



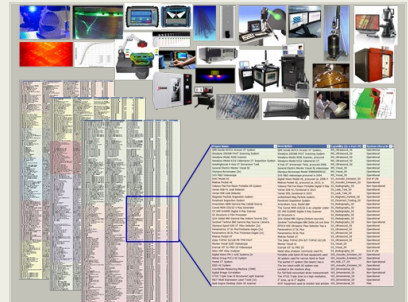
## Project Introduction

The most comprehensive assessment of NASA's Nondestructive Evaluation (NDE) capabilities ever attempted has been completed. NASA will use the information provided to prioritize areas requiring attention and capital investments. Led by Jess Waller of White Sands Test Facility and Bryan Bookhart of Kennedy Space Center, and in collaboration with the NASA Office of the Chief Information Officer, ten centers and the NASA Engineering Safety Center plus field locations were polled. This resulted in an inventory of over 500 pieces of NDE equipment valued in excess of \$40 million, and over 100 NDE services spread across 18 methods.

Following a 2016 NDE Capability Leadership Team assessment, opportunities for optimization were addressed, including aligning equipment with Agency needs, identifying capability gaps and growth areas, and improving mechanisms for cross-Center reliance. The project was funded by Eric Burke and the Office of Safety and Mission Assurance. Scores of NDE professionals engaged in research and development, engineering evaluations and production floor inspections were polled, allowing for better matrixed agency teams and the clearest picture yet of the current state of the discipline and agency risks. In addition to the enterprise architecture expertise and support provided by Bryan Bookhart, this project also interfaced with a 2020 software deep dive for NASA Headquarters conducted by Robert Moreland to uncover opportunities for shared agency NDE software licenses and potential cost savings.

According to Bryan Bookhart, "by understanding our capabilities from an enterprise perspective, we can also understand how we can improve and get the best use out of our resources in a way that most benefits the Agency as a whole. The NDE capability architecture/digital twin effort does just that." The result is a powerful, reliable, and maintainable model that reveals opportunities and concerns across the Agency for a given capability.

All told, 121 models or 'digital twins' were generated to represent NASA's current NDE capability. Each digital twin contains detailed information about a given NDE method at a given NASA center or field location. Each digital twin further breaks each NDE method into separate enterprise architecture categories. The categories chosen for the NDE model were 1) equipment, 2) software, 3) personnel roles and certifications, 3) tasks, 4) constraints (procedures and policies), 5) services used, 6) unique accessories (for example, hoists, vacuum and pressure equipment, and x-ray cabinets), and 7) services provided. The resulting Agency capability model highlights areas of unusual risks or costs and can identify opportunities for standardization and rationalization. The capability model can also be used to identify areas where additional investments are needed and how these investments can best serve the achievement of the organization's desired future state and strategy. Lastly, the model can serve as a critical and effective communications tool to bring visibility to NASA's vision, goals, future state, services, customers, systems/equipment, infrastructure, etc. in terms that are relevant and meaningful to stakeholders.



NDE Enterprise Model Data

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To facilitate retrieval and use of the information contained in the digital twins representing the current state of NASA's NDE discipline, a secure keyword searchable online tool is available that searches the digital twins for currently available NDE services and capabilities. The online tool can also be used to generate reports and graphical dashboards showing the current health and status of the discipline. Lastly, the search engine polls a main software engine with far richer, cross-agency and cross-discipline content. Dashboards have been generated from compiled data showing current personnel distributions, equipment utilizations and lifecycles, and capability levels at each Center and for each NDE method. Additionally, NDE enterprise data within the digital twin feeds into agency-wide dashboards. OSMA is committed to maintaining the system with annual polling. Along with performing annual updates, future plans include exploration and deepening of connections between NDE and other NASA disciplines such as structures, materials, and IT management.

### Anticipated Benefits

Following a 2016 Capability Leadership Team assessment, several challenges were identified to improve the effectiveness and efficiency of NASA's NDE enterprise. Among the challenges were retention of NDE personnel and expertise, prioritized capital investments in equipment, consistent Agencywide personnel certification, and improved mechanisms for cross-Center collaboration and reliance. These challenges are addressed by this 2020 assessment. In addition to increased collaboration and improved cost efficiencies, the NDE capability architecture/digital twin provides a living model, which reveals opportunities and risks across the Agency or for any given Center or NDE method.

