Ball Aerospace

Scott Whitehill
Director, Supply Chain Management
Ball Aerospace

NASA HBCU/MI Technology Infusion Road Tour
Aug. 14-15, 2018
The Ball story

A history of innovation & customer partnership.

JARS TO STARS

From sustainable metal packaging products to ground-breaking aerospace and defense solutions, we enable our customers to succeed – no matter the challenge or mission.
Ball Aerospace
Who we are is in all we do.

GO BEYOND WITH BALL®

We pioneer discoveries that enable our customers to perform beyond expectation and protect what matters most.
Capabilities & Products
Our technologies deliver mission success.

AEROSPACE
- Missions
- Sensors & Instruments
- Spacecraft
- Ground Systems
- Components

TACTICAL
- Antenna Systems
- Electro-optical Systems
- Anti-jam Systems
- Mission Systems Analysis
- Pointing and Tracking
- Cryogenic Fuel Storage

INTELLIGENCE
- Data Processing & Analytics
- Cyber Security
- Human-Machine Teaming
- Laser Effects Research
- Modeling & Simulation
- Enterprise Data Management
Uncompromising Integrity

ACCOUNTABILITY

Every day, we Go Beyond® for our customers, each other and our community by delivering innovative solutions, creating a diverse and inclusive working environment and giving back.
60+ Years of Collaborating with NASA

DELIVERING NEXT-GENERATION
SCIENCE & TECH

JWST  Hubble  WFIRST  Kepler/K2  New Horizons
IXPE  JPSS-1  LANDSAT  GMI

GO BEYOND.

9/24/18
Ball Supply Chain Management

- Define, develop, improve supply base
- Supplier assessment, approval
- Strategic make-buy process
- Technology/supply base expertise
- **Manage supplier relationships**
- Measure, report supplier performance

- Own, manage, optimize end-end performance of the Integrated Supply Chain (Material Flow)
- Agile data management
- Material planning
- Piece part value-add processing
- Material tracking, traceability, mgmt
- SCM data analytics

- Procure Direct Materials
- Solicit, evaluate, negotiate, award & manage subcontracts
- Procure indirect goods & services
- Sole source of legal authority/direction
- Support new business: acquisition strategy, supplier pricing
- Plan and execute small business plans
- Manage P card program

- **Supply Base Development**
  - Define, develop, improve supply base
  - Supplier assessment, approval
  - Strategic make-buy process
  - Technology/supply base expertise
  - **Manage supplier relationships**
  - Measure, report supplier performance

- **Material Flow**
  - Own, manage, optimize end-end performance of the Integrated Supply Chain (Material Flow)
  - Agile data management
  - Material planning
  - Piece part value-add processing
  - Material tracking, traceability, mgmt
  - SCM data analytics

- **Inventory & Distribution**
  - Ensure accuracy, document all receipts
  - Provide safe, effective storage & distribution of materials
  - Ensure proper, authorized release of materials to production
  - Provide required logistical support for program product delivery
  - Ensure product is properly and safely prepared for shipment
  - Establish cost effective shipping solutions

- **Acquisition**
  - Procure Direct Materials
  - Solicit, evaluate, negotiate, award & manage subcontracts
  - Procure indirect goods & services
  - Sole source of legal authority/direction
  - Support new business: acquisition strategy, supplier pricing
  - Plan and execute small business plans
  - Manage P card program

- **Verification**
  - Supplier quality management
  - Verification of incoming materials
  - Material traceability
  - Material testing
  - Dimensional measurement of hardware

- **Governance**
  - Maintain government-approved procurement system
  - Maintain BPL compliance
  - Maximize opps to small businesses, achieve acceptable rating by DCMA/SBA
  - Meet all Federal acquisition regulations
  - Comply with contractual financial reporting requirements
  - Maintain Environmental, Health and Safety compliance
Small Business Program

- 2012 NASA Small Business Industry Award (SBIA) winner
- 2011 DoD Nunn-Perry Mentor Protégé Award winner
- Completed NASA Mentor/Protégé agreement in support of OLI
- Actively participate in Small Business conferences

<table>
<thead>
<tr>
<th>AUDIT PERFORMANCE HISTORY</th>
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<tbody>
<tr>
<td>Year</td>
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<tr>
<td>2018</td>
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<tr>
<td>2016</td>
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<table>
<thead>
<tr>
<th>5-YEAR PERFORMANCE HISTORY</th>
<th>5-Year Overall Performance History*</th>
<th>5-Year NASA Performance History*</th>
<th>5-Year NASA Performance History*</th>
<th>Statutory Goals</th>
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<tr>
<td>Type of Small Business Concern</td>
<td>SDB</td>
<td>2.7%</td>
<td>2.2%</td>
<td>2.9%</td>
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<td>WOSB</td>
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<td>HUBZone</td>
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<td>VOSB</td>
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<td>1.5%</td>
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<td>SD/VOSB</td>
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<td>0.3%</td>
<td>0.2%</td>
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<tr>
<td>Total Small Business Content</td>
<td>32.4%</td>
<td>37.7%</td>
<td>30.5%</td>
<td>33.0%</td>
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</table>

