MTS Systems Corporation Overview
Presenter name, Title
Month 2017
Who are we?

» Leading global supplier of high-performance test systems and position measurement sensors
» Test and Sensors businesses help researchers, engineers and manufacturers improve their products
» 3,500 employees, $650M revenue (fiscal year 2016)
» 51 years strong

Mission
To be the innovation leader in creating test and measurement solutions to enable our customers’ success

Vision
Through innovation, create value to drive growth
Customer value creation and competitive advantages

» Test & Measurement solutions that bring value to our customers’ products through:
  – Enhanced precision
  – Improved reliability
  – Greater sustainability
  – Superior safety
  – Rapid delivery to market

» Differentiated technology and application engineering expertise

» Deep long-term customer relationships

» Industry-leading geographic coverage spanning six continents
Why MTS Systems Corporation?

» 50 years of Innovation
» World-class Engineering Capability
» Advanced Service and Support
» Industry-leading Geographic Coverage
50 Years of Innovation

» Cultural “Can Do” attitude to take on the most complex challenges

» More than 250 patents awarded globally since 1966

» Dozens of “first-of-a-kind” inventions

- Flat-Trac® Rolling Road Systems
- Full-Scale Seismic Simulation Systems
- High-Speed Rail Pantograph Shoe Wear Simulation
World-class Engineering Capability

» More than 500 engineers across 10 regional business centers representing virtually every engineering discipline represented within MTS – from mechanical to software, electrical to aerodynamics

» Typically awarded $250M in custom orders annually

» In excess of $4.5B worth of installed equipment around the world
Advanced Service and Support

» Local field service expertise with broad application knowledge across many test markets
» Longstanding personal customer relationships – an extension of our customers’ labs
» Differentiating service technologies to maximize equipment uptime
Industry-leading Geographic Coverage

» 36 Sales and Service Offices

» Supporting more than…
  – 50 Applications Engineers
  – 300 Field Service Engineers

» Augmented with key Business Partners to cover more than 80% of the globe
Strong global footprint to support geographically diverse customer base

**GEOGRAPHIC COVERAGE**
- Manufacturing Facilities
- Sales & Service Affiliates
- Business Partners
- BP Coverage

**GEOGRAPHIC REVENUE***
- Americas: $262M
- Europe: $197M
- Asia: $159M
- China: $164M

* Based on proforma fiscal year 2016 revenue
MTS History

» Founded in 1966 and spun off from Research, Incorporated
  – MTS originally stood for Materials Testing Systems
  – Formed to develop and market systems for the dynamic testing of the mechanical properties and performance of materials, products and structures

» Moved to present location in 1967

» 1984 – purchased Temposonics, Inc., now Sensors division

» 2008 – SANS acquisition in China

» 2014 – Roehrig Engineering Inc. acquisition in U.S.A.

» 2016 – PCB Group, Inc. global acquisition

» Manufacturing in U.S., Germany, Japan, and China

» Sales and Services offices all over the world
Why we are leading

MTS Company-Wide

» Differentiated technology and application engineering expertise
» Industry-leading geographic coverage
» Track record of capital deployment to increase shareholder value

Test Products

» Technology and scale to become Intelligent Lab provider
» Unrivaled engineering expertise
» Industry partnerships to define test methods

Ground Vehicles
Materials
Structures

Test Services

» Connectivity
» Global aftermarket support capability
» $4.0B installed base

Sensor Products

» Unique automation and safety value proposition
» Broad-based application knowledge
» Rapid innovation

Industrial
Automotive
Liquid Level
MTS operates under two segments and serves eight distinct market sectors

- **Test Segment** - provides highly engineered testing systems and services fueled by our customers’ spending on research and new product development
  - Sectors:
    - Ground Vehicles ~46% of Test business
    - Materials ~23% of Test business
    - Structures ~14% of Test business
    - Service ~17% of Test business

- **Sensors Segment** – provides high performance sensors used for acceleration, position, vibration, motion, pressure and force measurement, partially fueled by customers’ spending on research and new product development and partially by industrial capacity utilization
  - Sectors:
    - Position ~35% of Sensors business*
    - Test ~35% of Sensors business*
    - Industrial ~20% of business*
    - Systems ~10% of Sensors business*

