.

Teledyne's goodwill was $2,050.5 million at December 29, 2019, and $1,735.2 million at December 30, 2018. The increase in the balance of goodwill in 2019 resulted from recent acquisitions and the impact of exchange rate changes. Teledyne's net acquired intangible assets were $430.8 million at December 29, 2019, and $344.3 million at December 30, 2018. The increase in the balance of acquired intangible assets in 2019 primarily resulted from recent acquisitions, partially offset by the amortization of acquired intangible assets and the impact of exchange rate changes. The Company's cost to acquire the 2019 and 2017 acquisitions has been allocated to the assets acquired and liabilities assumed based upon their respective fair values as of the date of the completion of the acquisition. The differences between the fair value of the consideration paid and the estimated fair value of the assets and liabilities acquired has been recorded as goodwill. The fair value of all the acquired identifiable assets and liabilities summarized below for the 2019 acquisitions is provisional pending finalization of the Company's acquisition accounting, including the finalization of the valuation of the intangible assets acquired, identification and measurement of certain inventory and property, plant and equipment balances, identification and measurement of certain liabilities, including the potential for loss contingencies and uncertain tax positions, if any, as well as the measurement of tax basis in certain jurisdictions and the resulting deferred taxes that might arise from book and tax basis differences, if any. The Company believes that such preliminary allocations provide a reasonable basis for estimating the fair values of assets acquired and liabilities assumed, but the Company is waiting for additional information necessary to finalize its fair value determination of these acquired identifiable assets and liabilities.

The following tables show the purchase price (net of cash acquired), provisional goodwill acquired and provisional intangible assets acquired for the acquisitions made in 2019 (in millions):

		2019		
Acquisitions	**Acquisition Date**	**Cash Paid (a)**	**Goodwill Acquired**	**Acquired Intangible Assets**
Scientific imaging businesses	February 5, 2019	**$ 224.8**	**$ 149.9**	**$ 52.4**
Gas and flame detection businesses	August 1, 2019	**233.5**	**147.7**	**69.0**
Micralyne Inc.	August 30, 2019	**25.7**	**7.3**	**0.9**
Total		**$ 484.0**	**$ 304.9**	**$ 122.3**

(a) Net of cash acquired and any purchase price adjustments.

The majority of the goodwill resulting from the acquisition of the scientific imaging businesses will be deductible for tax purposes. Goodwill resulting from the acquisition of the gas and flame detection businesses and Micralyne will not be deductible for tax purposes.

Provisional fair values allocated to the assets acquired and liabilities assumed (in millions):	2019
Current assets, excluding cash acquired	$ 83.0
Property, plant and equipment	30.7
Goodwill	304.9
Acquired intangible assets	122.3
Other long-term assets	7.1
Total assets acquired	548.0
Current liabilities	(33.4)
Long-term liabilities	(30.6)
Total liabilities assumed	(64.0)
Cash paid, net of cash acquired	$ 484.0

The following table is a summary at the acquisition date of the acquired intangible assets and weighted average useful life in years for the acquisitions made in 2019 (dollars in millions; amounts considered provisional as discussed above):

	2019	
Intangibles subject to amortization:	**Intangible Assets**	**Weighted average useful life in years**
Proprietary technology	$ 81.8	9.8
Customer list/relationships	27.9	11.9
Backlog	0.7	1.5
Total intangibles subject to amortization	110.4	10.3
Intangibles not subject to amortization:		
Trademarks	11.9	n/a
Total acquired intangible assets	$ 122.3	n/a
Goodwill	$ 304.9	n/a

Goodwill (in millions):	Instrumentation	Digital Imaging	Aerospace and Defense Electronics	Engineered Systems	Total
Balance at December 31, 2017	$ 756.4	$ 815.6	$ 182.0	$ 22.7	$ 1,776.7
Current year acquisitions	1.8	—	—	—	1.8
Foreign currency changes and other (a)	(3.5)	(5.9)	(33.5)	(0.4)	(43.3)
Balance at December 30, 2018	754.7	809.7	148.5	22.3	1,735.2
Current year acquisitions	147.7	157.2	—	—	304.9
Foreign currency changes and other (a)	3.5	(4.2)	15.8	(4.7)	10.4
Balance at December 29, 2019	$ 905.9	$ 962.7	$ 164.3	$ 17.6	$ 2,050.5

(a) Certain prior period balances have been recast due to a business realignment affecting the Aerospace and Defense Electronics segment the Digital Imaging segment and the Engineered Systems segment in 2019 and the Aerospace and Defense Electronics segment and the Digital Imaging segment Systems segment in 2018. Please refer to Note 12 Business Segments of the Notes to Consolidated Financial Statements included in this Form 10-K for further information.

	2019			2018		
	Gross carrying amount	Accumulated amortization	Net carrying amount	Gross carrying amount	Accumulated amortization	Net carrying amount
Acquired intangible assets (in millions):						
Proprietary technology	**$ 397.5**	**$ 207.6**	**$ 189.9**	$ 313.7	$ 179.8	$ 133.9
Customer list/relationships	**177.6**	**101.4**	**76.2**	148.8	90.9	57.9
Patents	**0.7**	**0.6**	**0.1**	0.7	0.6	0.1
Non-compete agreements	**0.9**	**0.9**	**—**	0.9	0.9	—
Trademarks	**4.1**	**3.3**	**0.8**	3.9	3.0	0.9
Backlog	**16.4**	**16.1**	**0.3**	15.6	15.6	—
Acquired intangible assets subject to amortization	**597.2**	**329.9**	**267.3**	483.6	290.8	192.8
Acquired intangible assets not subject to amortization:						
Trademarks	**163.5**	**—**	**163.5**	151.5	—	151.5
Total acquired intangible assets	**$ 760.7**	**$ 329.9**	**$ 430.8**	$ 635.1	$ 290.8	$ 344.3

Amortizable acquired intangible assets are amortized on a straight-line basis over their estimated useful lives ranging from one to 15 years. Consistent with Teledyne's growth strategy, we seek to acquire companies in markets characterized by high barriers to entry and that include specialized products not likely to be commoditized. Given our markets and highly engineered nature of our products, the rates of new technology development and customer acquisition and/or attrition are often not volatile. As such, we believe the value of acquired intangible assets decline in a linear, as opposed to an accelerated fashion, and we believe amortization on a straight-line basis is appropriate.

The Company recorded $37.4 million, $39.5 million and $41.4 million in amortization expense in 2019, 2018 and 2017, respectively, for acquired intangible assets. The expected future amortization expense, including provisional amounts for the 2019 acquisitions, for the next five years is as follows (in millions): 2020 - $38.5; 2021 - $37.1; 2022 - $34.3; 2023 - $30.5; 2024 - $28.7.

The estimated remaining useful lives by asset category as of December 29, 2019, are as follows:

Acquired intangibles subject to amortization	Weighted average remaining useful life in years
Proprietary technology	6.7
Customer list/relationships	7.0
Patents	2.9
Backlog	1.0
Trademarks	3.3
Total acquired intangibles subject to amortization	6.7

Note 4. Financial Instruments

The Company had no cash equivalents at December 29, 2019 or December 30, 2018. The fair value of the Company's forward currency contracts as of December 29, 2019 and December 30, 2018, are disclosed in Note 2, under "Derivative Instruments and Hedging Activities," of the Notes to Consolidated Financial Statements and are based on Level 2 inputs. Teledyne estimates the fair value of its long-term debt based on debt of similar type, rating and maturity and at comparable interest rates. The fair value of the Company's senior unsecured notes as described in Note 9, "Long-Term Debt," of the Notes to Consolidated Financial Statements approximated the carrying value based upon Level 2 inputs and is valued based on observable market data at December 29, 2019 and December 30, 2018. The fair value of the Company's credit facility, term loans and other debt, also described in Note 9, at December 29, 2019 and December 30, 2018, approximated the carrying value due to the variable market rate used to calculate interest payments. The Company does not have any other significant financial assets or liabilities that are measured at fair value. The carrying value of other on-balance-sheet financial instruments approximates fair value, and the cost, if any, to terminate off-balance sheet financial instruments (primarily letters of credit) is not significant.

Note 5. Accounts Receivable and Unbilled Receivables

Accounts Receivable and Unbilled Receivables (in millions):	Balance at year-end	
	2019	2018
Commercial and other billed receivables	**$ 440.1**	$ 381.9
U.S. Government and prime contractors billed receivables	**30.5**	41.3
	470.6	423.2
Allowance for doubtful accounts	**(10.2)**	(6.7)
Account receivable, net	**$ 460.4**	$ 416.5
Commercial and other unbilled receivables	**$ 143.9**	$ 96.4
U.S. Government and prime contractors unbilled receivables	**56.5**	48.9
Unbilled receivables, net	**$ 200.4**	$ 145.3

Note 6. Inventories

Inventories (in millions):	Balance at year-end	
	2019	2018
Raw materials and supplies	**$ 231.2**	$ 205.6
Work in process	**108.3**	117.5
Finished goods	**61.7**	50.5
	401.2	373.6
Reduction to LIFO cost basis	**(7.8)**	(9.3)
Total inventories, net	**$ 393.4**	$ 364.3

Inventories at cost determined on the LIFO method were $40.0 million at December 29, 2019, and $42.3 million at December 30, 2018. The remainder of the inventories using average cost or the FIFO methods, were $361.2 million at December 29, 2019, and $331.3 million at December 30, 2018.

The Company recorded LIFO income of $1.6 million, $0.1 million and $2.9 million in 2019, 2018 and 2017, respectively.

Note 7. Supplemental Balance Sheet Information

Property, plant and equipment (in millions):	Balance at year-end	
	2019	2018
Land	**$ 68.1**	$ 59.6
Buildings	**280.6**	254.7
Equipment and software and other	**763.1**	694.3
	1,111.8	1,008.6
Accumulated depreciation and amortization	**(623.9)**	(566.0)
Total property, plant and equipment, net	**$ 487.9**	$ 442.6

The following table presents selected balance sheet components (in millions):

Balance sheet items	Balance sheet location	December 29, 2019	December 30, 2018
Salaries and wage accruals	Accrued liabilities	**$ 124.1**	$ 116.5
Customer related accruals, deposits and credits	Accrued liabilities	**$ 127.0**	$ 111.6
Deferred tax liabilities	Other long-term liabilities	**$ 34.0**	$ 51.2

Note 8. Stockholders' Equity

Common stock and treasury stock activity:	Common Stock	Treasury Stock
Balance, January 1, 2017	37,697,865	2,587,103
Issued	—	(429,471)
Balance, December 31, 2017	37,697,865	2,157,632
Issued	—	(547,064)
Balance, December 30, 2018	**37,697,865**	**1,610,568**
Issued	—	**(460,669)**
Balance, December 29, 2019	**37,697,865**	**1,149,899**

Shares issued include stock options exercised as well as shares issued under certain compensation plans.

Treasury Stock

In January 2016, the Company's Board of Directors authorized a stock repurchase program authorizing the Company to repurchase up to 3,000,000 shares of its common stock. The number of shares repurchased will depend on a variety of factors, such as share price, levels of cash and borrowing capacity available, alternative investment opportunities available immediately or longer-term, and other regulatory, market or economic conditions. Future repurchases, if any, are expected to be funded with cash on hand and borrowings under the Company's credit facility. No repurchases were made in 2019, 2018 or 2017. Up to approximately three million shares may be repurchased under the stock repurchase program.

Preferred Stock

Authorized preferred stock may be issued with designations, powers and preferences designated by the Board of Directors. There were no shares of preferred stock issued or outstanding in 2019, 2018 or 2017.

