



WHEN PERFORMANCE  
REALLY MATTERS

MOOG

2018 | ANNUAL REPORT

# FINANCIAL HIGHLIGHTS

## RECENT FINANCIAL PERFORMANCE

(Dollars and shares in millions, except per share data)

	2018	2017
<b>NET SALES</b>	\$2,709	\$2,498
<b>NET EARNINGS</b>	\$97	\$141
<b>DILUTED EARNINGS PER SHARE</b>	\$2.68	\$3.90
<b>ADJUSTED EARNINGS PER SHARE*</b>	\$4.57	—
<b>EQUITY MARKET CAPITALIZATION</b>	\$2,985	\$2,984
<b>AVERAGE SHARES OUTSTANDING</b>	36.1	36.2

Measured as of fiscal year end

## SALES (Dollars in millions)



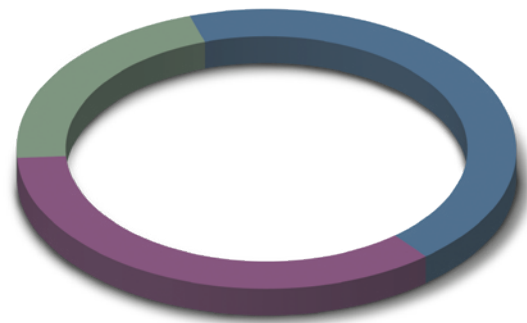
## DILUTED EARNINGS PER SHARE (In dollars)



\*2018 adjusted EPS of \$4.57 excludes the impact of charges associated with exiting the wind pitch control business and special impacts from the U.S. Tax Act.

Financial results for fiscal year 2018 are available in Moog's 10-K. The report was filed on November 13, 2018, pursuant to Section 13 OR 15(d) of the Securities Exchange Act of 1934 for the fiscal year ended September 29, 2018. The 10-K can be viewed at [www.moog.com/investors/10K](http://www.moog.com/investors/10K).

## REVENUE BY SEGMENT



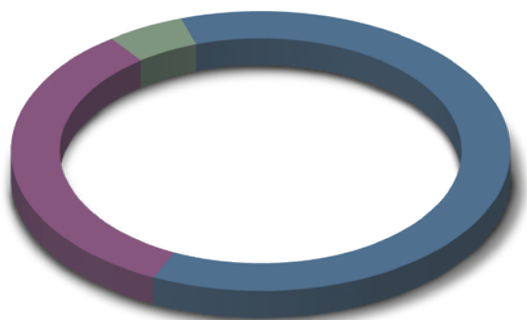
- Aircraft Controls 44%**
- Industrial Systems 35%**
- Space and Defense 21%**

## REVENUE BY MARKET



- Defense 34%**
- Commercial Aircraft 23%**
- Industrial Automation 16%**
- Space 8%**
- Medical 8%**
- Energy 6%**
- Simulation and Test 5%**

## REVENUE BY MARKET DISTRIBUTION



- Industrial and Commercial 62%**
- U.S. Military and Government Funded 33%**
- Foreign Government 5%**

Moog's geographic revenue distribution is 59% U.S. and 41% international.

# 2018 HIGHLIGHTS

Moog initiated a **dividend** program under which the Company intends to pay a regular quarterly cash dividend to shareholders of its Class A and Class B stock. During fiscal year 2018, the Company declared a \$.25 per share dividend in March and July. This marked the first time since 1988 that Moog paid cash dividends on common shares.



Moog **acquired** VUES s.r.o. headquartered in Brno, Czech Republic. VUES designs and manufactures customized electric motors and generators for applications in the automation, automotive test, energy and industrial markets. Founded in 1947, the business has a successful history of providing specialized machinery components to a diverse customer base in Europe.

Moog Inc. and Singapore Airlines Engineering Company announced the formation of a **joint venture company**, Moog Aircraft Services Asia. The joint venture company will provide maintenance, repair and overhaul services for Moog manufactured flight control systems fitted to new generation aircraft, including the Boeing 787 and Airbus A350. The new facility enhances Moog's service network within the Asia Pacific region and enables the delivery of efficient cost effective services as part of Moog's Total Support Program. Moog Inc. holds a 51% equity stake in the company.



Embraer, S.A. recognized Moog as a **Supplier of the Year** for new development. The award was the culmination of Moog's efforts to design, develop and qualify a full Fly-By-Wire flight control system for Embraer's new E2 family of commercial jets that entered into service in 2018.

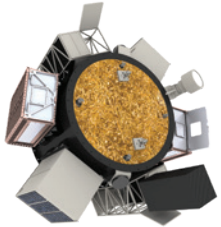
Bell Helicopter and Team Valor achieved **first flight** of the V-280 Valor™ tiltrotor, Bell's prototype aircraft designed and built for the Army's Joint Multi-Role Technology Demonstration (JMR-TD) Program – the precursor to the Department of Defense's Future Vertical Lift Program. Moog is responsible for the design, manufacture and flight qualification of an integrated flight control system.



Courtesy of Derek Gee, Buffalo News

As part of the Moog Defense sector's commitment to equipping those who defend freedom, the Company co-sponsored the U.S. Navy's **USS Little Rock LCS-9 Commissioning** held in Buffalo, NY. Moog's actuation and stabilization technology is incorporated into the ship's two MK46 naval turrets, each using 30mm high velocity cannon for shipboard self-defense. Moog also provides the tactical air navigation (TACAN) and surveillance system. The Little Rock, a Freedom Class LCS, deploys two Sikorsky SH-60 Seahawk® multi-mission helicopters that feature Moog integrated trim/boost servoactuator assemblies for pitch trim, roll trim and yaw boost as well as Moog active vibration controls.