*Pro-forma fiscal year 2016*
Research and development requirements drive growth for MTS

Increasing demands on product development pipeline requires increased capacity and productivity

Research and related challenges drive testing demand

OEM R&D Growth*

<table>
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<th>Region</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
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<td>5%</td>
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*30-Year Average

Vehicles Sales by Type

- Plug-ins incl. BEVs
- Full Hybrid
- Mild Hybrid
- Conventional including stop-start

Component Vibration | Electric Durability Test
Rolling Road Systems | MTS Pathway™ Plan (HSRC)
Outlook for R&D spending remains positive given the critical importance of product innovation

Strong global R&D spending growth of 5.2% annually since 2006

Although Y/Y spending was flat in 2016, recent trend includes five years of consistent growth from 2010-2015, increasing 6.0% annually.

R&D growth in Asia has outpaced growth in North America and Europe, becoming the number one region for corporate R&D spending

Opportunities to expand Service offerings – from increased uptime and productivity to comprehensive testing expertise
Environmental and energy conservation are driving explosive growth in ground vehicle and advanced materials testing.

CAFE standard for compact cars increases to 60 mpg by 2025, full-size car efficiency will also increase to 45 mpg.

Tire performance and durability as well as aero dynamic testing and advanced composite materials are critical to meeting new fuel efficiency standards.

Source: Car and Driver, November 21, 2014
Realize growth within rapidly expanding sensors market; strong growth forecasted over the next 5 years

» Broad sensor product offering with leading technical capabilities – Motion, position, pressure, force, load & torque, acoustic

» Sensors that facilitate
  – Continuing trend for increased automation and precision to drive productivity improvements
  – Enhance testing of products and decrease downtime
  – Meet expanding safety regulations
  – Increase reliability and data gathering to drive better decision making
Sensors Mobile Hydraulic opportunity: intelligent machines enable higher productivity, advanced safety and increased automation

- Motion control automation in large machine market is in early stage of adoption
- Continuing trend for increased safety regulations
- Automation provides measurable improvements in productivity
- MTS positioned to capture share in early stage of technology adoption; current adoption rate <10%
Product development professionals rely on MTS expertise and technology to optimize their designs, improve productivity and enhance time-to-market performance.

**INDUSTRIES** – aerospace, automotive, biomedical, geo-materials, civil engineering, energy, materials sciences, motorsports, rail

**CUSTOMERS** – OEM Research and development organizations, Quality Assurance labs, suppliers, governments and universities

**MTS ADVANTGES** – Global reach, application knowledge, scale, technology and performance

**SELECT AWARDS & CERTIFICATIONS**

- Quality, Environment, and Safety: ISO 9001, 14001, OSHA 18001; China Environmental Award 2013
- Results: Top 25 Minnesota Public Companies 2013
- Customer Recognition: Boeing Gold Supplier Award 2013; Ferrari Innovative Supplier of the Year 2010
Component and full-vehicle testing solutions for everything from motorcycles and passenger cars to heavy-duty trucks and rail vehicles.

APPLICATIONS
Measurement and simulation solutions to assess durability, vehicle dynamics and aerodynamics of full vehicles, subsystems & components

» Enables close collaboration with China’s largest domestic automotive OEM
» Provides platform for showcasing MTS capabilities and expanding influence in Chinese market
Enable the acquisition of precision measurements early in the development cycle for efficient benchmarking and optimization of component, system and full-vehicle performance.

PORTFOLIO

Kinematic and compliance (K&C) deflection measurement systems; Flat-Trac® roadways, wind tunnel rolling roads; tire force & moment measurement, rolling resistance measurement, and tread wear simulation systems; numerous subsystem-specific testing systems; elastomer, damper and component testing solutions; hybrid simulation technology (mHIL).

» Patented moving belt technology enables creation of realistic laboratory environment for evaluating noise, suspension performance, and fuel economy.
Enable high-fidelity replication of real-world test track conditions in laboratory environments for conducting accurate and repeatable studies of component, subsystem and full vehicle service lives.