Stock Incentive Plan

Teledyne has long-term incentive plans which provide its Board of Directors the flexibility to grant restricted stock, restricted stock units, performance shares, non-qualified stock options, incentive stock options and stock appreciation rights to officers and employees of Teledyne. Employee stock options become exercisable in one-third increments on the first, second and third anniversary of the grant and have a maximum 10-year life.

Stock Options

Stock option compensation expense is recorded on a straight line basis over the appropriate vesting period, generally three years except for stock options that were granted after 2018 to Teledyne's President and Chief Executive Officer and Teledyne's Executive Chairman, which were expensed immediately. The Company recorded $26.1 million, $19.8 million, and $14.2 million for stock option expense, for 2019, 2018 and 2017, respectively. The Company issues shares of common stock upon the exercise of stock options. On January 21, 2020, the Company granted 245,985 stock options to its employees at an exercise price of $383.33 per share.

The total pretax intrinsic value of options exercised during 2019 and 2018 (which is the amount by which the stock price exceeded the exercise price of the options on the date of exercise) was $82.5 million and $69.6 million, respectively. At December 29, 2019, the intrinsic value of stock options outstanding was $431.5 million and the intrinsic value of stock options exercisable was $315.2 million. During 2019 and 2018, the amount of cash received from the exercise of stock options was $34.6 million and $37.2 million, respectively.

At December 29, 2019, there was $25.6 million of total unrecognized compensation cost related to non-vested stock option awards which is expected to be recognized over a weighted-average period of 1.3 years.

The fair value of stock options is determined by using a lattice-based option pricing model. The Company uses a combination of its historical stock price volatility and the volatility of exchange traded options, if any, on the Company stock to compute the expected volatility for purposes of valuing stock options granted. The period used for the historical stock price corresponded to the expected term of the options. The period used for the exchange traded options, if any, included the longest-dated options publicly available, generally three months. The expected dividend yield is based on Teledyne's practice of not paying dividends. The risk-free rate of return is based on the yield of U.S. Treasury Strips with terms equal to the expected life of the options as of the grant date. The expected life in years is based on historical actual stock option exercise experience.

Stock option valuation assumptions:	2019	2018	2017
Expected dividend yield	—	—	—
Expected volatility	26.7 %	31.0 %	32.3 %
Risk-free interest rate	2.47% to 2.70%	1.99% to 2.58%	1.0 % to 2.5%
Expected life in years	6.6	6.8	7.2

Based on the assumptions used in the valuation of stock options, the grant date weighted average fair value of stock options granted in 2019, 2018 and 2017 was $72.00, $71.89 and $48.45, respectively.

Stock option transactions for Teledyne's stock option plans are summarized as follows:

	2019		2018		2017	
	Shares	Weighted Average Exercise Price	Shares	Weighted Average Exercise Price	Shares	Weighted Average Exercise Price
Beginning balance	**2,064,740**	**$ 104.66**	2,285,703	$ 83.73	2,175,442	$ 70.44
Granted	**390,789**	**$ 217.58**	376,065	$ 192.28	543,880	$ 123.40
Exercised	**(429,654)**	**$ 80.31**	(516,927)	$ 71.95	(390,835)	$ 63.96
Canceled or expired	**(37,299)**	**$ 181.62**	(80,101)	$ 129.85	(42,784)	$ 92.79
Ending balance	**1,988,576**	**$ 130.67**	2,064,740	$ 104.66	2,285,703	$ 83.73
Options exercisable at end of period	**1,242,205**	**$ 94.04**	1,257,766	$ 78.26	1,443,241	$ 70.35

The following table provides certain information with respect to stock options outstanding and stock options exercisable at December 29, 2019, under the stock option plans:

	Stock Options Outstanding			Stock Options Exercisable	
Range of Exercise Prices	Shares	Weighted Average Exercise Price	Remaining life in years	Shares	Weighted Average Exercise Price
$20.70-$49.99	120,459	$ 44.70	1.2	120,459	$ 44.70
$50.00-$99.99	786,518	$ 80.73	4.5	786,518	$ 80.73
$100.00-$149.99	386,443	$ 123.40	7.2	239,913	$ 123.39
$150.00-$199.99	314,364	$ 192.00	8.2	94,214	$ 191.97
$200.00-$237.01	380,792	$ 217.69	9.1	1,101	$ 228.84
	1,988,576	$ 130.67	6.3	1,242,205	$ 94.04

Performance Shares

Teledyne's Performance Share Plan ("PSP") provides grants of performance share units, which key officers and executives may earn if Teledyne meets specified performance objectives over a three-year period. Awards are payable in cash and to the extent available, shares of Teledyne common stock. Awards are generally paid to the participants in three annual installments after the end of the performance cycle so long as they remain employed by Teledyne (with an exception for retirement). Participants in the PSP program can elect to receive a cash payment in lieu of awarded shares to pay income taxes due with respect to an installment payment. The cash payment in lieu of awarded shares is based on the then current market value of Teledyne stock.

In February 2015, the performance cycle for the three-year period ending December 31, 2017, was set. Under the plan, and based on actual performance, the Company issued 6,481 shares in 2018, 8,586 shares in 2019 and 7,673 shares in February 2020.

In February 2018, the performance cycle for the three-year period ending December 31, 2020, was set. Under the plan, and based on actual performance, the maximum number of shares that could be issued in three equal installments in 2021, 2022 and 2023, is 59,427.

The estimated expense for each plan year was based on the expected cash payout and the expected shares to be issued, valued at the share price at the inception of the performance cycle, except for the shares that can be issued based on a market comparison. The estimated expense for these shares was calculated using a lattice-based simulation which takes into consideration several factors including volatility, risk free interest rates and correlation of Teledyne's stock price with the comparator, the Russell 2000 Index (for the 2018 performance cycle, the comparator is the Russell 1000). No adjustment to the calculated expense for the shares issued based on a market based comparison will be made regardless of the actual performance. The Company recorded $7.5 million, $5.1 million and $4.6 million in compensation expense related to the PSP program for fiscal years 2019, 2018 and 2017, respectively.

Restricted Stock

Under Teledyne's restricted stock award program key officers and executives receive a grant of stock equal to a specified percentage of the participant's annual base salary at the date of grant. The restricted stock is subject to transfer and forfeiture restrictions during an applicable "restricted period". The restrictions have both time-based and performance-based components. The restricted period expires (and the restrictions lapse) on the third anniversary of the date of grant, subject to the achievement of stated performance objectives over a specified three-year performance period. If employment is terminated (other than by death, retirement or disability) during the restricted period, the stock grant is forfeited.

The estimated expense for restricted stock awards to employees is based on a lattice-based simulation which takes into consideration several factors including volatility, risk free interest rates and the correlation of Teledyne's stock price with the comparator, the Russell 2000 Index (for awards granted after 2017 the comparator is the Russell 1000). No adjustment to the estimated expense will be made regardless of actual performance. The Company recorded $3.0 million, $2.7 million and $2.7 million in compensation expense related to restricted stock awards to employees, for fiscal years 2019, 2018 and 2017, respectively. At December 29, 2019, there was $3.3 million of total estimated unrecognized compensation cost related to non-vested awards which is expected to be recognized over a weighted-average period of approximately 1.5 years.

The following table shows restricted stock award activity for grants made to employees:

Restricted Stock:	**Shares**	**Weighted average fair value per share**
Balance, January 1, 2017	97,044	$ 83.68
Granted	24,232	$ 114.74
Issued	(30,704)	$ 87.98
Forfeited/Canceled	(2,136)	$ 82.58
Balance, December 31, 2017	88,436	$ 90.72
Granted	16,733	$ 176.64
Issued	(28,855)	$ 92.74
Forfeited/Canceled	(2,094)	$ 135.48
Balance, December 30, 2018	**74,220**	**$ 108.05**
Granted	**17,522**	**$ 200.00**
Issued	**(35,330)**	**$ 72.91**
Balance, December 29, 2019	**56,412**	**$ 158.62**

In December 2016, Teledyne granted 16,045 restricted stock units with a grant date fair value of $2.0 million to Teledyne's then Chief Executive Officer, which vest in equal annual installments over three years. The calculated expense for restricted stock units is based on the market price of a share of Teledyne common stock at the grant date, which is recognized over the vesting period and was $0.6 million in 2019, $0.7 million in 2018 and $0.7 million in 2017. In both December 2019 and December 2018, we issued 2,697 shares under the plan and 2,651 shares were withheld to pay income taxes. In December 2017, we issued 2,389 shares under the plan and 2,960 shares were withheld to pay income taxes.

Non-employee directors each receive restricted stock units valued at $110,000 (or valued at $55,000 for a person who becomes a director for the first time after the date of the Annual Meeting). The restricted stock units generally vest one year following the date of grant and are settled in shares of common stock on the date of vesting unless a director has elected to defer settlement of the award until his or her separation from Board service. The annual expense related to non-employee director's restricted stock units was approximately $1.0 million for each of 2019, 2018 and 2017.

The following table shows restricted stock award activity for grants made to non-employee directors:

Directors Restricted Stock:	**Shares**	**Weighted average fair value per share**
Balance, January 1, 2017	11,307	$ 97.16
Granted	7,371	$ 134.26
Issued	(10,305)	$ 96.00
Balance, December 31, 2017	8,373	$ 131.25
Granted	5,112	$ 193.39
Issued	(5,733)	$ 134.26
Balance, December 30, 2018	**7,752**	**$ 170.00**
Granted	**4,155**	**$ 251.23**
Issued	**(2,840)**	**$ 193.39**
Balance, December 29, 2019	**9,067**	**$ 199.90**

Note 9. Long-Term Debt

Long-Term Debt (in millions):	December 29, 2019	December 30, 2018
$750.0 million credit facility, due March 2024, weighted average rate of 2.80% at December 29, 2019 and 5.50% at December 30, 2018	**$ 125.0**	$ 29.0
Term loan repaid October 2019, variable rate of 3.63% at December 30, 2018, swapped to a Euro fixed rate of 0.7055%	**—**	100.0
Term loan due October 2024, variable rate of 2.702% at December 29, 2019, swapped to a Euro fixed rate of 0.612%	**150.0**	**—**
2.61% Fixed Rate Senior Notes repaid December 2019	**—**	30.0
5.30% Fixed Rate Senior Notes due September 2020	**75.0**	75.0
2.81% Fixed Rate Senior Notes due November 2020	**25.0**	25.0
3.09% Fixed Rate Senior Notes due December 2021	**95.0**	95.0
3.28% Fixed Rate Senior Notes due November 2022	**100.0**	100.0
0.70% €50 Million Fixed Rate Senior Notes due April 2022	**56.0**	57.2
0.92% €100 Million Fixed Rate Senior Notes due April 2023	**111.9**	114.4
1.09% €100 Million Fixed Rate Senior Notes due April 2024	**111.9**	114.4
Other debt	**2.0**	8.8
Debt issuance costs	**(1.2)**	(1.3)
Total long-debt	**850.6**	747.5
Current portion of long-term debt and other debt	**(100.6)**	(137.4)
Total long-term debt, net of current portion	**$ 750.0**	$ 610.1

Maturities of long-term debt as of December 29, 2019 (dollars in millions):

Fiscal year	
2020	**$ 100.6**
2021	**95.4**
2022	**156.0**
2023	**111.9**
2024	**386.9**
Thereafter	**1.0**
Total principal payments	**851.8**
Debt issuance costs	**(1.2)**
Total debt	**$ 850.6**

The Company has no sinking fund requirements.