The Space and Defense Segment, in partnership with Lockheed Martin and the UK Space Agency, announced the **first scheduled launch** of its Small Launch Orbital Maneuvering Vehicle (SL-OMV). The SL-OMV is a lightweight and low-cost propulsive adapter that distributes small satellites and CubeSats and deploys multiple payloads to different orbits. The maiden voyage will launch in the early 2020s from the U.K.'s commercial spaceport in Scotland. Moog's Reading, U.K. site will perform final integration and testing. Lockheed Martin is the launch provider responsible for payload integration and launch service.



Moog opened the Moog Electro-Mechanical (EM) Solutions India Pvt Ltd. factory in Bangalore, India to produce servomotors, actuators and other EM products. The **new facility** specializes in the manufacturing and testing of Moog's new large motor solutions for the global market and will provide customers with system integration for motion control products. Moog's presence in India began in 1991 with the opening of a technology center and servo motor production facility in Bangalore's Electronic City. The Moog EM Solutions factory is Moog's fourth facility in India. Moog's large motor solutions are newly designed primary motion systems that include high-power servomotors, servo drives, controllers and energy management systems.

# CHAIRMAN'S LETTER

To Our Shareholders, Employees and Friends,

2018 was a very good year for our Company. We had top-line growth in each of our operating segments with consolidated sales up 8% over the prior year. Our Aircraft segment was up on higher military investment in new platforms and the production ramp-up on the F-35 program. In the commercial aircraft market, our major programs continued at record production rates, and our aftermarket powered ahead on strong initial provisioning and solid legacy work. In Space and Defense, both markets benefited from higher U.S. defense spending and the success of strategic investments we have made in new technologies over the last few years. Finally, our Industrial markets were up across the board, as we benefited from the strong economic activity across the globe as well as the recovery in energy prices. We continued to invest in new products and technologies in each of our segments; investments which will transition into annuity businesses for future decades. In addition, we intensified our focus on operational excellence to ensure we are delivering outstanding products in the shortest possible lead times to our customers around the globe.

Our bottom-line earnings were impacted adversely by the transition taxes associated with the change in the U.S. Tax Code and our strategic decision to exit the wind pitch control business. Absent these one-time effects, our earnings per share were up a very healthy 17%. Over the course of the year, we used our free cash flow to fully fund our U.S. defined benefit pension plan. We also started paying a quarterly dividend, reflecting our belief in the positive long-term outlook for our business.

As we look to 2019, we're optimistic. Our aerospace and defense portfolio, representing over 60% of our business, enters the year with a record backlog and a very positive outlook across both commercial and military platforms. Our industrial businesses are also starting the year in a healthy state. However, political uncertainty, the threat of a trade war, and falling oil prices are reasons for caution. We'll monitor these developments carefully and respond appropriately as events unfold throughout 2019.

Looking beyond 2019, we are very excited about our longer-term future. We are a company with outstanding engineering talent that is dedicated to solving the most challenging problems for our customers. As we think about the developments that are happening in the world, we see enormous opportunities for our Company. Entire industries are changing as concerns about global warming and international security combine with demographic shifts and technological advances to reshape industries from transportation and agriculture to defense and space. Robots are emerging from the structured setting of the factory floor onto the streets and into the fields of everyday life. Autonomous technology and artificial intelligence will change our lives in ways we cannot yet imagine. All of this change is creating exciting opportunities for Moog's technical capabilities. Our continued investment in innovation is the key to bringing these opportunities to life.

Every year, we invest in incremental innovation in each of our business lines to ensure we are meeting the needs of our existing customers. Beyond that, we invest in selected emerging technologies in entirely new markets. We identify lead customers who share our vision of a new future and are seeking to work collaboratively to define that future. These customers are trying to solve whole new challenges that have never been tackled in the past. For example, we're collaborating with customers looking to automate agricultural production by using autonomous technology to address the challenge of scarce labor. In addition, we have customers who are working to create the next generation of connected machines using internet of things technology or by seeking smart, miniaturized actuators manufactured using additive 3D technology for use in medical applications. In each of these areas, we are investing to create an entirely new set of markets for Moog.

In this environment of revolutionary opportunities, we believe our culture and values are our most important assets. Our culture encourages working together to overcome technical challenges and unexpected setbacks – because what we do is never easy. When we make a commitment, we keep it. At Moog, success is a team effort and our customers know that Moog employees will support them through the tough times and deliver on our promises. On day one, every new Moog employee is introduced to our culture. From newly hired machinists to seasoned design engineers and assembly technicians, our employees count on each other to produce the very best products. Products that will be tested in the toughest and most demanding environments. In the face of the dramatic change we are seeing in many of our industries, we remain steadfast in our values. These values have served us well in the past and I believe they will continue to do so into the future.

We believe our employees are what make our Company successful. Our goal is to make Moog a great place to work, where every employee feels like they are making a valuable contribution to the long-term success of the Company. This goal guides our daily actions and is the foundation of our employee recruitment and retention activities. Our employees create value for customers and returns for our shareholders. As we close out 2018, I am pleased to report that over half of our employees are also shareholders. Our retirement plans, our employee stock ownership plan, and our profit-sharing plan have provided avenues for more of our employees than ever to be able to acquire Moog stock in 2018, thus allowing them to share in the success of our Company while investing for their future.

## Special Thanks

Over the course of the last year, Larry Ball and Gary Szakmary retired from the ranks of our officer group. Larry led our Components Group and Gary was our Chief Human Resources Officer. Each of them was with our Company for over three decades and dedicated their working lives to making Moog a success. Their contributions are too numerous to mention. We will miss them both. We thank them for their tireless efforts and wish them well in their retirement.