**PORTFOLIO**

Spindle-coupled road simulators; tire-coupled road simulators; multi-axial simulation table (MAST) systems; numerous subsystem-specific testing systems; elastomer, damper and component testing solutions; industry-leading RPC® Pro software; hybrid simulation technology (HSRC).

» State-of-the-art controls and servohydraulics enable high-fidelity replication of real-world road conditions in six degrees of freedom.
Test – Ground Vehicles: Motorsports

Accurately and efficiently simulate real-world racing conditions in the lab or at the track to optimize Formula 1, Le Mans and NASCAR vehicle design, development and setup.

PORTFOLIO

Wind tunnel rolling road systems; tire-coupled road simulators (hydraulic & electric); kinematic and compliance (K&C) deflection measurement systems; tire force & moment measurement systems; engine transmission test systems; damper test systems (hydraulic & electric); advanced energy recovery technologies (electro-dynamic braking & electric turbo-compounding).

» Provides moving ground plane, critical for acquiring precise aerodynamic drag and down-force measurements
» Also used in passenger car development to help achieve higher fuel efficiency, lower emissions and less noise
Test – Materials

Testing solutions for materials science, aerospace, biomedical, and geomechanical industries.

APPLICATIONS

Characterization of material properties and behavior across a broad range of environments and loading conditions in support of materials research and development for product design

» Enables high-temperature testing of new gas turbine materials, including alloys and ceramic matrix composites
» Helps establish knowledge base for broadening the use of composites to develop more fuel-efficient aircraft designs

Photo courtesy of National Research Council - Canada
Greater fuel efficiency is increasing the need for lighter-weight materials. A complex segment of materials science, composite testing results in significant quantities data gathering and statistical analysis for characterization of material properties.

**PORTFOLIO**

New product offerings are the key to MTS' Materials test business growth. Expanding capabilities and areas of expertise continues to grow in the Composites field.


» Fatigue test of high strength composite material with equipment to characterize mechanical behavior.
Driven by demands of the turbine engine industry, engine performance envelopes are increasingly requiring higher operating speeds and temperatures. New materials are being developed that require sophisticated material characterization tests.

**PORTFOLIO**

New product offerings are the key to MTS' Materials test business growth. Expanding capabilities and areas of expertise continues to grow in the Composites field.


» Featured with our MTS Landmark Servohydraulic System, this standard solution was designed and validated to speed implementation of high-temperature materials testing.
Driving the technology and expertise researchers need to accurately and efficiently determine the physical characteristics of rock and concrete materials, components and structures for research, industrial and commercial applications.

APPLICATIONS
Compression, direct shear, direct tension, fracture toughness, indirect tension, triaxial and ultrasonic velocity

TRIAXIAL TESTING
Helps predict how the entire rock mass will respond to changes in load, stress, displacements, pore pressure, pore volume, failure and other conditions

» Researchers use these studies to yield insight into the specimen’s porosity, elastic constants, anisotropy, fluid saturation and other critical attributes.
Offering biomedical engineers and researchers advanced testing technology that helps characterize materials, validate designs, meet regulatory standards and ensure reliable performance.

PORTFOLIO

Orthopaedic Testing
Fatigue, wear and performance testing of large and small joint prosthetics, device and constructs

Biomaterial Testing
Metal, tubing, packaging, cements, wires

Device Testing
Fixation devices, components, plates, screws

Spine kinematic test solution offers greater understanding of the body’s mechanical behavior

» Whether the approach involves fixation techniques or the use of motion preservation devices, meaningful development requires extensive knowledge of the complexities of spine kinematics.

Photo courtesy of Institute of Technology, Tallaght (ITT Dublin)
Energy scarcity drives the need for testing new techniques to access reserves

Testing solutions for a wide range of large structures

» Civil engineering
» Wind power
» Oil and gas
» Seismic
» Fixed-wing aircraft
» Helicopters
» Space structures

Applications

Static & fatigue testing of structures such as aircraft, wind turbines, buildings, bridges and associated components & subsystems

» Pipe and pipe casings undergo immense pressure and corrosive environments
» Hard-to-access reserves require new drilling techniques

Photo courtesy of Coppe, Universidade Federal do Rio de Janeiro, Brazil
Aerospace Solutions are used for conducting static and fatigue studies of components and structures of fixed-wing aircraft, helicopters, launch vehicles and space structures.