On March 15, 2019, Teledyne amended its $750.0 million credit agreement to extend the maturity date from December 2020 to March 2024. While the borrowing capacity remains at $750.0 million, the amendment permits Teledyne to increase the aggregate amount of the borrowing capacity by up to $250.0 million subject to certain conditions. Excluding interest and fees, no payments are due under the $750.0 million unsecured credit facility ("credit facility") until it matures. Borrowings under our credit facility and term loans are at variable rates which are, at our option, tied to a Eurocurrency rate equal to LIBOR (London Interbank Offered Rate) plus an applicable rate or a base rate as defined in our credit agreements. Eurocurrency rate loans may be denominated in U.S. dollars or an alternative currency as defined in the agreement. Eurocurrency or LIBOR based loans under the facility typically have terms of one, two, three or six months and the interest rate for each such loan is subject to change if the loan is continued or converted following the applicable maturity date. The Company has not drawn any loans with a term longer than three months under the credit facility. Base rate loans have interest rates that primarily fluctuate with changes in the prime rate. Interest rates are also subject to change based on our consolidated leverage ratio as defined in the credit agreement. The credit facility also provides for facility fees that vary between 0.12% and 0.25% of the credit line, depending on our consolidated leverage ratio as calculated from time to time. Available borrowing capacity under the credit facility, which is reduced by borrowings and certain outstanding letters of credit, was $598.3 million at December 29, 2019. The credit agreement and term loans requires the Company to comply with various financial and operating covenants and at December 29, 2019, the Company was in compliance with these covenants. At December 29, 2019, Teledyne had $29.2 million in outstanding letters of credit.

In October 2019, Teledyne and its subsidiary, Teledyne Netherlands B.V., as borrowers, entered into an Amended and Restated Term Loan Credit Agreement (the "Amended Term Loan Credit Agreement") that amends and restates the Term Loan Credit Agreement dated as of March 17, 2017. Pursuant to the Amended Term Loan Credit Agreement, the lenders thereunder made unsecured term loans in an aggregate principal amount of $150.0 million, denominated in US dollars, $100.0 million of which was used to repay outstanding loans, which had a maturity date of October 30, 2019. Also, on October 30, 2019, Teledyne entered into a cross currency swap to effectively convert the $150.0 million term loan to a €135.2 million denominated instrument with a fixed euro interest rate of 0.612%.

Total interest expense including credit facility fees and other bank charges was $22.0 million in 2019, $29.2 million in 2018 and $35.5 million in 2017.

Note 10. Income Taxes

On December 22, 2017, the Tax Act was enacted, which significantly revised the U.S. corporate income tax by, among other things, lowering corporate income tax rates, implementing the territorial tax system and imposing a tax on deemed repatriation of non-U.S. earnings. The repatriation tax resulted in a net tax expense of $26.2 million and the remeasurement of U.S. deferred tax assets and liabilities resulted in a net tax benefit of $21.5 million, for a net provisional charge of $4.7 million recorded in the fourth quarter of 2017. The Company finalized its assessment of the Tax Act during the fourth quarter of 2018, resulting in a decrease of $0.8 million to the provisional charge and the repatriation tax. The $12.0 million balance of the repatriation tax at outstanding at December 30, 2018 was paid in February 2019.

Income before income taxes included income from domestic operations of $295.9 million for 2019, $243.7 million for 2018 and $187.2 million for 2017. Income before taxes included income from foreign operations of $177.8 million for 2019, $150.2 million for 2018 and $99.8 million for 2017.

Income tax provision/(benefit) - (in millions):	**2019**	**2018**	**2017**
Current			
Federal	**$ 66.0**	$ 22.9	$ 54.0
State	**10.6**	8.1	6.4
Foreign	**28.4**	31.8	22.8
Total current	**105.0**	62.8	83.2
Deferred			
Federal	**(37.0)**	2.3	(10.7)
State	**(2.3)**	0.6	(3.6)
Foreign	**5.7**	(5.6)	(9.1)
Total deferred	**(33.6)**	(2.7)	(23.4)
Provision for income taxes	**$ 71.4**	$ 60.1	$ 59.8

The following is a reconciliation of the statutory federal income tax rate to the actual effective income tax rate:

Tax rate reconciliation:	**2019**	**2018**	**2017**
U.S. federal statutory income tax rate	**21.0 %**	21.0 %	35.0 %
State and local taxes, net of federal benefit	**2.1**	1.9	1.8
Research and development tax credits	**(2.1)**	(2.3)	(3.2)
Investment tax credits	**(1.1)**	(1.2)	(1.5)
Qualified production activity deduction	**—**	—	(1.3)
Foreign rate differential	**0.7**	1.1	(4.2)
Net reversals for unrecognized tax benefits	**(0.6)**	(0.3)	(0.8)
Stock-based compensation	**(3.3)**	(3.3)	(3.1)
U.S. export sales	**(2.4)**	(1.3)	—
Provisional charges related to U.S. tax reform	**—**	(0.2)	1.6
Other	**0.8**	(0.1)	(3.5)
Effective income tax rate	**15.1 %**	15.3 %	20.8 %

Deferred income taxes result from temporary differences in the recognition of income and expense for financial and income tax reporting purposes, and differences between the fair value of assets acquired in business combinations accounted for as purchases for financial reporting purposes and their corresponding tax bases. Deferred income taxes represent future tax benefits or costs to be recognized when those temporary differences reverse.

The categories of assets and liabilities that have resulted in differences in the timing of the recognition of income and expense were as follows (in millions):

Deferred income tax assets:	**2019**	**2018**
Long-term:		
Accrued liabilities	**$ 20.5**	$ 20.3
Inventory valuation	**14.5**	11.9
Accrued vacation	**7.8**	7.8
Deferred compensation and other benefit plans	**30.2**	20.0
Postretirement benefits other than pensions	**1.8**	2.5
Operating lease liabilities	**33.5**	—
Capitalization of research and development	**38.8**	—
Tax credit and net operating loss carryforward	**30.2**	43.8
Valuation allowance	**(6.1)**	(5.4)
Total deferred income tax assets	**171.2**	100.9
Deferred income tax liabilities:		
Long-term:		
Property, plant and equipment differences	**16.0**	20.5
Intangible amortization	**133.5**	112.0
Operating lease right-of-use assets	**33.5**	—
Other	**5.5**	7.1
Total deferred income tax liabilities	**188.5**	139.6
Net deferred income tax liabilities	**$ 17.3**	$ 38.7

We intend to reinvest indefinitely the earnings of our material foreign subsidiaries in our operations outside of the United States. The cash that the Company's foreign subsidiaries hold for indefinite reinvestment is generally used to finance foreign operations and investments, including acquisitions. We estimate that future domestic cash generation will be sufficient to meet future domestic cash requirements. Due to the Tax Act, U.S. federal and applicable state income taxes have been accrued for the deemed repatriation. At December 29, 2019, the amount of undistributed foreign earnings was $309.5 million, for which we have not recorded a deferred tax liability of approximately $1.4 million for corporate income taxes which would be due if reinvested foreign earnings were repatriated. Should we decide to repatriate the foreign earnings, we would need to adjust our income tax provision in the period we determined that we would no longer indefinitely reinvest the earnings outside the United States.

In assessing the need for a valuation allowance, we consider all positive and negative evidence, including recent financial performance, scheduled reversals of temporary differences, projected future taxable income, availability of taxable income in carryback periods and tax planning strategies. Based on a review of such information, management believes that it is possible that some portion of deferred tax assets will not be realized as a future benefit and therefore has recorded a valuation allowance. The valuation allowance for deferred tax assets increased by $0.7 million in 2019, primarily related to the evidence for future utilization of the remaining investment tax credits.

At December 29, 2019, the Company had approximately $43.6 million of net operating loss carryforward primarily from the Company's entity in Denmark, which has no expiration date. The Company had foreign capital loss carryforward in the amount of $2.1 million which has no expiration date. Also the Company had aggregate Canadian federal and provincial investment tax credits of $8.6 million, which have expiration dates of 2030 to 2040. In addition, the Company had domestic federal and state net operating loss carryforward of $3.8 million and $105.6 million, respectively. Generally, federal net operating loss carryforward amounts are limited in their use by earnings of certain acquired subsidiaries, and have expiration dates ranging from 2030 to 2037 and the state net operating loss carryforward amounts have expiration dates ranging from 2020 to 2039. Finally, the Company had federal research and development credit carryforward in the amount of $0.9 million which will expire between 2032 and 2035 and state tax credits of $10.6 million, of which $9.7 million have no expiration date and $0.8 million have expiration dates ranging from 2023 to 2033.

Unrecognized tax benefits (in millions):	2019	2018	2017
Beginning of year	**$ 25.0**	$ 26.0	$ 24.5
Increase in prior year tax positions (a)	**4.2**	2.3	0.5
Increase for tax positions taken during the current period	**4.3**	2.1	9.8
Reduction related to settlements with taxing authorities	**(4.6)**	(0.1)	—
Reduction related to lapse of the statute of limitations	**(4.3)**	(5.2)	(8.8)
Impact of exchange rate changes	**(0.1)**	(0.1)	—
End of year	**$ 24.5**	$ 25.0	$ 26.0

a) Includes the impact of acquisitions in all years.

The Company anticipates the total unrecognized tax benefit for various federal, state and foreign tax items may be reduced by $3.4 million due to the expiration of statutes of limitation for various federal, state and foreign tax issues in the next 12 months.

We recognized net tax benefits and expense for interest and penalties related to unrecognized tax benefits within the provision for income taxes in our statements of operations of $0.3 million of benefit, $0.3 million of expense and $0.5 million of benefit, for 2019, 2018 and 2017, respectively. Interest and penalties in the amount of $1.1 million, $1.7 million and $1.4 million were recognized in the 2019, 2018 and 2017 statement of financial position, respectively. Substantially all of the unrecognized tax benefits as of December 29, 2019, if recognized, would affect our effective tax rate.

We file income tax returns in the United States federal jurisdiction and in various states and foreign jurisdictions. The Company has substantially concluded on all U.S. federal income tax matters for all years through 2015, United Kingdom income tax matters for all years through 2017, France income tax matters for all years through 2016 and Canadian income tax matters for all years through 2011.

Note 11. Pension Plans and Postretirement Benefits

Pension Plans

As of December 29, 2019, Teledyne has a defined benefit pension plan covering substantially all U.S. employees hired before January 1, 2004, or approximately 10% of Teledyne's active employees. As of January 1, 2004, new hires participate in a defined contribution plan only. The Company also has several small domestic non-qualified and foreign-based defined benefit pension plans.

In 2018 and 2017, the Company's U.S. domestic qualified pension plan purchased group annuity contracts from insurance companies and paid a total annuity premium of $17.8 million in 2018 and $19.0 million in 2017. These annuity contracts transfer the obligation to the insurance companies to guarantee the full payment of all annuity payments to existing retired pension plan participants or their surviving beneficiaries. These annuity contracts assume all investment risk associated with the assets that were delivered as the annuity contract premiums. These annuity contracts covered 321 and 412 existing retired pension plan participants for 2018 and 2017, respectively, at the time of purchase. No annuity contracts were purchased in 2019.

The domestic qualified pension plan allows participants to elect a lump-sum payment at retirement. In 2019, 2018 and 2017, the Company made lump sum payments of $17.2 million, $18.6 million and $21.7 million, respectively, from the domestic qualified pension plan assets to certain participants in the plan. Each year beginning with 2014, the Society of Actuaries released revised mortality tables, which updated life expectancy assumptions. In consideration of these tables, each year the Company reviews the mortality assumptions used in determining our pension and post-retirement obligations.