*Percent of Subcontracted Work
Engaging with Universities/Colleges

Programs/missions
Research & development
Other

- Arizona State
- Boston University
- Colorado School of Mines
- Colorado State
- Columbia
- Florida International
- Georgia Tech
- Johns Hopkins
- Harvard
- Michigan State
- Montana State University
- Ohio State
- Ohio University
- Prairie View A&M
- U of Arizona
- U of California, Davis
- U of Colorado, Boulder
- U of Iowa
- U of Nebraska, Lincoln
- U of Texas, Austin
- Wilberforce University
- Wright State
How Do We Work Together?

**BUSINESS SYSTEMS**

- Robust accounting system
- Delineate costs
  - Labor
  - Material
  - Other direct costs
- Track labor hours, personnel
- Specified Labor Rates
- Ability to invoice
- Contracting
  - NDAs
  - Agreements
  - Intellectual Property
  - Conflicts of Interest
- Understanding of ITAR limitations
- Facility clearance for classified collaborations

**TECHNICAL AREAS OF INTEREST**

- Optical engineering
- Spacecraft engineering
- Instrument engineering
- Cyber
- Robotics
- 3D printing
- RF antennas
- Small satellites
- Artificial intelligence
- Mission analysis
- Algorithm development
- Advanced electronics
Example: Working with FIU

- Ball Aerospace subcontracted to Florida International University (FIU), a Minority Institution
- Worked with FIU on two mentor/protégé agreements

PROJECTS WITH FIU

Colorado Engineering, Inc. (CEI)
- FIU & Ball mentored CEI in the implementation of a Quality Management System
  - Readiness for AS9100 certification
  - International Traffic in Arms Regulations (ITAR) Training
  - Security Indoctrination Training including understanding the SF312
  - Electro-Static Discharge (ESD)
  - Lean Manufacturing Technology
  - Internal Audit Training (AS9100C)
  - Joint Personnel Adjudication System (JPAS)

Princeton Microwave Technology (PMT)
- FIU & Ball mentored PMT to improve delivery and enhance manufacturing performance
  - Enterprise Resource Planning (ERP) technology transfer and Manufacturing process technology support, including Selection of Enterprise Resource Planning tool
  - Readiness for AS9100 certification
  - Development of a layout for the protégé’s new facility that improved manufacturing efficiency and workspace utilization
  - Full and comprehensive Electro-Static Discharge training to improve workspace efficiency and safety
Let’s collaborate!

WE WANT TO GET TO KNOW YOU

Tell us more about:
- Your expertise
- Your business models
- Your desires
- What’s working/what’s not

CONTACT US

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Visit us online at ball.com/aerospace
Deep Space Exploration Overview

Chris McCaa
Lockheed Martin Space
Deep Space Exploration

August 15, 2018
Lockheed Martin Business Areas

**Aeronautics**
- Tactical Fighters
- Tactical /Strategic Airlift
- Advanced Development
- Sustainment Operations

**Missiles and Fire Control**
- Air and Missile Defense
- Tactical Missiles
- Fire Control
- Combat Maneuver Systems
- Energy

**Rotary and Mission Systems**
- Naval Combat Systems
- Radar and Surveillance Systems
- Aviation Systems
- Training and Logistics Solutions
- DOD Cyber Security

**Space**
- Surveillance and Navigation
- Global Communications
- Human & Robotic Space Exploration
- Environmental Observation Systems
- Strategic and Defensive Systems
- Strategic / Operational Command & Control Systems
Civil Space Locations

- **Palo Alto, CA**
  - GOES-R, GLM, SUVI

- **Sunnyvale, CA**
  - GOES-R, GLM, SUVI, Orion

- **Denver, CO**
  - Orion, GOES-R, Deep Space Exploration, Mission Operations, Advanced Programs

- **Houston, TX**
  - Orion

- **New Orleans, LA**
  - Advanced Programs, Orion, STS

- **Crystal City, VA**
  - Government Relations

- **Kennedy Space Center, FL**
  - Orion

- **Greenbelt, MD**
  - Hubble MO, SS&ES

- **Valley Forge, PA**
  - SS&ES

- **Huntsville, AL**
  - Advanced Programs, STS
Deep Space Exploration Mission History