PORTFOLIO

AeroPro™ Software; FlexTest® Controllers; MTS FlexDAC™ Data Acquisition Systems; SilentFlo™ Hydraulic Power Units; Active & Passive Load Abort Systems; Servohydraulic Test Actuators; Hydraulic Service Manifolds; and more.

» Enables advanced research into extending the service life of aging composite components and structures.

Photo courtesy of National Institute for Aviation Research (NIAR) at Wichita State University
Seismic simulation technologies and expertise to accurately and efficiently evaluate the behavior of building components and full-scale structures under true earthquake conditions within controlled laboratory settings.

APPLICATIONS
Large scale structural simulation, seismic simulation or complex hybrid simulation

HYBRID SIMULATION
Providing customer complex and innovative solutions to meet the demands of quasi-static, real-time and fast hybrid simulations

» The multiple shake tables aligned in adjacent trenches allow engineers flexibility to configure the test space to the structure specimen instead of the other way around.

Photo courtesy of Tongji University
Renewable Energy Solutions are used for simulating the complex and extreme loading environments wind and tidal turbines endure to improve their reliability and durability.

PORTFOLIO

Non-torque Loading (NTL) Systems for drive train and bearing testing; blade static test systems; GREX and IREX blade fatigue test solutions; seismic simulators for wind turbine tower testing.

» NTL at Narec’s 3MW Drive Train Test Facility - Atlantis Resources AR1000 Tidal Turbine shown

Photo courtesy of National Renewable Energy Centre (Narec) in the UK
Delivering productivity, reliability, connectivity and performance to your test lab

- Lab management through connectivity, equipment health monitoring, test tracking and superior onsite services, including installation, maintenance and repairs.

**APPLICATIONS**

MTS Echo™ Intelligent Lab, routine maintenance, calibration, condition monitoring, operator training, systems optimization, hydraulic fluid health management and technical support
Test – Service

Delivering productivity, reliability, connectivity and performance to your test lab

» Lab management through connectivity, equipment health monitoring, test tracking and superior onsite services, including installation, maintenance and repairs.

APPLICATIONS

MTS Echo™ Intelligent Lab, routine maintenance, calibration, condition monitoring, operator training, systems optimization, hydraulic fluid health management and technical support

Connecting you to your test and your lab the way you want to be connected

By adding connectivity to everything in the lab previously unconnected things

Can now become Intelligent and work together

Helping the entire lab run better than ever before!

- More Efficient
- Better Results
- Lower Cost
- Happier Customers

People
Equipment
Processes
Software
Reliable and rugged sensors improve machine uptime, reduce maintenance costs, and enhance safety

Precise, accurate measurement improves manufactured product quality

INDUSTRIES – Fluid power, metal working, plastics & rubber processing, renewable energy, food & beverage plants, printing, wood factory automation, drive technology, mobile equipment for construction, agriculture and mining

CUSTOMERS – OEM (Manufacturing, Vehicles, Medical), End Use Manufacturing, Energy Producers, Industrial Process Plants

MTS ADVANTAGES – Technology leader, unrivaled application expertise, worldwide support and consultation

SELECT AWARDS & CERTIFICATIONS


» Results: Control Design “Top Supplier Linear Position Sensors” 2013
Sensors – Position (~35% of Sensors Business*).

- Reliable and rugged sensors improve machine uptime, reduce maintenance costs, and enhance safety.
- Precise, accurate measurement improves manufactured product quality.

APPLICATIONS – Fluid power, metal working, plastics & rubber processing, renewable energy, food & beverage plants, printing, wood factory automation, drive technology, mobile equipment for construction, and agriculture and mining.

COMPETITORS – Balluff, Santest, Kangyu, TR Electronic, Heidenhain, Turk, Hydac, ASM

* Market size is based on all linear position sensors.

$1.8B* Market

PRODUCT MARKET GROWTH: 4%

MTS Sensors: R-Series

Customer Industry: Lumber Mills

MTS sensor integrated into a hydraulic actuator offers the precise linear feedback needed by the saw motion controller.