	Domestic			Foreign		
	2019	2018	2017	2019	2018	2017
Service cost - benefits earned during the period (in millions)	**$ 8.5**	$ 9.8	$ 10.2	**$ 0.9**	$ 0.9	$ 1.0

	Domestic			Foreign		
Pension non-service income (in millions):	2019	2018	2017	2019	2018	2017
Interest cost on benefit obligation	**32.4**	31.5	35.6	**1.2**	1.3	1.2
Expected return on plan assets	**(64.8)**	(70.0)	(71.3)	**(1.4)**	(1.7)	(2.1)
Amortization of prior service cost	**(6.0)**	(6.0)	(6.0)	**0.1**	(0.1)	(0.1)
Amortization of actuarial loss	**30.6**	31.1	28.6	**0.3**	0.4	0.6
Curtailment	**—**	—	—	**(0.5)**	(0.1)	(0.4)
Pension non-service income	**$ (7.8)**	$ (13.4)	$ (13.1)	**$ (0.3)**	$ (0.2)	$ (0.8)

The expected long-term rate of return on plan assets is reviewed annually, taking into consideration the Company's asset allocation, historical returns on the types of assets held, the current economic environment, and prospective expectations. We determined the discount rate based on a model which matches the timing and amount of expected benefit payments to maturities of high-quality corporate bonds priced as of the pension plan measurement date. The yields on the bonds are used to derive a discount rate for the obligation.

The following assumptions were used to measure the net benefit income/cost within each respective year for the domestic qualified plan and the foreign plans:

Pension Plan Assumptions:	Weighted average discount rate	Weighted average increase in future compensation levels	Expected weighted-average long-term rate of return
Domestic plan - 2019	4.59%	2.75%	7.80%
Domestic plan - 2018	4.02%	2.75%	8.00%
Domestic plan - 2017	4.54%	2.75%	8.00%
Foreign plans - 2019	0.90% - 2.60%	1.00% - 2.50%	1.00% - 3.80%
Foreign plans - 2018	0.70% - 2.40%	1.00% - 2.50%	1.00% - 4.50%
Foreign plans - 2017	0.60% - 2.50%	1.00% - 2.50%	1.00% - 5.90%

See Note 15 of the Notes to Consolidated Financial Statements for information on the projected long-term rate of return on domestic plan assets for 2020. For its foreign based pension plans the Company is projecting a long-term rate of return on plan assets will range from 1.00% to 3.80% in 2020.

	Domestic		Foreign	
	2019	2018	2019	2018
Changes in benefit obligation (in millions):				
Benefit obligation - beginning of year	**$ 731.7**	$ 812.3	**$ 52.3**	$ 57.8
Service cost - benefits earned during the year	**8.5**	9.8	**0.9**	0.9
Interest cost on projected benefit obligation	**32.4**	31.5	**1.2**	1.3
Actuarial (gain) loss	**93.1**	(41.2)	**5.6**	(1.7)
Benefits paid	**(60.0)**	(80.7)	**(2.0)**	(1.9)
Plan amendments	**—**	—	**—**	1.1
Settlements/curtailments	**—**	—	**1.9**	(2.4)
Other - including foreign currency	**—**	—	**0.4**	(2.8)
Benefit obligation - end of year	**$ 805.7**	$ 731.7	**$ 60.3**	$ 52.3
Accumulated benefit obligation - end of year	**$ 801.3**	$ 728.5	**$ 56.3**	$ 53.7

The key assumptions used to measure the benefit obligation at each respective year-end were:

Key assumptions:	Domestic Plan			Foreign Plans		
	2019	2018	2017	2019	2018	2017
Discount rate	3.41 %	4.59 %	4.02 %	0.20% - 1.80%	0.90% - 2.60%	0.70% - 2.40%
Salary growth rate	2.75 %	2.75 %	2.75 %	1.00% - 2.50%	1.00% - 2.50%	1.00% - 2.50%

	Domestic		Foreign	
	2019	2018	2019	2018
Changes in plan assets (in millions):				
Fair value of net plan assets - beginning of year	**$ 780.3**	$ 896.0	**$ 43.4**	$ 46.7
Actual return on plan assets	**113.1**	(37.0)	**5.4**	0.8
Employer contribution - other benefit plan	**2.3**	2.0	**0.7**	2.2
Foreign currency changes	**—**	—	**0.6**	(2.5)
Benefits paid	**(60.0)**	(80.7)	**(2.0)**	(1.9)
Other	**—**	—	**(0.1)**	(1.9)
Fair value of net plan assets - end of year	**$ 835.7**	$ 780.3	**$ 48.0**	$ 43.4

The measurement date for the Company's pension plans is December 31.

The following tables sets forth the funded status and amounts recognized in the consolidated balance sheets at year-end 2019 and 2018 for the domestic qualified and nonqualified pension plans and the foreign-based pension plans for benefits provided to certain employees (in millions):

	Domestic		Foreign	
	2019	2018	2019	2018
Funded status	**$ 30.0**	$ 48.6	**$ (12.3)**	$ (8.9)
Amounts recognized in the consolidated balance sheets:				
Prepaid pension asset long-term	**$ 71.8**	$ 88.2	**$ —**	$ —
Accrued pension obligation long-term	**(33.8)**	(31.8)	**(11.7)**	(8.6)
Accrued pension obligation short-term	**(2.7)**	(2.6)	**(0.6)**	(0.3)
Other long-term liabilities	**(5.3)**	(5.2)	**—**	—
Net amount recognized	**$ 30.0**	$ 48.6	**$ (12.3)**	$ (8.9)
Amounts recognized in accumulated other comprehensive loss:				
Net prior service cost (credit)	**$ (30.6)**	$ (18.6)	**$ (0.4)**	$ 0.8
Net loss	**431.7**	417.6	**7.8**	6.4
Net amount recognized, before tax effect	**$ 401.1**	$ 399.0	**$ 7.4**	$ 7.2

Amounts for pension plans with accumulated benefit obligations in excess of fair value of plan assets are as follows (in millions):

	2019	2018
Projected benefit obligation	**$ 102.0**	$ 91.9
Accumulated benefit obligation	**$ 98.0**	$ 88.8
Fair value of plan assets	**$ 48.0**	$ 43.4

At year-end 2019 and 2018 the Company had an accumulated non-cash reduction to stockholders' equity of $323.1 million and $306.8 million, respectively, related to its pension and postretirement plans. The accumulated non-cash reductions to stockholders' equity did not affect net income and were recorded net of accumulated deferred taxes of $102.5 million at year end 2019 and $96.9 million at year end 2018.

At December 29, 2019, the estimated amounts of the minimum liability adjustment that are expected to be recognized as components of net periodic benefit cost during 2020 for the pension plans are: net loss $22.9 million and net prior service credit $6.0 million.

Estimated future pension plan benefit payments (in millions):	Domestic	Foreign
2020	$ 55.0	$ 2.5
2021	55.0	2.1
2022	56.6	2.1
2023	55.8	2.4
2024	55.4	2.5
2025-2029	271.7	12.6
Total	$ 549.5	$ 24.2

The following table sets forth the percentage of year-end market value by asset class for the pension plans:

Market value by asset class:	Domestic Plan Assets % to Total		Foreign Plan Assets % to Total	
	2019	2018	2019	2018
Equity instruments	**49 %**	51 %	**56 %**	53 %
Fixed income instruments	**31**	34	**25**	27
Alternatives and other	**20**	15	**19**	20
Total	**100 %**	100 %	**100 %**	100 %

The Company has an active management policy for the pension assets in the qualified domestic pension plan. As of December 29, 2019, the long term asset allocation target for the domestic plan consists of approximately 52% in equity instruments, approximately 34% in fixed income instruments and approximately 14% in alternatives.

The pension plan's investments are stated at fair value. Plan investments that are considered a level 1 fair value hierarchy and are valued at quoted market prices in active markets. Plan investments that are considered a level 2 fair value hierarchy and are valued based on observable market data. Plan investments that would be considered a level 3 fair value hierarchy are valued based on management's own assumption about the assumptions that market participants would use in pricing the asset or liability (including assumptions about risk).

Certain investments measured at fair value using net asset values as a practical expedient are not required to be categorized in the fair value hierarchy table listed below. As such, the total fair value of these net asset values based investments has been included in the table below to permit reconciliation to the plan asset amounts previously disclosed.

The fair values of the Company's net pension assets, by fair value hierarchy, for both the U.S. and foreign pension plans as of December 29, 2019, by asset category are as follows (in millions):

Asset category:(a)	**Level 1**	**Level 2**	**Level 3**	**Total**
Cash and cash equivalents (b)	$ —	$ 65.4	$ —	$ 65.4
Equity securities	52.5	266.7	—	319.2
U.S. government securities and futures	128.3	6.6	—	134.9
Corporate bonds	—	47.4	—	47.4
Insurance contracts related to foreign plans	—	14.0	—	14.0
Fair value of net plan assets at the end of the year	$ 180.8	$ 400.1	$ —	$ 580.9
Investments measured at net asset value:				
Alternatives				$ 195.3
Mutual funds (c)				29.7
Mortgage-backed securities				49.2
High yield bonds				28.7
Fair value of net plan assets at the end of the year				$ 302.9

a) There were no transfers of plan assets between the three levels of the fair value hierarchy during the year.
b) Reflects cash and cash equivalents held in overnight cash investments.
c) The mutual funds are invested in equity securities.

The fair values of the Company's net pension assets, by fair value hierarchy, for both the U.S. and foreign pension plans as of December 30, 2018, by asset category are as follows (in millions):

Asset category: (a)	**Level 1**	**Level 2**	**Level 3**	**Total**
Cash and cash equivalents (b)	$ —	$ 53.0	$ —	$ 53.0
Equity securities	56.3	233.6	—	289.9
U.S. government securities and futures	99.3	—	—	99.3
Corporate bonds	—	34.3	—	34.3
Insurance contracts related to foreign plans	—	12.0	—	12.0
Fair value of net plan assets at the end of the year	$ 155.6	$ 332.9	$ —	$ 488.5
Investments measured at net asset value:				
Alternatives				$ 204.1
Mutual funds (c)				63.0
Senior secured loans				0.2
Mortgage-backed securities				42.8
High yield bonds				25.2
Fair value of net plan assets at the end of the year				$ 335.3

(a) There were no transfers of plan assets between the three levels of the fair value hierarchy during the year.
(b) Reflects cash and cash equivalents held in overnight cash investments.
(c) 53% of mutual funds invest in fixed income types of securities; 47% invest in equity securities.

U.S. equities are valued at the closing price reported in an active market on which the individual securities are traded. U.S. equities and non-U.S. equities are also valued at the net asset value provided by the independent administrator or custodian of the commingled fund. The net asset value is based on the value of the underlying equities, which are traded on an active market. Corporate bonds are valued using inputs such as the closing price reported, if traded on an active market, values derived from comparable securities of issuers with similar credit ratings, or under a discounted cash flow approach that utilizes observable inputs, such as current yields of similar instruments. Fixed income investments are also valued at the net asset value provided by the independent administrator or custodian of the fund. The net asset value is based on the underlying assets, which are valued using inputs such as the closing price reported, if traded on an active market, values derived from comparable securities of issuers with similar credit ratings, or under a discounted cash flow approach that utilizes observable inputs, such as current yields of similar instruments. Alternative investments are primarily valued at the net asset value as determined by the independent administrator or custodian of the fund. The net asset value is based on the underlying investments, which are valued using inputs such as quoted market prices of identical instruments or values derived from comparable securities of issuers with similar credit ratings, or under a discounted cash flow approach that utilizes observable inputs, such as current yields of similar instruments.

See Note 15 to these Consolidated Financial Statements for information on the changes to our domestic qualified benefit plan effective January 1, 2020.

The Company's contributions associated with its 401(k) plans were $13.4 million, $11.9 million and $9.8 million, for 2019, 2018 and 2017, respectively.

Postretirement Plans

The Company sponsors several postretirement defined benefit plans covering certain salaried and hourly employees. The plans provide health care and life insurance benefits for certain eligible retirees. No service cost was incurred for these plans in 2019, 2018 or 2017.