- **Viking** 1975
- **Magellan** 1989
- **Hubble Space Telescope** 1990
- **Mars Global Surveyor** 1996
- **Cassini (Prop)** 1997
- **Lunar Prospector** 1998
- **Stardust** 1999
- **Mars Odyssey** 2001
- **Genesis** 2001
- **Spitzer** 2003
- **Mars Reconnaissance Orbiter** 2005
- **Phoenix** 2007
- **Juno** 2011
- **GRAIL Aeroshell** 2011
- **MAVEN** 2013
- **OSIRIS–REx** 2016
- **InSight** 2018
- **Mars 2020 Aeroshell** 2020
- **Lucy** 2021
- **Futre Opportunities**
How to Partner with LM – Mission Team

• Prime Investigator (PI)
  – Responsible for the overall content and execution of the mission
    • Typically determined around initial Announcement of Opportunity (AO)

• Co-Investigator Roles (Co-I)
  – Instrument contribution
    • Typically determined prior to final Announcement of Opportunity (AO)

• Mission Science Team member
  – Material testing / Data Analysis
    • Determined anytime from AO to post-mission

• How to partner with LM
  – Important to develop reputation in science community
    • Write papers on science, instruments or analysis capabilities
    • Become part of deep space assessment groups and steering committees (terrestrial planets, small body, outer planets, etc)
  – How/who to contact at LM
    • Beau Bierhaus (LM Advanced Programs Scientist): edward.b.Bierhaus@lmco.com, 303-971-4240
    • Tim Linn (LM Advanced Programs Sr. Mgr.): timothy.m.linn@lmco.com, 303-977-0659
How to Partner with LM – Supplier

• How to partner with LM
  – LM is always looking for flight proven, low mass, low power, low cost hardware options for deep space missions
  – Visit the Lockheed Martin Portal to get started
  – If you have questions getting started:
    • Michelle Butzke, LM Supplier Relations Manager: michelle.butzke@lmco.com

• Recent examples of procured hardware
  – Command and Data Handling avionics hardware (processors, interface cards, etc.)
  – Guidance, Navigation and Control hardware (star trackers, inertial measurement units, sun sensors, etc.)
  – Telecom hardware (small deep space transponders, power amplifies, antennas, switches, etc.)
  – Propulsion hardware (tanks, thrusters, latch valves, pyro valves, etc.)
  – Solar arrays
Phoenix Descent Captured by MRO
Competing in the AO Process: An Industry Perspective

NASA HBCU/MI Technology Infusion Road Tour
August 13-14

Kendall Nii
Senior Director, Program Management
## Four Operating Sectors at a Glance

<table>
<thead>
<tr>
<th>Aerospace Systems</th>
<th>Innovation Systems</th>
<th>Mission Systems</th>
<th>Technology Services</th>
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<tbody>
<tr>
<td>Autonomous Systems</td>
<td>Launch Vehicles</td>
<td>Airborne C4ISR Systems</td>
<td>Technology-differentiated, Mission Services and Training Systems</td>
</tr>
<tr>
<td>Strike Operations</td>
<td>Propulsion Systems</td>
<td>Cyber and Intelligence Mission Solutions</td>
<td>Logistics and Modernization of Military Equipment</td>
</tr>
<tr>
<td>Military and Civil Space Systems</td>
<td>Aerospace Structures</td>
<td>Land and Avionics C4ISR Mission Solutions</td>
<td>Global Sustainment Engineering and Support</td>
</tr>
<tr>
<td>Aircraft and Spacecraft Design, Integration and Manufacturing</td>
<td>Missile Products</td>
<td>Missile Defense and Protective Systems</td>
<td>New Innovative Logistics Products</td>
</tr>
<tr>
<td>Intelligence, Surveillance and Reconnaissance</td>
<td>Defense Electronic Systems</td>
<td>Navigation and Maritime Systems</td>
<td>Health IT</td>
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<tr>
<td>Protected Communications</td>
<td>Armament Systems</td>
<td>Space ISR Systems</td>
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<tr>
<td>Battle Management</td>
<td>Small Caliber Systems</td>
<td>Space ISRS</td>
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<tr>
<td>Missile Defense</td>
<td>Commercial Satellites</td>
<td>Engineering, Sciences and Technology</td>
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<tr>
<td>Space Exploration</td>
<td>Science and National Security Satellites</td>
<td>Civil Security and Public Safety Systems</td>
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<td>Advanced Technologies</td>
<td>Human Space and Advanced Systems</td>
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**科技创新系统**
- 发射车辆
- 推进系统
- 航空结构
- 导弹产品
- 防卫电子系统
- 武器系统
- 小口径系统
- 商用卫星
- 科学和国家安全卫星
- 空间组件
- 技术服务