*Based on pro-forma fiscal year 2016.
Sensors – Test (~35% of Sensors Business*)

» Reliable sensors used by engineers and scientists
  – Take precise/accurate measurements
  – Facilitate technology advancements
  – Reduce development times and bring new products to market

$850M* Market

MTS 10% Share

PRODUCT MARKET GROWTH: 8%

APPLICATIONS – Research & Development, Structural Monitoring, Component & System Performance, Modal Analysis, Ground and Flight Testing for Aircraft

COMPETITORS – B&K, Dytran, GRAS, Kistler, Meggitt/Endevco

*Market size is based on an estimate of the current addressable market

Pressure Testing in Jet Engine

» Customer Industry: Aircraft Vehicles
» MTS Sensors: 176M0X with UHT-12™ technology
» The UHT-12™ crystal solves the pyroelectric noise problem found with ceramic based sensors. It eliminates the sharp spikes in piezoelectric sensor data after large temperature changes.

*Based on pro-forma fiscal year 2016
Sensors – Industrial (~20% of Sensors Business*)

» Rugged industrial vibration monitoring instrumentation and intrinsically safe sensors and signal conditioners
  - Survive in harsh environments, reduce downtime, increase production efficiencies, and protect critical industrial machinery
  - Detect dynamic pressure pulsations and vibration and accurately identify potential failures

PRODUCT MARKET GROWTH: 4%

APPLICATIONS – Monitoring & Assessment for Gas and Wind Turbines, Oil & Gas Wells & Pipelines, Nuclear Power Instrumentation, Vibration Monitoring for Motors, Pumps, Paper Machines, Machine Tools, Steel Rollers

COMPETITORS – Meggitt/Wilcoxon, Meggitt/Vibro-Meter, Meggitt/Endevco, CTC, Hansford, Murphy

$450M* Market
MTS 12% Share

*Market size is based on an estimate of the current addressable market

Wind Turbine Condition Monitoring

Customer Industry: Power Generation/Energy
MTS Sensors: 607 series
Some of the world's largest wind farms rely on our sensors to keep their wind turbine operations at optimal performance by increasing reliability and reducing downtime.

*Based on pro-forma fiscal year 2016
Sensors – Systems (~10% of Sensors Business*)

» Dynamic test, measurement, metrology and sensing systems as well as rental and calibration services used by engineers worldwide
» Used to test, model, and modify the dynamic behavior of structures and processes
» Noise and vibration monitoring instrumentation

$400* Market

MTS 7% Share

PRODUCT MARKET GROWTH: 11%

APPLICATIONS – Vibration/Pressure/Force Sensor Calibration, Modal Analysis, Experimental Sound & Vibration Testing, End of Line Product Testing

COMPETITORS – B&K, Kistler, LDS, MB Dynamics, Meggitt/Endevco, Spektra, Tira, Unholtz Dickie,

*Market size is based on an estimate of the current addressable market

Automated Test System

» Customer Industry: Automotive Ductile Iron Market
» MTS Sensors: NDT-RAM Automated Test System
» High speed, fully automated part testing with complete sorting and marking capabilities including a heavy duty design to withstand the most challenging foundry conditions.

*Based on pro-forma fiscal year 2016
be certain.

» Delivering innovation and value to customers through collaboration
» Resolve your testing challenges through industry-leading applications expertise
» Collaborate with a proven technology leader
» Choose from a broad array of solutions, tailored to your needs
» Maximize efficiency with responsive, expert global service and support
» Receive the best value for your investment
Daimler: Progression of Test Technology

» Situation
  – Sustained collaboration between MTS and Mercedes for over thirty years

» Constraints
  – Tool had to fit with their current development processes

» MTS Solution
  – MTS 329 Road Simulator

» Outcomes
  – Initial system able to replicate durability failures in laboratory environment
  – World-class vehicle durability quality at Daimler
  – MTS and Daimler now have a 30 year relationship that includes over 20 systems using the latest test equipment technologies
Audi: Roadway Technology

» Situation
  – Make the new Audi Q5 SUV have sporty handling characteristics with the ride comfort of A4 and A5 wagon cars