Postretirement benefits non-service expense (in millions):	**2019**	**2018**	**2017**
Interest cost on benefit obligation	**0.4**	0.4	0.4
Amortization of actuarial gain	**(0.3)**	(0.3)	(0.4)
Postretirement benefits non-service expense	**$ 0.1**	$ 0.1	$ —

Changes in benefit obligation (in millions):	**2019**	**2018**
Benefit obligation - beginning of year	**$ 8.7**	$ 9.7
Interest cost on projected benefit obligation	**0.4**	0.4
Actuarial (gain) loss	**0.1**	(0.1)
Benefits paid	**(1.2)**	(1.3)
Other	**0.1**	—
Benefit obligation - end of year	**$ 8.1**	$ 8.7

The measurement date for the Company's postretirement plans is December 31.

Future postretirement plan benefit payments (in millions):	
2020	$ 0.9
2021	0.8
2022	0.8
2023	0.7
2024	0.7
2025-2029	2.7
Total	$ 6.6

The following table sets forth the funded status and amounts recognized in Teledyne's consolidated balance sheets for the postretirement plans at year-end 2019 and 2018 (in millions):

	2019	2018
Funded status:		
Funded status	**$ (8.1)**	$ (8.7)
Unrecognized net gain	**(2.2)**	(2.5)
Accrued benefit cost	**$ (10.3)**	$ (11.2)
Amounts recognized in the consolidated balance sheets:		
Accrued postretirement benefits (long-term)	**$ (7.2)**	$ (7.7)
Accrued postretirement benefits (short-term)	**(0.9)**	(1.0)
Accumulated other comprehensive income	**(2.2)**	(2.5)
Net amount recognized	**$ (10.3)**	$ (11.2)

At December 29, 2019, the amount in AOCI that has not yet been recognized as a component of net periodic benefit income for the retiree medical plans is a net gain $2.2 million and no net prior service credit. At December 29, 2019, the estimated amortization from AOCI expected to be recognized as components of net periodic benefit income during 2020 for the retiree medical plans is a net gain of $0.2 million and no net prior service cost.

The annual assumed rate of increase in the per capita cost of covered benefits (the health care cost trend rate) for health care plans is 6.25% in 2020 and was assumed to decrease to 5.0% by the year 2027 and remain at that level thereafter. Assumed health care cost trend rates have a significant effect on the amounts reported for the health care plans. A one percentage point increase in the assumed health care cost trend rates would result in an increase in the annual service and interest costs by less than $0.1 million for 2019 and would result in an increase in the postretirement benefit obligation by $0.2 million at December 29, 2019. A one percentage point decrease in the assumed health care cost trend rates would result in a decrease in the annual service and interest costs by less than $0.1 million for 2018 and would result in a decrease in the postretirement benefit obligation by $0.2 million at December 29, 2019.

Note 12. Business Segments

The Company has four reportable segments: Instrumentation; Digital Imaging; Aerospace and Defense Electronics; and Engineered Systems. The Company manages, evaluates and aggregates its operating segments for segment reporting purposes primarily on the basis of product and service type, production process, distribution methods, type of customer, management organization, sales growth potential and long-term profitability. The Instrumentation segment provides monitoring and control instruments for marine, environmental, industrial and other applications, electronic test and measurement equipment and harsh environment interconnect products. The Digital Imaging segment includes high-performance sensors, cameras and systems, within the visible, infrared and X-ray spectra, for use in industrial, government and medical applications, as well as micro electro-mechanical systems ("MEMS") and high-performance, high-reliability semiconductors including analog-to-digital and digital-to-analog converters. It also includes our sponsored and centralized research laboratories benefiting government programs and businesses. The Aerospace and Defense Electronics segment provides sophisticated electronic components and subsystems and communications products, including defense electronics, harsh environment interconnects, data acquisition and communications equipment for aircraft and components and subsystems for wireless and satellite communications, as well as general aviation batteries. The Engineered Systems segment provides innovative systems engineering and integration, advanced technology application, software development and manufacturing solutions for defense, space, environmental and energy applications. The Engineered Systems segment also designs and manufactures electrochemical energy systems and small turbine engines.

In the third quarter of 2019, we realigned the segment reporting structure for certain business units, primarily related to certain refinements of our management reporting structure. This change primarily related to moving certain electronic manufacturing services products from the Aerospace and Defense Electronics segment to the Engineered Systems segment. Total net sales for these products were $76.2 million for fiscal year 2018. Other immaterial changes included moving certain United Kingdom (U.K.) microwave product lines (previously within the Digital Imaging segment) and certain U.K. manufactured composite parts (previously within the Engineered Systems segment) into the Aerospace and Defense Electronics segment. Total net sales for these U.K. product lines was less than $20.0 million for fiscal year 2018. The realignment had no impact on the Instrumentation segment or the Consolidated Financial Statements. Previously reported segment data has been adjusted to reflect these changes.

Segment results include net sales and operating income by segment but excludes noncontrolling interest, equity income or loss, unusual non-recurring legal matter settlements, interest income and expense, gains and losses on the disposition of assets, sublease rental income and non-revenue licensing and royalty income, domestic and foreign income taxes and corporate office expenses. Corporate expense includes various administrative expenses relating to the corporate office and certain nonoperating expenses not allocated to our segments.

As part of a continuing effort to reduce costs and improve operating performance, the Company may take and has taken actions to consolidate and relocate certain facilities and reduce headcount across various businesses, reducing our exposure to weak end markets and high cost locations. At December 29, 2019, $1.5 million remains to be paid related to these actions.

The following pre-tax charges were incurred related to severance and facility consolidations (in millions):

	2019	2018	2017
Instrumentation	**$ 1.5**	$ 5.6	$ 2.1
Digital Imaging	**1.1**	0.7	—
Aerospace and Defense Electronics	**0.5**	1.3	2.1
Engineered Systems	**0.1**	0.2	—
Total	**$ 3.2**	$ 7.8	$ 4.2

Information on the Company's business segments was as follows (in millions):

Net sales:	2019	2018	2017
Instrumentation	**$ 1,105.1**	$ 1,021.2	$ 953.9
Digital Imaging	**992.9**	875.3	710.4
Aerospace and Defense Electronics	**690.1**	640.2	591.2
Engineered Systems	**375.5**	365.1	348.3
Total net sales	**$ 3,163.6**	$ 2,901.8	$ 2,603.8

Operating income:	2019	2018	2017
Instrumentation	**$ 200.4**	$ 147.4	$ 126.0
Digital Imaging	**176.5**	155.5	110.2
Aerospace and Defense Electronics	**143.4**	131.8	113.0
Engineered Systems	**36.5**	37.9	35.5
Corporate expense	**(65.1)**	(56.0)	(63.0)
Total operating income	**$ 491.7**	$ 416.6	$ 321.7

Depreciation and amortization:	2019	2018	2017
Instrumentation	**$ 35.9**	$ 37.0	$ 38.2
Digital Imaging	**48.5**	50.8	49.6
Aerospace and Defense Electronics	**14.3**	13.8	14.0
Engineered Systems	**6.0**	4.3	4.6
Corporate	**7.2**	7.1	6.6
Total depreciation and amortization	**$ 111.9**	$ 113.0	$ 113.0

Capital expenditures:	2019	2018	2017
Instrumentation	**$ 18.9**	$ 14.8	$ 13.7
Digital Imaging	**45.2**	35.8	23.4
Aerospace and Defense Electronics	**19.0**	18.7	9.3
Engineered Systems	**3.6**	13.6	7.4
Corporate	**1.7**	3.9	4.7
Total capital expenditures	**$ 88.4**	$ 86.8	$ 58.5

Identifiable assets are those assets used in the operations of the segments. Corporate assets primarily consist of cash, deferred taxes, pension assets and other assets.

Identifiable assets:	**2019**	**2018**	**2017**
Instrumentation	**$ 1,680.2**	$ 1,392.7	$ 1,413.6
Digital Imaging	**1,874.6**	1,577.5	1,582.2
Aerospace and Defense Electronics	**618.3**	509.9	491.2
Engineered Systems	**143.4**	151.5	135.5
Corporate	**263.3**	177.7	223.9
Total identifiable assets	**$ 4,579.8**	$ 3,809.3	$ 3,846.4

Information on the Company's sales by country of origin and long-lived assets by major geographic area was as follows (in millions):

Sales by country of origin:	**2019**	**2018**	**2017**
United States	**$ 2,179.6**	$ 2,044.9	$ 1,849.4
Canada	**301.0**	294.8	266.1
United Kingdom	**251.7**	178.8	197.5
The Netherlands	**134.2**	105.3	68.0
All other countries	**297.1**	278.0	222.8
Total sales	**$ 3,163.6**	$ 2,901.8	$ 2,603.8

Long-lived assets:	**2019**	**2018**	**2017**
United States	**$ 1,839.4**	$ 1,402.3	$ 1,495.4
Canada	**355.0**	264.6	288.2
United Kingdom	**492.2**	414.9	487.9
France	**367.1**	353.8	370.2
All other countries	**195.6**	246.7	182.0
Total long-lived assets	**$ 3,249.3**	$ 2,682.3	$2,823.7

Long-lived assets consist of property, plant and equipment, goodwill, acquired intangible assets, prepaid pension assets and other long-term assets including deferred compensation assets but excluding any deferred tax assets. The all other countries category primarily consists of Teledyne's operations in Europe.

Product Lines

The Instrumentation segment includes three product lines: Environmental Instrumentation, Marine Instrumentation and Test and Measurement Instrumentation. All other segments each contain one product line.

The tables below provide a summary of the sales by product line for the Instrumentation segment (in millions):

Instrumentation:	**2019**	**2018**	**2017**
Environmental Instrumentation	**$ 391.4**	$ 339.6	$ 314.3
Marine Instrumentation	**450.2**	433.0	430.7
Test and Measurement Instrumentation	**263.5**	248.6	208.9
Total	**$1,105.1**	$1,021.2	$ 953.9

Sales to the U.S. Government included sales to the U.S. Department of Defense of $545.5 million in 2019, $494.9 million in 2018, and $479.7 million in 2017. Total sales to international customers were $1,391.6 million in 2019, $1,353.7 million in 2018, and $1,208.5 million in 2017. Of these amounts, sales by operations in the United States to customers in other countries were $638.0 million in 2019, $600.5 million in 2018, and $555.5 million in 2017. There were no sales to individual countries outside of the United States in excess of 10 percent of the Company's sales. Sales between business segments generally were priced at prevailing market prices and were $30.3 million, $23.4 million and $22.8 million for 2019, 2018 and 2017, respectively.

We also disaggregate our revenue from contracts with customers by customer type, contract-type and geographic region for each of our segments, as we believe it best depicts how the nature, amount, timing and uncertainty of our revenue and cash flows are affected by economic factors. As we adopted Topic 606 during fiscal year 2018 using the modified retrospective transition method, prior period information was not adjusted for Topic 606 and comparative disclosures for disaggregated revenue are not required for the year prior to adoption.

(in millions)	Twelve Months Ended December 29, 2019			Twelve Months Ended December 30, 2018		
	Customer Type			Customer Type		
	United States Government (a)	Other, Primarily Commercial	Total	United States Government (a)	Other, Primarily Commercial	Total
Net Sales:						
Instrumentation	**$ 80.4**	**$ 1,024.7**	**$1,105.1**	$ 68.3	$ 952.9	$1,021.2
Digital Imaging	**107.4**	**885.5**	**992.9**	90.5	784.8	875.3
Aerospace and Defense Electronics	**225.3**	**464.8**	**690.1**	177.2	463.0	640.2
Engineered Systems	**338.9**	**36.6**	**375.5**	319.3	45.8	365.1
Total	**$ 752.0**	**$ 2,411.6**	**$3,163.6**	$ 655.3	$ 2,246.5	$2,901.8

a) Includes sales as a prime contractor or subcontractor.