Respectfully submitted,



John Scannell

Chairman and Chief Executive Officer



Left to Right, Top to Bottom: Paul Wilkinson, Eric Burghardt, Pat Roche, Don Fishback, John Scannell, Maureen Athoe, Mark Trabert

**DIRECTORS**

**John R. Scannell**  
Chairman of the Board  
Chief Executive Officer

**Donald R. Fishback**  
Director  
Vice President  
Chief Financial Officer

**William G. Gisel, Jr.**  
Director  
President and CEO  
Rich Products Corp.

**Peter J. Gundermann**  
Director  
President and CEO  
Astronics Corp.

**Kraig H. Kayser**  
Director  
President and CEO  
Seneca Foods Corp.

**R. Bradley Lawrence**  
Director  
Retired Chairman and CEO  
Esterline Technologies

**Brian J. Lipke**  
Director  
Retired Chairman and CEO  
Gibraltar Industries

**Brenda L. Reichelderfer**  
Director  
Retired Sr. VP, Managing Director  
TriVista

**OFFICERS**

**R. Eric Burghardt**  
President  
Aircraft Controls

**Mark J. Trabert**  
President  
Aircraft Controls

**Maureen M. Athoe**  
President  
Space and Defense

**Patrick J. Roche**  
President  
Industrial Systems

**Paul Wilkinson**  
Vice President  
Chief Human Resources Officer

**Richard A. Aubrecht**  
Vice President  
Strategy and Technology

**Jennifer Walter**  
Vice President  
Finance and Controller  
Principal Accounting Officer

**Timothy P. Balkin**  
Treasurer  
Assistant Secretary

**Robert J. Olivieri**  
Secretary  
Partner  
Hodgson Russ, LLP

Retired 2018:  
Gary A. Szakmary  
Vice President  
Chief Human Resources Officer  
Lawrence J. Ball  
President  
Components Group



# AIRCRAFT CONTROLS

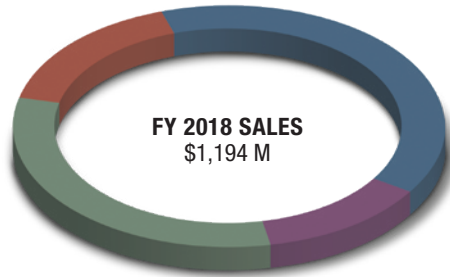
Our broad technology portfolio and collaborative customer relationships deliver high value-added, tailored solutions to commercial and military customers.

## Product Portfolio

- Flight control computers and flight-critical software
- Primary and secondary flight control actuation – all technologies
- High lift/flap actuation systems
- Specialty actuation systems
- Critical control components

## Competitive Advantages

- State-of-the-art technology and intellectual property in flight controls, engine controls, door drive controls, active vibration controls and engineered components
- Critical component knowledge
- Complete flight control system design and integration capability
- World-class manufacturing facilities and skilled, experienced, team-based workforce
- Focused, highly-responsive global aftermarket support organization



- Commercial Aircraft OEM \$470 M
- Commercial Aircraft Aftermarket \$152 M
- Military Aircraft OEM \$382 M
- Military Aircraft Aftermarket \$190 M

## F-35 Lightning II, Joint Strike Fighter (JSF)

Lockheed Martin's F-35 is the world's first 5th generation fighter. All three F-35 distinct variants have similar performance characteristics, allowing them to fulfill the wide range of mission requirements for the U.S. armed forces and its global military partners with service-specific missions. All three models feature stealth technology, advanced sensor fusion, internal weapons capacity and improved range. It's the most lethal, survivable and connected fighter aircraft to ever enter production. In June 2018, Lockheed delivered the 300th production F-35.

The F-35A conventional takeoff and landing (CTOL) variant is designed to operate from conventional runways and is primarily used by the U.S. Air Force. The "A" is expected to be the variant most widely operated by our global partner nations.

The F-35B short takeoff/vertical landing (STOVL) variant is uniquely designed to operate on short-field forward operating bases and on air-capable ships. This variant is primarily operated by the U.S. Marine Corps, with a limited number to be operated by global partners.

The F-35C carrier variant (CV) is the U.S. Navy's first stealth aircraft and its primary fighter aircraft of the future. The "C" is designed to takeoff and land on large aircraft carriers.

### Moog's F-35 Content

The F-35 is the first production aircraft whose primary flight control system exclusively uses next-generation Electrohydrostatic Actuation (EHA) technology. Moog is the system integrator and supplier of EHA technology for all F-35 variants, which includes actuators, electronics and flight-critical software. Moog also provides the maneuvering leading edge flap actuation system for all F-35 variants.

On the F-35B lift system, Moog hardware helps enable the unique takeoff and vertical landing ability.

On the F-35C, Moog also provides the wingfold actuation system that allows the Navy to fold the F-35C's wingtips for stowage on an aircraft carrier.

Beyond its substantial role as a production supplier, Moog is also an established provider of aftermarket services for the F-35, both in the U.S. and globally.



F-35A Lightning II, CTOL  
Courtesy of U.S. Air Force / Alex R. Lloyd



F-35B Lightning II, STOVL  
Courtesy of U.S. Marine Corps / Lance Cpl. Dana Beesley



F-35C Lightning II, CV  
Courtesy of U.S. Navy / Chief MC Spec. Shannon E. Renfroe

## Supplier of integrated systems and critical control products for military, commercial and business aircraft.

### Military Aircraft

F-35, F-15, F/A-18E/F, EA-18G, F-16, KC-46, A400M, Korea KFX, Korea T-50, C-27J, C-295, CN-235, Eurofighter-Typhoon, JAS 39, India LCA, Japan XC-2, XP-1, Hawk AJT, M346

### Military and Commercial Helicopters

H-60/S-70, H-53, EH-101, S-76, S-92, V-22, V-280, AH-64, A109, A129, AB139, AW159, AW609, Future Lynx, B525

### Commercial Airplanes

Boeing 737, 747, 767, 777, 787, Airbus A320, A330, A350, A380, Embraer E-Jets E2 Family, COMAC C919

### Business Jets

Bombardier Challenger 350, 605 and Global Express, Gulfstream G280, G500, G550, G600, G650

### Customer Support

All current production programs above plus legacy programs including A-7, A-10, A300, A340, AH-64, AMX, B-1B, B-2, B-52, BAE-146, C-5, C-130, C-141, CH-46, CH-47, CH-53, Cessna Citation X, Bombardier Challenger 300, 604, DC-8, DC-9, DC-10, E-2C, EA-6B, F-2, F-4, F-100, F/A-18C/D, F/A-22, Gulfstream , G350, G400, G450, Hawk, KC-10, KC-135, MD-11, MD-80, MD-90, P-3, T-45, Tornado, U-2, VC-10, 757