» Constraints
  – Interior noise level were derived from the wagon
  – Concept, cost and complexity: all components were required to display similarly standards as would be expected of a wagon in the upper midsize model category

» MTS Solution
  – MTS Flat-Trac® Dynamic Roadway System

» Outcomes
  – Use of “the finest rig testing technology made it possible to efficiently develop an SUV with a level of comfort and road dynamics comparable to a saloon car”
Nissan: mHIL Initial Development

» Situation
  - Design, build, and validate a new Hydraulic Body Motion Control System for a next generation SUV platform

» Constraints
  - Limited traditional design support
  - Multiple new technologies
  - Limited models and history

» MTS Solution
  - mHIL FCD: mechanical Hardware-in-the-Loop Four Corner Damper System

» Outcomes
  - FCD allowed Nissan to understand, characterize and debug new system and reach test track with a virtually zero problem system
Hyundai Mobis: mHIL Applied

» Situation
  – Design, build, and validate a semi-active suspension system (active air spring, CDC damper, air supply system, ECU, etc.)

» Constraints
  – Multiple vehicle development engineering disciplines needing a validation platform
  – Accelerated development timing
  – Limited access to prototype vehicles
  – Goal to "increase quality and functionality" of design

» MTS Solution
  – Mechanical Hardware-in-the-Loop (mHIL) Quarter Suspension Development System

» Outcomes
  – Able to develop and validate a semi-active suspension system, and enhance characterization
Toyota: High-Fidelity Driving Simulator

» Situation
  – Aggressive long-term goal with its vehicle development: zero traffic fatalities

» Constraints
  – Laboratory Installation (cannot expose drivers to dangerous situations on test track)
  – Must be realistic to real-world driving conditions

» MTS Solution
  – Driving Simulator with full visual, acoustic, and motion simulation

» Outcomes
  – Progressed development of vehicles that automatically sense and react to dangerous situations on the road.
  – Increased understanding of the affects of fatigue, illness, inebriation and cell phone use on driver performance
Ferrari: Kinetic Energy Recovery System

» Situation
  - Ferrari sought a supplier to develop state-of-the-art kinetic energy recovery system

» Constraints
  - High power density, high rotational speed, very small packaging space
  - Accelerated development timing
  - Extremely robust
  - No access to prototype vehicles; have to get it right before hitting the track

» MTS Solution
  - KERS: Kinetic Energy Recovery System

» Outcomes
  - Reduced design iterations from years to months
  - Ferrari recognized MTS capability with a supplier innovation award
### Acquired PCB Group, Inc.

- Transaction creates a technology-leading “Test and Measurement” solutions provider
- The combined company will serve a global customer base ranging from leading OEMs in automotive, aerospace, infrastructure and industrial products to universities and research laboratories

### Strategic Rationale

- Create a sustainable, technology-leading “Test and Measurement” solutions provider
- Achieve critical mass for sustainable value creation
- Cultivate attractive revenue growth and cost synergy opportunities
- Grow through service
- Combine complementary businesses
- Leverage global footprint

### PCB Overview

- PCB is a manufacturer of piezoelectric sensors and components used for motion, pressure, force and vibration measurement
- PCB's products include accelerometers, microphones, calibration systems, pressure sensors, load and torque sensors, force sensors, single- and multi-channel telemetry, ground fault detection and smart sensing solutions
## Strategic rationale for PCB acquisition

### Creates a sustainable, technology-leading “Test and Measurement” solution provider
- Strong focus on operational excellence
- Provide products to the Test business that are currently sourced elsewhere
- Strengthens Test Service position in calibration and builds a strong service footprint, especially in the US

### Critical mass for sustainable value creation
- Global footprint, diverse markets/customers, broad product portfolio
- Significantly broadens the Company’s sensors offering and adds piezoelectric as a major new core technology
- Embrace the PCB culture of competitive differentiation through product innovation and exceptional customer service

### Expand into adjacent markets
- Sensors would expand into pressure, acoustic, force, strain and vibration sensors
- MTS Testing products can be sold into PCB customer base
- Calibration is a large growth opportunity for existing PCB customers
Products and Systems

Test Ground Vehicles

Test Materials

Test Structures

Sensors