**任务系统**
- 航空反导系统
- 网络和智能
- 任务解决方案
- 导弹防御和防护系统
- 导航和海上系统
- 空间ISR系统
- 工程、科学和技术
- 民用安全和公共安全系统
Our Products and Services for NASA’s AOs

**Dedicated Launch Free Flyer Spacecraft**
- Astrophysics, heliophysics, planetary and Earth science

**Shared Ride Free Flyer Spacecraft**
- ESPA ring mounted
- Propulsive ESPA rings

**Launch Services**
- Dedicated Pegasus
- Dedicated Minotaur-C
- Dedicated Antares

**Observatory and Integration and Test**
- Mission Integration

**Mission Operations**
- Complete suite of mission operations options from turn-key systems to on-site support

**Thermally Stable Structures**
- Deployable Booms and Trusses

**Cygnus Hosted Payload**
- Frequent flights to ISS orbit: 350 km, 51.6°
- Up to 1 year mission duration

**Sounding Rockets and Scientific Balloons**
- Management and execution
- Integration, test, operations

**MEV Hosted Payload**
- Geosynchronous or geosynchronous transfer orbit
- Mission duration up to 15 years
- Data delivered directly to SOC

**GEOStar Hosted Payload**
- Geosynchronous orbit
- Mission duration up to 15 years
- Data delivered directly to SOC
MIDEX
Heliophysics
PI: J. Burch
Mass: 536 Kg
Power: 250 W
Orbit: 1000 x 46004 km 90°
LV: Delta 7326
SC: L-M
Launch: 03-2000

WMAP
Astrophysics
PI: C. Bennett
Mass: 840 Kg
Power: 419 W
Orbit: L2 Lissajous
LV: Delta 7425
SC: GSFC
Launch: 06-2001

Swift
Astrophysics
PI: N. Gehrels
Mass: 1470 Kg
Power: 650 W
Orbit: 600 km Cir 20°
LV: Delta 7320
SC: NGIS
Launch: 11-2004

THEMIS
Heliophysics
PI: V. Angelopoulos
Mass: 126Kg x 5
Power: 37 W x 5
Orbit: 1.5Re x 10-30Re
LV: Delta 7295
SC: NGIS
Launch: 02-2007

WISE
Astrophysics
PI: N. Wright
Mass: 324 Kg
Power: 249 W
Orbit: 17 Re x 59 Re
LV: Falcon 9
SC: NGIS
Launch: 12-2009

TESS
Astrophysics
PI: G. Ricker
Mass: 324 Kg
Power: 249 W
Orbit: 17 Re x 59 Re
LV: Falcon 9
SC: NGIS
Launch: 2018

ICON
Heliophysics
PI: T. Immel
Mass: 258 Kg
Power: 240 W
Orbit: 550 km Cir 24°
LV: Pegasus
SC: NGIS
Launch: 2017

9 of the last 14 Explorer missions use our spacecraft
Industry Perspective on NASA AO Process

Science concepts meeting NASA requirements

- Teaming discussions
- Vet concepts
- Community Announcement

3-12 months

Teaming
- RFI, POD, re-proposals

Teamed!

Refine concepts
- Draft AO
- Freeze concept
- Start writing

6-12 months

AO release

Finish and submit the proposal (90 days)
- Wait….
- Answer Questions

Phase A selection!

Phase A
- Mature concept
- Submit the CSR

9-12 months

Submit CSR

Site visit
- Wait….
- Answer Questions

Selection for flight!

Site visit

Flight confirmation!

Phase C/D/E/F
- CDR, build, launch, operate
- Get science results

Science continues
Industry Perspective on NASA AO Process

• Responding to an AO is a marathon not a sprint
  – Getting an investigation selected for implementation takes several years
  – Great science is necessary to win, but
  – High risk always loses

• Examples of risk raisers
  – Poor traceability – unclear if instrument performance or mission design supports science objectives
  – Immature technology without good maturation plan
  – Proposed costs do not match cost models

• Engage with industry early in the process
  – Solicit industry input around the community announcement or before
  – Engagement can be formal (RFIs) or informal
    • Solicit our inputs to help define the mission and mission trades
    • Solicit our inputs to identify risks, costs, and fit
  – Select your team before the Draft AO release

Early engagement allows risk mitigation
Contact

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  – Senior Director, Program Management
  – 480-355-7787 or 480-261-4689
  – kendall.nii@ngc.com

• John Dyster
  – Senior Director, Business Development
  – 480-355-7739 or 480-435-5114
  – john.dyster@ngc.com
THE VALUE OF PERFORMANCE.