*Eurofighter EF-2000 Typhoon S  
Courtesy of Marcin Nowaczyk / Aviationpictures.pl*



*KC-46 Refueling Boom Actuation System  
Courtesy of U.S. Air Force*



*Embraer E2 Family, E190  
Courtesy of Dr. Andreas Zeitler*



*Boeing 787-9 Dreamliner  
Courtesy of James Rowson*



*Airbus A350-900  
Courtesy of Andre Giam*



*Gulfstream G500  
Courtesy of Gulfstream (© Gulfstream Aerospace Corporation)*



# SPACE AND DEFENSE

We provide reliable hardware, integration and launch support to the space industry, and components and systems that are critical to the U.S. war fighter and our global military allies.

## Space Product Portfolio

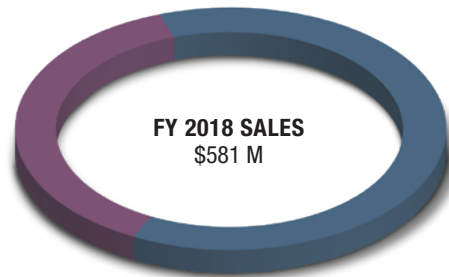
- Multi-tier provider capable of components, systems and prime level integration
- Thrust vector control and flight control actuation systems, avionics, propulsion controls and structures for missiles and launch vehicles
- Liquid rocket engines, tanks, chemical and electric propulsion systems, subsystems and components for spacecraft and launch vehicles
- Satellite integrated avionics, solar array drives, antenna pointing mechanisms and vibration isolation systems

## Defense Controls Product Portfolio

- Fin and Thrust Vector Control actuation systems, divert and attitude control components for missiles and interceptors
- Weapon Stores Management Systems (SMS) and launchers for the deployment of missiles, guns and rockets
- Turreted weapon systems, precision motion controls and slip rings for gun laying/stabilization, ammunition handling and expeditionary radar
- Electromechanical and electrohydraulic actuation products for Naval ships, submarines and Unmanned Underwater Vehicles (UUVs)
- Integrated counter unmanned aerial systems (C-UAS), sensor-based security systems and sensor positioning sub-systems

## Competitive Advantages

- 65+ years of heritage with highly-skilled engineers, technologists and rocket scientists
- Success for military and space missions in a business built on strong customer relationships – translates decades of expertise and know-how into superior solutions
- Focus on delivering 100% quality products, on time through use of lean manufacturing principles
- A one-stop resource for space and defense actuation plus control electronics



- Defense Controls \$366 M
- Space \$215 M

## Reconfigurable Integrated-weapons Platform (RIwP™)

RIwP is Moog's flexible, scalable reconfigurable turret that provides tailored overmatch and improved survivability in every combat situation. The system was developed with battlefield input allowing Moog engineers to create a multi-mission turret.

Its modular and reconfigurable design gives battlefield commanders flexibility and options, including direct fire weapons, missiles, non-lethal effects and sensors to target and defeat current and emerging threats.

The availability of small, inexpensive unmanned aerial systems has created an urgent operational need for improved sensors and weapon systems that can be integrated for battlefield use. Vehicle-mounted Counter-Unmanned Aerial Systems (C-UAS) are in demand by the U.S. Army and allied forces to combat small drones and unmanned quadcopters and fixed-wing aircraft. Moog and teammate Leonardo DRS collaborated to integrate and demonstrate RIwP's flexible capability as the right solution for this C-UAS mission.

RIwP is light enough for installation on a tactical vehicle and has greater fire power potential than most currently-fielded combat vehicle weapon systems. With more than 125 available configurations that can be housed on a single base platform, RIwP also offers common training, logistics and other life cycle cost benefits.



Javelin / XM813 / M240 / LRAS3

TOW / MK44 / M240 / IBAS



## Extensive heritage and industry expertise with a focus on mission critical solutions.

### Space

Satellite Controls: LS-1300, Eurostar, Spacebus, A2100, DS-1000/2000, GEOStar, James Webb Space Telescope, GPS III, Galileo, Europa Clipper, NICER, SkySat, InSight, OSIRIS-Rex, Bepi Colombo, H2 Transfer Vehicle

Launch Vehicle, Manned Space and Strategic Missile Controls: Antares®, Atlas V, Delta IV, Ariane 5, Vega, Minotaur, Minuteman III, Falcon 9, NASA Space Launch System and Orion, European Service Module, CST-100 Commercial Crew Vehicle, Sierra Nevada Dream Chaser®, International Space Station, Trident D-5

### Defense

Missile Systems: HELLFIRE®, TOW, Tomahawk, MALD, EKV, THAAD

Defense Control Systems: Abrams, AC-130J, AJAX, Aegis Combat System, CV90 family, FLW 100/200 RWS, G/ATOR Radar, LAV-25, LAV-AT, Littoral Combat Ship MK46, U.S. Army MLIDS and USMC MADIS C-UAS, Multi-Mission Launcher, Stryker

Naval Systems: Virginia and Columbia-class submarines, USS Gerald R. Ford aircraft carrier

Sensor & Surveillance Systems: Ground Based Operational Surveillance System, Mine Resistant Ambush Protection (MRAP), RQ-7 Shadow



LAV-AT  
Courtesy of U.S. Marine Corp / Lance Cpl. Elijah J. Abernathy



HELLFIRE® Missile and Gray Eagle Unmanned Aircraft System  
Courtesy of U.S. Army



Atlas V carrying the Geostationary Operational Environmental Satellite-S, GOES-S  
Courtesy of United Launch Alliance



GPS III  
Courtesy of U.S. Air Force – SMC/GP



EXO® GeminEye® Camera System  
C-UAS, New Orleans, LA



USS New Mexico (SSN779), Virginia-class Submarine, Quiet Actuation  
Courtesy of U.S. Navy / MC Spec 3rd Class Nicholas Hall



# INDUSTRIAL SYSTEMS

We create a competitive advantage for our customers by providing unique motion control solutions.