(in millions)	Twelve Months Ended December 29, 2019			Twelve Months Ended December 30, 2018		
	Contract Type			Contract Type		
	Fixed Price	Cost Type	Total	Fixed Price	Cost Type	Total
Net Sales:						
Instrumentation	**$ 1,094.4**	**$ 10.7**	**$1,105.1**	$ 1,001.0	$ 20.2	$1,021.2
Digital Imaging	**903.1**	**89.8**	**992.9**	795.5	79.8	875.3
Aerospace and Defense Electronics	**687.8**	**2.3**	**690.1**	637.4	2.8	640.2
Engineered Systems	**168.9**	**206.6**	**375.5**	165.8	199.3	365.1
Total	**$ 2,854.2**	**$ 309.4**	**$3,163.6**	$ 2,599.7	$ 302.1	$2,901.8

(in millions)	Twelve Months Ended December 29, 2019				Twelve Months Ended December 30, 2018			
	Geographic Region (a)				Geographic Region (a)			
	United States	Europe	All other	Total	United States	Europe	All other	Total
Net sales:								
Instrumentation	**$ 899.7**	**$ 164.8**	**$ 40.6**	**$1,105.1**	$ 835.0	$ 134.6	$ 51.6	$1,021.2
Digital Imaging	**316.1**	**299.4**	**377.4**	**992.9**	239.3	270.2	365.8	875.3
Aerospace and Defense Electronics	**588.3**	**100.8**	**1.0**	**690.1**	605.5	32.5	2.2	640.2
Engineered Systems	**375.5**	**—**	**—**	**375.5**	365.1	—	—	365.1
Total	**$2,179.6**	**$ 565.0**	**$ 419.0**	**$3,163.6**	$2,044.9	$ 437.3	$ 419.6	$2,901.8

a) Net sales by geographic region of origin.

Note 13. Lease Commitments

Lease Commitments

We determine if an arrangement is a lease at inception. Effective December 31, 2018, operating leases are recorded as right-of-use assets, other long-term lease liabilities and current accrued liabilities in our consolidated balance sheets. Finance leases are included in property and equipment, current accrued liabilities, and other long-term liabilities in our consolidated balance sheets.

Operating lease right-of-use assets represent our right to use an underlying asset for the lease term and lease liabilities represent our obligation to make lease payments arising from the lease. Operating lease right-of-use assets and lease liabilities are recognized at commencement date based on the present value of lease payments over the lease term and use an implicit rate when readily available. Since most of our leases do not provide an implicit rate, we use the incremental borrowing rate to determine the present value of lease payments. The rate will take into consideration the underlying asset's economic environment, including the length of the lease term and currency that the lease is payable in. Our lease agreements may include options to extend the lease term. We include those options to extend the lease term in determining the present value of the future lease payments when it is reasonably certain that we will exercise such option. Lease expense for lease payments is recognized on a straight-line basis over the lease term.

Many lease agreements contain renewal options at either a fixed cost, fixed increase or market value adjustment. For those leases with renewal options, we will include the renewal options that are reasonably certain to be exercised for purposes of calculating the lease liability and corresponding right-of-use asset. We evaluate the likelihood of exercising each renewal option based on many factors, including the length of the renewal option and the future new lease cost, if known, or the estimated future new lease cost if it is not a fixed amount.

Operating Leases

Teledyne has approximately 125 long-term operating lease agreements for manufacturing facilities and office space. These agreements frequently include one or more renewal options and may require the Company to pay for non-lease components such as utilities, taxes, insurance and maintenance expense. We account for lease and non-lease components as a single lease component when the payments are fixed. Variable payments included in the lease agreement are expensed as incurred. No lease agreement imposes a restriction on the Company's ability to engage in financing transactions or enter into further lease agreements. At December 29, 2019, Teledyne has right-of-use assets of $127.1 million.

At December 29, 2019, future minimum lease payments for operating leases with non-cancelable terms of more than one year were as follows (in millions):

Operating lease commitments:	
2020	$ 24.5
2021	23.0
2022	19.7
2023	16.9
2024	15.1
Thereafter	70.1
Total minimum lease payments	169.3
Less:	
Imputed interest	(30.4)
Current portion (included in other current liabilities)	(19.6)
Present value of minimum lease payments, net of current portion	$ 119.3

The weighted average remaining lease term for operating leases is approximately 9 years and the weighted average discount rate is 4.05%. Rental expense under operating leases, including leases with a term of 12 months or less, net of immaterial sublease income, was $26.5 million in 2019, $30.7 million in 2018 and $26.9 million in 2017.

Finance Leases and Subleases

Our finance leases and subleases are not material.

Note 14. Commitments and Contingencies

The Company is subject to federal, state and local environmental laws and regulations which require that it investigate and remediate the effects of the release or disposal of materials at sites associated with past and present operations, including sites at which the Company has been identified as a potentially responsible party under the federal Superfund laws and comparable state laws.

In accordance with the Company's accounting policy disclosed in Note 2, environmental liabilities are recorded when the Company's liability is probable and the costs are reasonably estimable. In many cases, however, investigations are not yet at a stage where the Company has been able to determine whether it is liable or, if liability is probable, to reasonably estimate the loss or range of loss, or certain components thereof. Estimates of the Company's liability are further subject to uncertainties regarding the nature and extent of site contamination, the range of remediation alternatives available, evolving remediation standards, imprecise engineering evaluations and estimates of appropriate cleanup technology, methodology and cost, the extent of corrective actions that may be required, and the number and financial condition of other potentially responsible parties, as well as the extent of their responsibility for the remediation. Accordingly, as investigation and remediation of these sites proceeds, it is likely that adjustments in the Company's accruals will be necessary to reflect new information. The amounts of any such adjustments could have a material adverse effect on the Company's results of operations in a given period, but the amounts, and the possible range of loss in excess of the amounts accrued, are not reasonably estimable. Based on currently available information, however, management does not believe that future environmental costs in excess of those accrued with respect to sites with which the Company has been identified are likely to have a material adverse effect on the Company's financial condition or liquidity.

At December 29, 2019, the Company's reserves for environmental remediation obligations totaled $6.0 million, of which $1.6 million is included in current accrued liabilities with the remainder included in long-term accrued liabilities. The Company periodically evaluates whether it may be able to recover a portion of future costs for environmental liabilities from its insurance carriers and from third parties. The timing of expenditures depends on a number of factors that vary by site, including the nature and extent of contamination, the number of potentially responsible parties, the timing of regulatory approvals, the complexity of the investigation and remediation, and the standards for remediation. The Company expects that it will expend present accruals over many years, and will complete remediation of all sites with which it has been identified in up to thirty years.

Various claims (whether based on U.S. Government or Company audits and investigations or otherwise) may be asserted against the Company related to its U.S. Government contract work, including claims based on business practices and cost classifications and actions under the False Claims Act. Although such claims are generally resolved by detailed fact-finding and negotiation, on those occasions when they are not so resolved, civil or criminal legal or administrative proceedings may ensue. Depending on the circumstances and the outcome, such proceedings could result in fines, penalties, compensatory and treble damages or the cancellation or suspension of payments under one or more U.S. Government contracts. Under government regulations, a company, or one or more of its operating divisions or units, can also be suspended or debarred from government contracts based on the results of investigations. However, although the outcome of these matters cannot be predicted with certainty, management does not believe there is any audit, review or investigation currently pending against the Company of which management is aware that is likely to result in suspension or debarment of the Company, or that is otherwise likely to have a material adverse effect on the Company's financial condition or liquidity, although the resolution in any reporting period of one or more of these matters could have a material adverse effect on the Company's results of operations for that period.

A number of other lawsuits, claims and proceedings have been or may be asserted against the Company, including those pertaining to product liability, acquisitions, patent infringement, commercial contracts, employment and employee benefits. While the outcome of litigation cannot be predicted with certainty, and some of these lawsuits, claims or proceedings may be determined adversely to the Company, management does not believe that the disposition of any such pending matters is likely to have a material adverse effect on the Company's financial condition.

Note 15. Subsequent Events

The Company continues to manage the risks related to its defined benefit pension plan liabilities. Effective January 1, 2020, Teledyne restructured its domestic qualified defined benefit pension plan. The restructuring involved dividing our domestic qualified defined pension plan into two separate plans, one comprised primarily of inactive participants (the "inactive plan") and the other comprised primarily of active participants (the "active plan"). The reorganization was made to facilitate a targeted investment strategy over time and to provide additional flexibility in evaluating opportunities to reduce risk and volatility. As a result of the restructuring, the Company re-measured the assets and liabilities of the two plans, as required under U.S. GAAP, based on assumptions and market conditions on the January 1, 2020 effective date. Actuarial gains and losses associated with the active plan will continue to be amortized over the average remaining service period of the active participants, while the actuarial gains and losses associated with the inactive plan will be amortized over the average remaining life expectancy of the inactive participants which is currently approximately 17.7 years. Based on the new targeted investment strategy, the company is projecting for 2020 a long term rate of return on plan assets for the inactive plan of 6.71% and 7.80% for the active plan. As a primary result of these changes, the net pre-tax pension expense for all benefit plans is expected to decrease in 2020 by approximately $3.9 million to $2.6 million in pension income for 2020 from $1.3 million in pension expense in 2019.

On January 3, 2020, we acquired OakGate Technology, Inc. ("OakGate") for $28.0 million in cash. Based in Loomis, California, OakGate provides software and hardware designed to test electronic data storage devices from development through manufacturing and end-use applications. The acquired business is part of the Test and Measurement product line of the Instrumentation segment.

Note 16. Quarterly Financial Data (Unaudited)

Fiscal Year 2019 (a) (in millions, except per-share amounts)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Net Sales	$ 745.2	$ 782.0	$ 802.2	$ 834.2
Costs and expenses				
Cost of sales	463.9	463.6	487.7	505.1
Selling, general and administrative expenses	184.0	186.5	185.8	195.3
Total costs and expenses	647.9	650.1	673.5	700.4
Operating income	97.3	131.9	128.7	133.8
Interest and debt expense, net	(5.4)	(5.4)	(5.5)	(4.7)
Non-service retirement benefit income	2.2	2.0	1.9	1.9
Other expense, net	(1.2)	(0.6)	(1.7)	(1.5)
Income before income taxes	92.9	127.9	123.4	129.5
Provision for income taxes (b)	17.6	23.3	16.7	13.8
Net income	$ 75.3	$ 104.6	$ 106.7	$ 115.7
Basic earnings per common share	$ 2.09	$ 2.89	$ 2.93	$ 3.17
Diluted earnings per common share	$ 2.02	$ 2.80	$ 2.84	$ 3.06

a) Fiscal year 2019 was a 52-week fiscal-year, each quarter contained 13 weeks.
b) Includes $3.1 million in net discrete income tax benefits in the first quarter, $4.3 million in net discrete income tax benefits in the second quarter, $10.4 million in net discrete income tax benefits the third quarter and $8.3 million in net discrete income tax benefits in the fourth quarter.