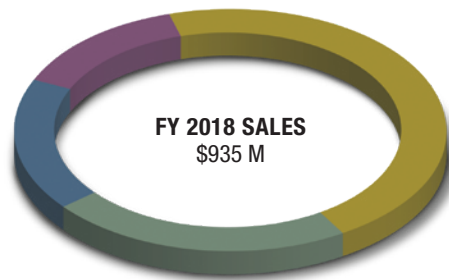
## Product Portfolio

- Slip ring assemblies for industrial automation, construction equipment and Floating Production, Storage and Offloading (FPSO) vessels
- Hydraulic servovalves, including valves with embedded intelligence
- Brush, brushless DC and servo electric motors and actuators for material handling and industrial automation
- Controllers, servo drives and software for a broad range of motion control applications
- High-performance servo pumps for a wide range of high-end industrial applications
- Electro-hydrostatic actuation systems for applications requiring high forces and energy efficiency
- Fiber optic rotary joints for Remotely Operated Vehicles (ROVs)
- Acoustic sensors, sonars and video cameras for subsea imaging and Remotely Operated Vehicles (ROVs)
- Medical OEM air detection sensors, surgical handpieces, ambulatory care infusion pumps and enteral feeding pumps
- Motors and blowers for sleep therapy, ventilators and portable oxygen concentrators



## Competitive Advantages

- Global reach with sales, engineering and operations across 22 countries
- Engineering heritage with decades of motion control experience
- Ability to customize our technology and leverage system engineering expertise to create unique solutions
- Low to high volume manufacturing complemented by supplier partnerships
- Significant domain expertise in our customers' machines, design challenges and industry applications



- **Industrial Automation** \$431 M
- **Medical** \$213 M
- **Energy / Marine** \$164 M
- **Simulation and Test** \$127 M

## Test Solutions

Moog test systems incorporate both electric and hydraulic servo actuation solutions with a design approach that achieves faster and better tests for new models, parts and prototypes. Moog engineers collaborate closely with customers to develop the right system, based on performance requirements and applications. Product development tests simulate conditions, stress and the loads that new designs and products will face when installed and in use.

SAIC Volkswagen Automotive Co., Ltd. selected a Moog electric multi-axis system to test seatbelt anchors in the carmaker's lab in Shanghai. The test lab previously relied on a hydraulic test system but reliability, maintenance and safety improvements resulted in the transition to a Moog electric test rig.

Moog's engineering expertise and proven experience helps customers define their specific customized testing solution – electric or hydraulic. Offering both electric and hydraulic technologies ensures that a system meets customer requirements for frequency, payload, and stiffness in order to validate new designs prior to the start of production.

The components of the electric seatbelt test system include nine electric servo actuators for applying a load, which allows simultaneous testing of three sets of three seatbelts and seatbelt anchoring systems. Moog test systems allow manufacturers to react faster to market changes, validate designs quickly and adapt to the latest safety and environmental regulations.



SAIC Volkswagen Electric Multi-axis Test System  
Moog Electromechanical Actuator

## Recognized brand in key markets with capabilities in actuation, sensing, data and power transmission.

### Industrial Automation

Plastic injection and blow molding machine controls – both hydraulic and electric, steel production, metal forming and presses, packaging, robotics, construction, material handling and industrial automation

### Energy/Marine

Gas and steam turbine solutions, oil and gas exploration and production solutions, Remotely Operated Vehicles (ROVs), Floating Production, Storage and Offloading Vessels (FPSO), wind energy turbine components

### Simulation and Test

Flight simulation motion systems including control loading systems and control cabinets for realistic pilot training, automotive turnkey testing systems for component performance testing, aerospace turnkey testing systems for iron bird, structural and components

### Medical

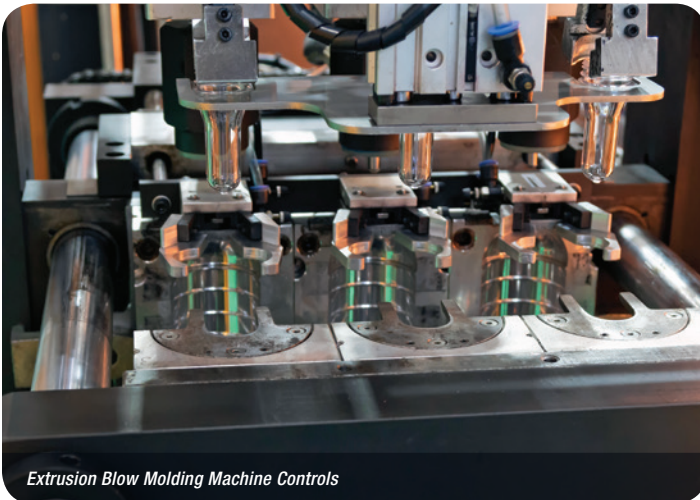
Oxygen therapy, sleep therapy, computed tomography (CAT scan), IV pumps, enteral pumps, sensors, surgical handpieces



Oil and Gas Exploration and Production Products



Full-flight Level D Simulator Motion System – C-130J U.S. Air Force  
Courtesy of CAE



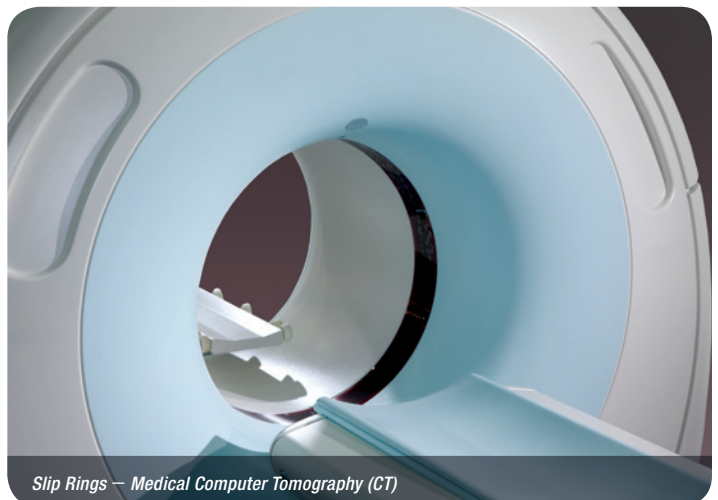
Extrusion Blow Molding Machine Controls



Rotary Platforms – Construction Equipment



Moog IV and Enteral Medical Pumps



Slip Rings – Medical Computer Tomography (CT)

# TECHNOLOGY INNOVATIONS



Courtesy of Bell

## Team Valor V-280

The U.S. Army-led Joint Multi-Role Technical Demonstrator (JMR-TD) program is the precursor to the Department of Defense's Future Vertical Lift program – the expected next-generation replacement for all DoD helicopters.

Bell selected Moog and other industry partner companies to combine their best engineering resources to develop the third-generation Valor tiltrotor for the vertical lift program. The V-280 Valor acts like a helicopter when taking off and landing but while in the air it can reconfigure itself with propellers. Moog is designing, manufacturing and qualifying the integrated flight control system.

Bell's V-280 is a clean-sheet design that benefits from the heritage and lessons learned from the successful V-22 Osprey's design, flight-testing, production and combat experience. Smaller and faster than the V-22, the V-280's rotors tilt, while the engines remain fixed in place. The Valor's crew of four can carry a squad of up to 14 Army or Marine Corps personnel to assault areas faster and further than the V-22.

Since first flight a year ago, the Valor team has compiled nearly 85 hours of flight, forward flight at 250 knots true airspeed with an ultimate goal of 280 knots, sustained flight at 11,500 feet altitude, and demonstrated low and high-speed agility with fly-by-wire controls. The Moog flight control system includes three flight control computers with support software, six triplex swashplate actuators to control the rotors, and the flaperon and ruddervator actuators that control the wing and tail.

## Rideshare

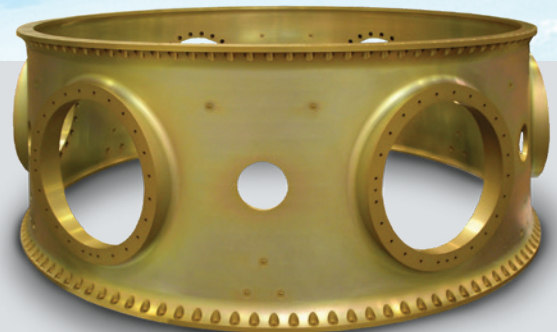
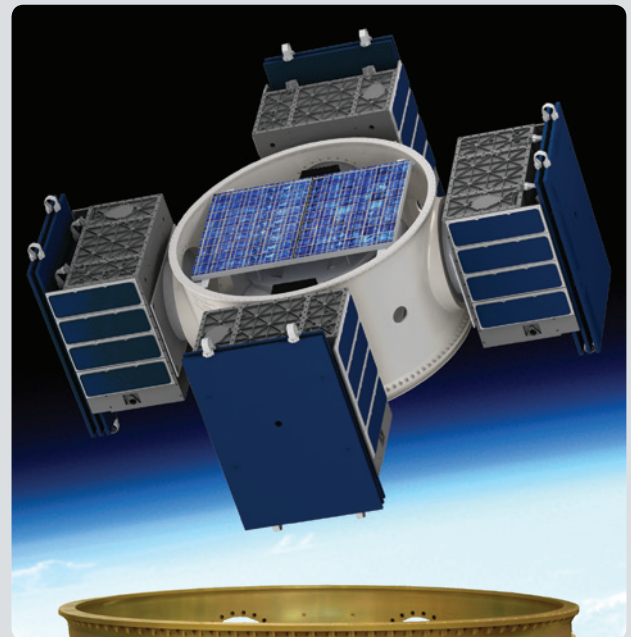
How does a small satellite mission navigate launch cost, deployment risk and overall mission success? Rideshare. Multiple missions stacked on a common launch vehicle and sharing launch costs allow small satellites, including CubeSats, an economical deployment option and access to low-Earth orbit.

Moog rideshare components and systems enable efficient space access for small satellites and space-based payloads. With a strong heritage in U.S. space programs, Moog engineers have capitalized on the growing rideshare market and positioned Moog as an industry leader in rideshare hardware solutions.

Moog's ESPA ring, a structural support ring used as a secondary payload adapter, allows up to six secondary satellites to share a ride to space with large primary satellite payloads. ESPA is a drop-in component in the launch stack, compatible with multiple payloads and launch vehicles.

While affordable deployment is a benefit of ridesharing, secondary payload status is the trade-off. Orbital Maneuvering Vehicles (OMVs) can help leverage rideshare infrastructure by equipping payload adapters like the ESPA with propulsion systems, avionics, sensors and power. Moog engineers developed the COMET for U.S. launchers – a commercial OMV that can disperse small satellite constellations, act as a hosted payload platform, or deliver a single spacecraft to ideal orbits beyond the primary payload orbit.

Moog's new Small Launch Orbital Maneuvering Vehicle (SL-OMV) is a propulsive vehicle for secondary payload deployment based on the ESPA ring. Configured for short duration missions using the smaller Venture Class of launchers, SL-OMV can disperse CubeSat constellations or deliver ESPA-Class spacecraft to their ideal orbits at a highly affordable price. Moog's SL-OMV's maiden voyage will launch in the early 2020s from the UK's first commercial spaceport in Melness, Scotland.



SL-OMV  
ESPA Secondary Payload Adapter



Moog's fully automated machining cell

## Automated Machining Cell

Future opportunities and an on-going focus on operational excellence require investments in manufacturing technology, new machines and training. Upgrades to advanced manufacturing machinery allow machinists to produce the complex geometries and close tolerances designed into Moog products with better overall return on capital investment.