Fiscal Year 2019 (in millions)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Net Sales:				
Instrumentation	$ 256.5	$ 264.1	$ 282.9	$ 301.6
Digital Imaging	232.4	248.4	244.0	268.1
Aerospace and Defense Electronics	166.6	176.0	177.1	170.4
Engineered Systems	89.7	93.5	98.2	94.1
Total net sales	$ 745.2	$ 782.0	$ 802.2	$ 834.2
Operating income:				
Instrumentation	$ 39.9	$ 49.0	$ 52.0	$ 59.5
Digital Imaging	36.6	51.6	41.2	47.1
Aerospace and Defense Electronics	32.5	38.6	39.5	32.8
Engineered Systems	6.4	9.0	10.6	10.5
Corporate expense	(18.1)	(16.3)	(14.6)	(16.1)
Total operating income	$ 97.3	$ 131.9	$ 128.7	$ 133.8

Fiscal Year 2018 (a) (in millions, except per-share amounts)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Net Sales	$ 695.6	$ 732.5	$ 725.3	$ 748.4
Costs and expenses				
Cost of sales	438.2	447.0	446.2	459.6
Selling, general and administrative expenses	169.0	174.0	173.6	177.6
Total costs and expenses	607.2	621.0	619.8	637.2
Operating income	88.4	111.5	105.5	111.2
Interest and debt expense, net	(7.1)	(6.7)	(6.0)	(5.7)
Non-service retirement benefit income	3.4	3.3	3.4	3.4
Other expense, net	(2.5)	(3.7)	(2.7)	(1.8)
Income before income taxes	82.2	104.4	100.2	107.1
Provision for income taxes (b)	15.7	18.5	9.9	16.0
Net income	$ 66.5	$ 85.9	$ 90.3	$ 91.1
Basic earnings per common share	$ 1.87	$ 2.40	$ 2.52	$ 2.53
Diluted earnings per common share	$ 1.81	$ 2.32	$ 2.43	$ 2.45

a) Fiscal year 2018 was a 52-week fiscal-year, each quarter contained 13 weeks.
b) Includes $2.1 million in net discrete income tax benefits in the first quarter, $3.4 million in net discrete income tax benefits in the second quarter, $11.4 million in net discrete income tax benefits the third quarter and $6.9 million in net discrete income tax benefits in the fourth quarter.

Fiscal Year 2018 (in millions)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Net Sales:				
Instrumentation	$ 239.0	$ 262.6	$ 256.2	$ 263.4
Digital Imaging	208.3	223.0	220.7	223.3
Aerospace and Defense Electronics	156.4	157.5	160.3	166.0
Engineered Systems	91.9	89.4	88.1	95.7
Total net sales	$ 695.6	$ 732.5	$ 725.3	$ 748.4
Operating income:				
Instrumentation	$ 27.8	$ 40.9	$ 35.7	$ 43.0
Digital Imaging	33.8	43.1	42.3	36.3
Aerospace and Defense Electronics	30.8	32.6	33.0	35.4
Engineered Systems	8.9	8.7	9.6	10.7
Corporate expense	(12.9)	(13.8)	(15.1)	(14.2)
Total operating income	$ 88.4	$ 111.5	$ 105.5	$ 111.2

(a) The 2018 periods have been adjusted to reflect the realignment, in the third quarter of 2019, of the reporting structure for certain business units, primarily related to certain refinements of our management reporting structure. This change primarily related to moving certain electronic manufacturing services products from the Aerospace and Defense Electronics segment to the Engineered Systems segment. Other immaterial changes included moving certain United Kingdom (U.K.) microwave product lines (previously within the Digital Imaging segment) and certain U.K. manufactured composite parts (previously within the Engineered Systems segment) into the Aerospace and Defense Electronics segment.

Schedule II VALUATION AND QUALIFYING ACCOUNTS

Schedule II

VALUATION AND QUALIFYING ACCOUNTS

For the Fiscal Years Ended December 29, 2019, December 30, 2018 and December 31, 2017
(In millions)

Description	Balance at beginning of period	Additions: Charged to costs and expenses	Additions: Acquisitions	Deductions and other (a)	Balance at end of period
Fiscal Year 2019					
Allowance for doubtful accounts	$ 6.7	1.3	2.3	(0.1)	$ 10.2
Environmental reserves	$ 6.0	0.6	—	(0.6)	$ 6.0
Fiscal Year 2018					
Allowance for doubtful accounts	$ 10.3	0.6	—	(4.2)	$ 6.7
Environmental reserves	$ 5.1	1.6	—	(0.7)	$ 6.0
Fiscal Year 2017					
Allowance for doubtful accounts	$ 5.2	4.2	1.6	(0.7)	$ 10.3
Environmental reserves	$ 7.0	2.3	0.3	(4.5)	$ 5.1

(a) Represents payments except the amounts for allowance for doubtful accounts primarily represents uncollectible accounts written-off, net of recoveries.

Item 16. Form 10-K Summary

None

EXHIBIT INDEX

Exhibit No.	Description
2.1	Separation and Distribution Agreement dated as of November 29, 1999 by and among Allegheny Teledyne Incorporated, TDY Holdings, LLC, Teledyne Industries, Inc. and Teledyne Technologies Incorporated (incorporated by reference to Exhibit 2.1 to the Company's Current Report on Form 8-K dated as of November 29, 1999 (File No. 1-15295))
3.1	Restated Certificate of Incorporation of Teledyne Technologies Incorporated (including Certificate of Designation of Series A Junior Participating Preferred Stock) (incorporated by reference to Exhibit 3.1 to the Company's Annual Report on Form 10-K for the year ended January 2, 2000 (File No. 1-15295))
3.2	Amended and Restated Bylaws of Teledyne Technologies Incorporated (incorporated by reference to Exhibit 3.1 to the Company's Quarterly Report on Form 10-Q for the fiscal quarter ended June 29, 2014 (File No. 1-15295))
4.1	Description of the Registrant's Securities*
10.1	Employee Benefits Agreement between Allegheny Teledyne Incorporated and Teledyne Technologies Incorporated (incorporated by reference to Exhibit 10.3 to the Company's Current Report on Form 8-K/A (Amendment No. 1) dated as of November 29, 199 (File No. 1-15295))†
10.2	Teledyne Technologies Incorporated 2008 Incentive Award Plan (incorporated by reference to Annex A of the Company's Definitive Proxy Statement filed March 7, 2008 (File No. 1-15295))†
10.3	Teledyne Technologies Incorporated Administrative Rules of the 2008 Incentive Award Plan Related to Non-Employee Director Stock Compensation (incorporated by reference to Exhibit 10.2 to the Company's Quarterly Report on Form 10-Q for the fiscal quarter ended March 30, 2008 (File No. 1-15295))†
10.4	Form of Stock Option Agreement under the 2008 Incentive Award Plan (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated January 19, 2010 (File No.1-15295))†
10.5	Teledyne Technologies Incorporated Amended and Restated 2008 Incentive Award Plan (incorporated by reference to Annex A of the Company's Definitive Proxy Statement filed March 8, 2012 (File No. 1-15295))†
10.6	Administrative Rules of the Teledyne Technologies Incorporated Amended and Restated 2008 Incentive Award Plan Related to Non-Employee Director Stock Compensation (incorporated by reference to Exhibit 10.2 to the Company's Quarterly Report on Form 10-Q for the fiscal quarter ended April 1, 2012 (File No. 1-15295))†
10.7	Form of Stock Option Agreement under the Teledyne Technologies Incorporated Amended and Restated 2008 Incentive Award Plan (incorporated by reference to Exhibit 10.3 to the Company's Quarterly Report on Form 10-Q for the fiscal quarter ended April 1, 2012 (File No. 1-15295))†
10.8	Teledyne Technologies Incorporated 2014 Incentive Award Plan (incorporated by reference to Annex A of the Company's Definitive Proxy Statement filed March 5, 2014 (File No. 1-15295))†
10.9	Form of stock option agreement and conditions under the Teledyne Technologies Incorporated 2014 Incentive Award Plan (incorporated by reference to Exhibit 10.2 to the Company's Current Report on Form 8-K dated April 23, 2014 File No. 1-15295))†
10.10	Administrative Rules of the Teledyne Technologies Incorporated 2014 Incentive Plan Related to Non-Employee Director Stock Compensation (incorporated by reference to Exhibit 10.3 to the Company's Current Report on Form 8-K dated April 23, 2014 (File No. 1-15295))†

10.11 Administrative Rules of the 2014 Incentive Award Plan Related to Non-Employee Director Restricted Stock Unit Awards and Fees (incorporated by reference to Exhibit 10.4 to the Company's Current Report on Form 8-K dated December 31, 2014 (File No. 1-15295))†

10.12 Amended and Restated Teledyne Technologies Incorporated 2014 Incentive Award Plan (incorporated by reference to Annex A of the Company's Definitive Proxy Statement filed March 10, 2017)†

10.13 Standing resolutions of the Nominating and Governance Committee related to non-employee director compensation (incorporated by reference to Exhibit 10.2 to the Company's Current Report on Form 8-K dated April 26, 2017).†

10.14 Administrative Rules of the Amended and Restated Teledyne Technologies Incorporated 2014 Incentive Award Plan Related to Non-Employee Director Restricted Stock Unit Awards and Fees (incorporated by reference to Exhibit 10.3 to the Company's Current Report on Form 8-K dated April 26, 2017).†

10.15 Administrative Rules for the Restricted Stock Award Program under the Amended and Restated Teledyne Technologies Incorporated 2014 Incentive Award Plan (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated January 23, 2018)†

10.16 Form of Restricted Stock Award Agreement under the Amended and Restated Teledyne Technologies Incorporated 2014 Incentive Award Plan (incorporated by reference to Exhibit 10.2 to the Company's Current Report on Form 8-K dated January 23, 2018)†

10.17 Form of Stock Option Award Agreement under the Amended and Restated Teledyne Technologies Incorporated 2014 Incentive Award Plan (incorporated by reference to Exhibit 10.3 to the Company's Current Report on Form 8-K dated January 23, 2018)†

10.18 Terms and Conditions of Stock Option Award Agreement under the Amended and Restated Teledyne Technologies Incorporated 2014 Incentive Award Plan for grants made after 2018†*

10.19 Summary Plan Description for the Performance Share Plan 2018-2020 Cycle under the Amended and Restated Teledyne Technologies Incorporated 2014 Incentive Award Plan (incorporated by reference to Exhibit 10.4 to the Company's Current Report on Form 8-K dated January 23, 2018)†

10.20 Sixth Amended and Restated Employment Agreement, by and between Teledyne Technologies Incorporated and Robert Mehrabian, dated as of October 23, 2018. (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K filed on October 23, 2018) (File No. 1-15295)†

10.21 Employment Agreement, by and between Teledyne Technologies Incorporated and Aldo Pichelli, dated as of October 23, 2018. (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K filed on October 23, 2018) (File No. 1-15295)†

10.22 Amended and Restated Change in Control Severance Agreement, dated as of January 31, 2011, by and between Teledyne Technologies Incorporated and Robert Mehrabian (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated January 31, 2011 (File No. 1-15295))†

10.23 Amended and Restated Change in Control Severance Agreement, dated as of January 31, 2011, by and between Teledyne Technologies Incorporated and Al Pichelli (incorporated by reference to Exhibit 10.2 to the Company's Current Report on Form 8-K dated January 31, 2011 (File No. 1-15295))†

10.24 Amended and Restated change in Control Severance Agreement dated January 31, 2011, by and between Teledyne Technologies Incorporated and Susan L. Main (incorporated by reference to Exhibit 10.12 to Company's Annual Report on Form 10-K for the fiscal years ended December 29, 2013 (File No. 1-15295))†

10.25 Amended and Restated Change in Control Severance Agreement, dated as of January 31, 2011, by and between Teledyne Technologies Incorporated and Melanie Cibik (incorporated by reference to Exhibit 10.13 to the Company's Annual Report on Form 10-K for the fiscal year end December 29, 2013 (File No. 1-15295))†

10.26 Amended and Restated Change in Control Severance Agreement, dated as of January 31, 2011, by and between Teledyne Technologies Incorporated and Edwin Roks (incorporated by reference to Exhibit 10.13 to the Company's Annual Report on Form 10-K for the fiscal year end December 30, 2018 (File No. I-15295)†