During the design phase for Embraer's new E2 jet program, Moog engineers used a design-to-manufacturing teaming environment to create a production process for first development parts. The goal: reduce costs as the program transitioned from development to production. The team planned and proved-out the design of a small robotic cell for the manufacture of hydraulic manifolds to improve part flow, labor utilization and machine investment.

The result was a fully automated machining cell with standard off-the-shelf 5-axis equipment. Operated by a robot and using six automated machines for milling, the cell produces the full product family of complex milled aluminum manifolds for the E2 jet. The quality of the finished product, improvements in capacity along with reduction in cycle time, tooling costs, floor space and capital investment resulted in the construction of a second similar cell. This new operation is a larger automated manufacturing cell for manifolds for the Airbus A350 and Boeing 787 aircraft programs.

## Industrial Servo Valve with Additive Components

Traditional machining turns a block of titanium or aluminum into a part by shaping it with milling and boring machinery during part fabrication, removing portions of the material. The effects of traditional machining, heat-treat, casting and forging processes on material properties are well known. Additive Manufacturing (AM) describes a wide range of additive processes and methods. Metal additive at Moog mostly utilizes a Powder Bed Fusion (PBF) process. PBF is a digital automated metal part manufacturing process utilizing metal powder as raw material. AM allows for new design solutions but requires considerable research and development for use on critical applications and systems.

Commercial and military aviation, manned and unmanned space applications, certain industrial uses, and medical products require certifications to establish suitability for service – and often have strict quality and traceability standards. Additive introduces major process changes, especially for products that require certification because additive machinery is both the furnace and the mill. Extensive R&D and testing is required and additive isn't a complete replacement for traditional, or subtractive machining.

In one application, Moog engineers replaced a conventionally produced servo valve body with an additively manufactured titanium valve body. Leveraging the advantages of additive technology, the new body delivers a small internal hydraulic flow improvement and a 50% weight reduction. Future additive R&D includes identifying opportunities to consolidate parts into single additive components, reducing weight and solving thermal heat challenges.



Moog's powder-to-product Additive Manufacturing Center

Our engineers see additive manufacturing technology as a key enabler for future digital processing and leaner workflows. Additive offers high-quality rapid prototyping, the option for one-off customized parts and quantity-of-one production runs. In the field, the day will come when spare part printing is on-demand and completed at the point of use – underwater, in a factory far away, and even in space.

# FINANCIAL REVIEW

(Dollars and shares in millions, except per share data)

	2018	2017	2016	2015	2014	2013	2012*	2011*	2010*	2009*	2008*
<b>SEGMENT SALES</b>											
AIRCRAFT CONTROLS	\$ 1,194	\$ 1,125	\$ 1,064	\$ 1,087	\$ 1,118	\$ 1,060	\$ 964	\$ 850	\$ 757	\$ 663	\$ 673
SPACE AND DEFENSE CONTROLS <sup>1</sup>	\$ 581	\$ 529	\$ 499	\$ 381	\$ 395	\$ 396	\$ 359	\$ 356	\$ 325	\$ 275	\$ 253
INDUSTRIAL SYSTEMS <sup>1</sup>	\$ 935	\$ 843	\$ 849	\$ 522	\$ 591	\$ 592	\$ 634	\$ 629	\$ 546	\$ 455	\$ 532
COMPONENTS <sup>1</sup>	–	–	–	\$ 536	\$ 545	\$ 563	\$ 514	\$ 495	\$ 487	\$ 457	\$ 444
<b>NET SALES</b>	<b>\$ 2,709</b>	\$ 2,498	\$ 2,412	\$ 2,526	\$ 2,648	\$ 2,610	\$ 2,470	\$ 2,331	\$ 2,114	\$ 1,849	\$ 1,903
<b>EARNINGS BEFORE TAXES</b>	<b>\$ 184</b>	\$ 182	\$ 173	\$ 184	\$ 219	\$ 165	\$ 209	\$ 184	\$ 149	\$ 111	\$ 168
<b>NET EARNINGS</b>	<b>\$ 97</b>	\$ 141	\$ 127	\$ 132	\$ 158	\$ 120	\$ 152	\$ 136	\$ 108	\$ 85	\$ 119
<b>NET RETURN ON SALES</b>	<b>3.6%</b>	5.7%	5.3%	5.2%	6.0%	4.6%	6.2%	5.8%	5.1%	4.6%	6.3%
<b>EARNINGS PER SHARE</b>											
BASIC EPS	\$ 2.71	\$ 3.94	\$ 3.49	\$ 3.39	\$ 3.57	\$ 2.66	\$ 3.37	\$ 2.99	\$ 2.38	\$ 2.00	\$ 2.79
DILUTED EPS	\$ 2.68	\$ 3.90	\$ 3.47	\$ 3.35	\$ 3.52	\$ 2.63	\$ 3.33	\$ 2.95	\$ 2.36	\$ 1.98	\$ 2.75
ADJUSTED EPS <sup>2</sup>	\$ 4.57										
DILUTED WEIGHTED-AVERAGE SHARES OUTSTANDING (in millions)	36.1	36.2	36.5	39.3	45.0	45.8	45.7	46.0	45.7	42.9	43.3
<b>RESEARCH AND DEVELOPMENT</b>	<b>\$ 130</b>	\$ 145	\$ 147	\$ 132	\$ 139	\$ 135	\$ 116	\$ 106	\$ 103	\$ 100	\$ 110
<b>CAPITAL EXPENDITURES</b>	<b>\$ 95</b>	\$ 76	\$ 67	\$ 81	\$ 79	\$ 93	\$ 107	\$ 84	\$ 66	\$ 82	\$ 92
<b>DEPRECIATION AND AMORTIZATION</b>	<b>\$ 89</b>	\$ 90	\$ 99	\$ 104	\$ 109	\$ 108	\$ 101	\$ 96	\$ 91	\$ 76	\$ 63
<b>AT YEAR END</b>											
TOTAL ASSETS	\$ 2,964	\$ 3,091	\$ 3,005	\$ 3,037	\$ 3,140	\$ 3,151	\$ 3,106	\$ 2,843	\$ 2,712	\$ 2,634	\$ 2,227
WORKING CAPITAL	\$ 796	\$ 997	\$ 938	\$ 931	\$ 849	\$ 834	\$ 885	\$ 834	\$ 813	\$ 764	\$ 713
INDEBTEDNESS	\$ 863	\$ 957	\$ 1,006	\$ 1,070	\$ 872	\$ 706	\$ 765	\$ 725	\$ 765	\$ 833	\$ 671
SHAREHOLDERS' EQUITY	\$ 1,225	\$ 1,214	\$ 988	\$ 995	\$ 1,347	\$ 1,536	\$ 1,305	\$ 1,192	\$ 1,121	\$ 1,065	\$ 994
RETURN ON SHAREHOLDERS' EQUITY	7.8%	13.3%	12.6%	11.3%	10.4%	8.6%	12.1%	11.4%	9.8%	8.3%	12.7%
SHAREHOLDERS' EQUITY PER COMMON SHARE OUTSTANDING	\$ 35.20	\$ 33.94	\$ 27.56	\$ 27.09	\$ 32.51	\$ 33.86	\$ 28.80	\$ 26.38	\$ 24.70	\$ 23.53	\$ 23.30
BACKLOG (12 month)	\$ 1,481	\$ 1,212	\$ 1,225	\$ 1,273	\$ 1,340	\$ 1,296	\$ 1,279	\$ 1,325	\$ 1,181	\$ 1,098	\$ 862
NUMBER OF FULL-TIME EMPLOYEES	11,787	10,675	10,497	10,691	11,031	11,152	10,976	10,320	10,117	10,005	8,844

<sup>1</sup> The former Components segment has been divided and merged into Space and Defense Controls and Industrial Systems segments.

<sup>2</sup> 2018 adjusted EPS of \$4.57 excludes the impact of charges associated with exiting the wind pitch control business and special impacts from the U.S. Tax Act.

\* Not restated for Total Assets, Working Capital and Indebtedness. Amounts may not equal the total due to rounding.

# INVESTOR INFORMATION

## Reports

Shareholders receive a copy of our annual report and Form 10-K. All other public reports are available on our website or by contacting us via email, telephone or letter at:

### Investor Relations

Moog Inc. • East Aurora, New York 14052-0018 • Phone: 716-687-4225 • Email: [investorrelations@moog.com](mailto:investorrelations@moog.com)

## Electronic Information About Moog

In our annual report, we convey key information about our financial results. In addition, we have a website for investors. The site includes SEC filings, archived conference call remarks, answers to frequently asked questions, corporate governance information, press releases and links to our transfer agent. Please visit our website at: <http://www.moog.com>. Information contained on our website is not incorporated into this annual report or our other SEC filings.

## Annual Meeting

Our Annual Meeting of Shareholders will be held on February 12, 2019 at 9:00 am ET at The Alford Inn, 300 East New England Avenue, Winter Park Florida 32789. Proxy cards can be voted by internet, telephone or mail.

## Stock Exchange

Our two classes of common shares are traded on the New York Stock Exchange under the ticker symbols MOG.A and MOG.B.

## Financial Mailing List

Shareholders who hold Moog stock in the names of their brokers or bank nominees but wish to receive press releases by e-mail should contact Investor Relations at Moog.

## Transfer Agent and Registrar

EQ Shareowner Services is the stock transfer agent and registrar maintaining shareholder accounting records. If assistance is needed, it is possible for shareholders to view all facets of their accounts online at: [www.shareowneronline.com](http://www.shareowneronline.com). The agent will respond to questions on change of ownership, lost stock certificates and consolidation of accounts.

Please direct inquiries to:

EQ Shareowner Services • MAC N9173-010 • 1110 Centre Pointe Curve, Suite 101, Mendota Heights, MN 55120 • Toll Free: 1-800-468-9716

## Affirmative Action Program

In recognition of our role as a contributing corporate citizen, we have adopted all programs and procedures in our Affirmative Action Program as a matter of Corporate policy.

## Data Privacy

Moog is committed to protecting personal data in accordance with its responsibilities under U.S. and worldwide privacy regulations, including the General Data Protection Regulation (GDPR).

## Independent Auditors

Ernst & Young LLP

## Photographic Images

The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement.

### Front Cover:

*Moog senior project engineer Jonathan Kasper, an 11 year employee, inspects a Xenon Flowrate Controller which delivers fuel to the anode and cathode of an electric thruster used to maintain a satellite in its proper orbit.*

### Front Cover Small Photo Credits:

#### TOP ROW

*USS Little Rock (LCS 9) Courtesy of U.S. Navy / Lockheed Martin*

*F/A-18E Super Hornet Courtesy of U.S. Navy / MC Spec. 3rd Class Grant Grady*

*M1A1 Abrams Main Battle Tank Courtesy of U.S. Marine Corps / Lance Cpl. Dalton S. Swanbeck*

*MH-60 Jayhawk Courtesy of U.S. Coast Guard / Lt. Jeff Mistrick*

*United Launch Alliance Delta IV Heavy Courtesy of NASA / Bill Ingalls*

#### MIDDLE ROW

*NASA Mars InSight Courtesy of NASA / JPL-Caltech*

*KC-135 Stratotanker Flight Simulator Actuation Courtesy of U.S. Air Force / Airman 1st Class Scott Werner*

*Boeing 787-9 Courtesy of Gustavo Cañamero*

*Oil and Gas Exploration*

#### BOTTOM ROW

*Floating Production, Storage and Offloading (FPSO) Vessel*

*Turbine Controls Courtesy of H. Dimyadi*

*Steel Mill Controls*

**MOOG**

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