10.27 Teledyne Technologies Incorporated Executive Deferred Compensation Plan, as originally effective as of November 29, 1999, as amended and restated effective December 31, 2004 (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated December 31, 2008)(File No. 1-15295)†

10.28 Teledyne Technologies Incorporated Pension Equalization/Benefit Restoration Plan, as originally effective as of November 29, 1999, as amended and restated effective December 31, 2004 (incorporated by reference to Exhibit 10.2 to the Company's Current Report on Form 8-K dated December 31, 2008(File No. 1-15295))†

10.29 Teledyne Technologies Pension Equalization/Benefit Restoration Plan - Resolutions of the Plan Administration Committee (incorporated by reference to Exhibit 10.2 to the Company's Current Report on Form 8-K dated December 31, 2014 (File No. 1-15295))†

10.30 Note Purchase Agreement, dated May 12, 2010, by and among Teledyne Technologies Incorporated and the Purchasers identified therein (incorporated by reference to Exhibit 10.2 to the Company's Quarterly Report on Form 10-Q for the fiscal quarter ended July 4, 2010 (File No. 1-15295))

10.31 Amendment to Note Purchase Agreement, dated as of April 18, 2017, between Teledyne Technologies Incorporated and the noteholders under that certain Note Purchase Agreement dated as of May 12, 2010 (incorporated by reference to Exhibit 10.2 to the Company's Current Report on Form 8-K dated April 18, 2017)

10.32 Amended and Restated Credit Agreement, dated as of March 1, 2013, by and among Teledyne Technologies Incorporated (Teledyne), certain subsidiaries of Teledyne as Designated Borrowers, certain subsidiaries of Teledyne as Guarantors, the Lender parties thereto and Bank of America, N.A. as Administrative Agent, Swing-Line Lender and L/C Issuer (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated March 1, 2013) (File No. 1-15295))

10.33 First Amendment to Amended and Restated Credit Agreement, dated as of December 4, 2015,(incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated December 4, 2018 (File No. I-15295)

10.34 Second Amendment, dated as of January 17, 2017, to Amended and Restated Credit Agreement, (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated January 17, 2017 (File No. 1-15295)

10.35 Third Amendment, dated as of March 17, 2017, to Amended and Restated Credit Agreement (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated March 17, 2017)

10.36 Fourth Amendment, dated as of March 15, 2019, to Amended and Restated Credit Agreement (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated March 15, 2019)

10.37 Fifth Amendment, dated as of October 30, 2019, to Amended and Restated Credit Agreement (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated October 30, 2019)

10.38 Note Purchase Agreement, dated September 23, 2014, by and among Teledyne Technologies Incorporated and the Purchasers identified therein (incorporated by reference to Exhibit 99.1 to the Company's Current Report on Form 8-K filed on September 23, 2014 (File No. 1-15295))

10.39 Amendment to Note Purchase Agreement, dated as of April 18, 2017, between Teledyne Technologies Incorporated and the noteholders under that certain Note Purchase Agreement dated as of August 27, 2015 (incorporated by reference to Exhibit 10.4 to the Company's Current Report on Form 8-K dated April 18, 2017).

10.40	Note Purchase Agreement, dated August 27, 2015, by and among Teledyne Technologies Incorporated and the Purchasers identified therein (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated August 27, 2015) (File No. 1-15295))
10.41	Amendment to Note Purchase Agreement, dated as of April 18, 2017, between Teledyne Technologies Incorporated and the noteholders under that certain Note Purchase Agreement dated as of September 23, 2014 (incorporated by reference to Exhibit 10.3 to the Company's Current Report on Form 8-K dated April 18, 2017).
10.42	Amended and Restated Term Loan Credit Agreement, dated October 30, 2019, by an among Teledyne Technologies Incorporated and Teledyne Netherlands BV, as borrowers, the several banks and other financial institutions form time to time parties thereto as lenders, Bank of America, N.A., as administrative agent, and B of A Securities, Inc., as sole book manager and sole lead arranger (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated October 30, 2019).
10.43	Note Purchase and Guaranty Agreement, dated as of April 18, 2017, by and among Teledyne Technologies Incorporated, Teledyne Netherlands B.V. and the purchasers identified therein (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated April 18, 2017).
10.44	Guaranty Agreement to Note Purchase Agreement, dated as of April 18, 2017, made by the Subsidiary Guarantors (incorporated by reference to Exhibit 10.5 to the Company's Current Report on Form 8-K dated April 18, 2017).
10.45	Form of Indemnification Agreement executed by each of the Company's directors and named executive officers (incorporated by reference to Exhibit 10.1 to the Company's Current Report on Form 8-K dated April 22, 2009 (File No. 1-15295))†
14.1	Teledyne Technologies Incorporated Global Code of Ethical Conduct - this code of ethics may be accessed via the Company's website at www.teledyne.com/aboutus/ethics.pdf
14.2	Code of Ethics for Financial Professionals - this code of ethics may be accessed via the Company's website at www.teledyne.com/aboutus/ethics.asp
14.3	Directors, Code of Business Conduct and Ethics - this code of ethics may be accessed via the Company's website at www.teledyne.com/aboutus/ethics.asp
21	Subsidiaries of Teledyne Technologies Incorporated*
23.1	Consent of Deloitte & Touche LLP, Independent Registered Public Accounting Firm *
24.1	Power of Attorney - Directors*
31.1	Certification of Chief Executive Officer pursuant to Section 302 of the Sarbanes-Oxley Act of 2002*
31.2	Certification of Chief Financial Officer pursuant to Section 302 of the Sarbanes-Oxley Act of 2002*
32.1	Certification of Chief Executive Officer pursuant to Section 906 of the Sarbanes-Oxley Act of 2002*
32.2	Certification of Chief Financial Officer pursuant to Section 906 of the Sarbanes-Oxley Act of 2002*
101.INS	XBRL Instance Document**
101.SCH	XBRL Taxonomy Extension Schema Document**
101.CAL	XBRL Taxonomy Extension Calculation Linkbase Document**
101.DEF	XBRL Taxonomy Extension Definition Linkbase Document**
101.LAB	XBRL Taxonomy Extension Label Linkbase Document**
101.PRE	XBRL Taxonomy Extension Presentation Linkbase Document**
104	Cover Page Interactive Data File (formatted as Inline XBRL and contained in Exhibit 101)

* Submitted electronically herewith.

** Attached as Exhibit 101 to this report are the following documents formatted in XBRL (Extensible Business Reporting Language) for the year ended December 29, 2019: (i) the Consolidated Statement of Income, (ii) the Consolidated Balance Sheet, (iii) the Consolidated Statement of Shareholders' Equity, (iv) the Consolidated Statement of Comprehensive Income (Loss), (v) the Consolidated Statement of Cash Flows, (vi) Notes to Consolidated Financial Statements and (vii) Financial Schedule of Valuation and Qualifying Accounts.

† Denotes management contract or compensatory plan or arrangement required to be filed as an Exhibit to this Form 10-K.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized as of February 21, 2020.

Teledyne Technologies Incorporated (Registrant)

By: /s/ Aldo Pichelli

Aldo Pichelli
President and Chief Executive Officer

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

/s/ Aldo Pichelli Aldo Pichelli	President and Chief Executive Officer Chief Executive Officer (Principal Executive Officer)	February 21, 2020
/s/ Susan L. Main Susan L. Main	Senior Vice President and Chief Financial Officer (Principal Financial Officer)	February 21, 2020
/s/ Cynthia Belak Cynthia Belak	Vice President and Controller (Principal Accounting Officer)	February 21, 2020
/s/ Robert Mehrabian Robert Mehrabian	Executive Chairman and Director	February 21, 2020
* Roxanne S. Austin	Director	February 21, 2020
* Denise R. Cade	Director	February 21, 2020
* Charles Crocker	Director	February 21, 2020
* Kenneth C. Dahlberg	Director	February 21, 2020
* Simon M. Lorne	Director	February 21, 2020
* Robert A. Malone	Director	February 21, 2020
* Paul D. Miller	Director	February 21, 2020
* Jane C. Sherburne	Director	February 21, 2020
* Michael T. Smith	Director	February 21, 2020
* Wesley W. von Schack	Director	February 21, 2020

*By: /s/ Melanie S. Cibik
Melanie S. Cibik
Pursuant to Power of Attorney
filed as Exhibit 24.1

This page has intentionally been left blank


TELEDYNE TECHNOLOGIES
Everywhereyoulook™

Forward-looking Statements
Cautionary Notice

From time to time we make, and this Annual Report and our Annual Report on Form 10-K may contain, forward-looking statements, as defined in the Private Securities Litigation Reform Act of 1995, directly and indirectly relating to earnings, growth opportunities, acquisitions and divestitures, product sales, capital expenditures, pension matters, stock option compensation expense, our credit facility, interest expense, severance and relocation costs, environmental remediation cost, stock repurchases, taxes, exchange rate fluctuations, and strategic plans. All statements made in this Annual Report and the Company's Annual Report on Form 10-K that are not historical in nature should be considered forward-looking. Actual results could differ materially from these forward-looking statements.

Many factors could change the anticipated results, including: disruptions in the global economy; the spread of the Coronavirus resulting in lower demand for our products and global supply disruptions; changes in demand for products sold to the defense electronics, instrumentation, digital imaging, energy exploration and production, commercial aviation, semiconductor and communications markets; funding, continuation and award of government programs; cuts to defense spending resulting from existing and future deficit reduction measures; impacts from the United Kingdom's exit from the European Union; uncertainties related to the policies of the U.S. Presidential Administration; the imposition and expansion of, and responses to, trade sanctions and tariffs; and threats to the security of our confidential and proprietary information, including cyber security threats. Lower oil and natural gas prices, as well as instability in the Middle East or other oil producing regions, and new regulations or restrictions relating to energy production, including with respect to hydraulic fracturing, could further negatively affect our businesses that supply the oil and gas industry. Disruptions from the production delay of Boeing's 737 Max aircraft and increasing fuel costs will negatively affect the markets of our commercial aviation businesses. In addition, financial market fluctuations affect the value of the company's pension assets.

Changes in the policies of U.S. and foreign governments, including economic sanctions, could result, over time, in reductions or realignment in defense or other government spending and further changes in programs in which we participate.

While Teledyne's growth strategy includes possible acquisitions, we cannot provide any assurance as to when, if or on what terms any acquisitions will be made. Acquisitions involve various inherent risks, such as, among others, our ability to integrate acquired businesses, retain customers and achieve identified financial and operating synergies. There are additional risks associated with acquiring, owning and operating businesses outside of the United States, including those arising from U.S. and foreign government policy changes or actions and exchange rate fluctuations.

We continue to take action to assure compliance with the internal controls, disclosure controls and other requirements of the Sarbanes-Oxley Act of 2002. While we believe our control systems are effective, there are inherent limitations in all control systems, and misstatements due to error or fraud may occur and may not be detected.

Additional information concerning factors that could cause actual results to differ materially from those projected in the forward-looking statements is contained in Teledyne's periodic filings with the Securities and Exchange Commission, including its 2019 Annual Report on Form 10-K. Forward-looking statements are generally accompanied by words such as "estimate", "project", "predict", "believes" or "expect", that convey the uncertainty of future events or outcomes. We assume no obligation to publicly update or revise any forward-looking statements, whether as a result of new information or otherwise.

TELEDYNE TECHNOLOGIES

Everywhere**you**look™

1049 Camino Dos Rios, Thousand Oaks, CA 91360 | Telephone: (805) 373-4545 | Fax: (805) 373-4775

www.teledyne.com