### Organizational Responsibility

#### Responsible Mission Directorate:

Office of Safety and Mission Assurance (OSMA)

#### Lead Center / Facility:

White Sands Test Facility (WSTF)

#### Responsible Program:

Nondestructive Evaluation Program

### Project Management

#### Program Director:

Terrence Wilcutt

#### Program Managers:

Eric R Burke  
Jeannette F Plante  
Jason P Moore

#### Project Manager: Charles

T Nichols

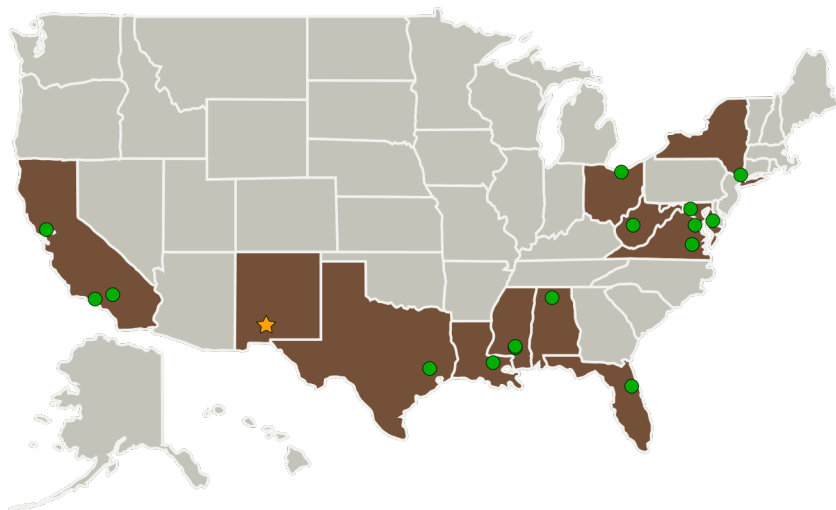
#### Principal Investigators:

Jess M Waller  
Bryan Bookhart

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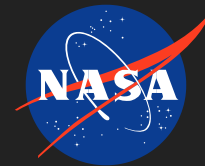
## Primary U.S. Work Locations and Key Partners



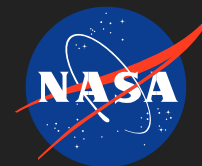
## Project Management (cont.)

### Co-Investigators:

Ajay M Koshti  
Kenneth Hodges  
David Farmer  
Larry Hudson  
Allen R Parker  
Kevin R Wheeler  
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Vincent Samuele  
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Antonia Moreno  
Grace Fischetti  
Ryan Kent  
Jonathan Smith  
Bruno Munoz  
Christopher Hoffman  
Allan Winters  
Christopher Greenwell  
Ryan Ross  
Edward Romero  
Michael Donahue  
Ian Luczon  
David M Stanley  
Jeffrey Loo  
Scott S Henricks  
Juan Lopez  
Robert Pitts  
Susana Harper  
Arturo Pardo  
Ralph E Lucero  
Tommy B Yoder  
Paul R Spencer  
Robert Scharf  
Randy Moore  
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Nathan Trepal  
Thad W Johnson  
Robert C Youngquist  
Bence B Bartha  
Elliott Cramer  
Russell A Wincheski  
David S Dawicke

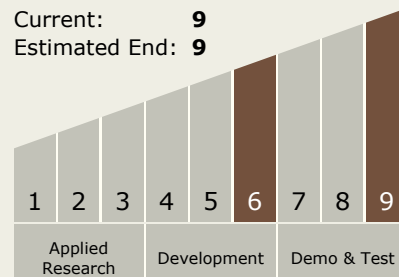


Organizations Performing Work	Role	Type	Location
★ White Sands Test Facility(WSTF)	Lead Organization	NASA Facility	Las Cruces, NM
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, CA
● Armstrong Flight Research Center(AFRC)	Supporting Organization	NASA Center	Edwards, CA
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, OH
● Goddard Institute of Space Studies(GISS)	Supporting Organization	NASA Facility	New York, NY
● Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, MD
● Independent Verification and Validation Facility(IV&V)	Supporting Organization	NASA Facility	Fairmont, WV
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, CA
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, TX
● Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, FL
● Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, VA
● Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, AL



## Technology Maturity (TRL)

Start: 6  
Current: 9  
Estimated End: 9



## Technology Areas

### Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.5 Nondestructive Evaluation and Sensors

## Target Destinations

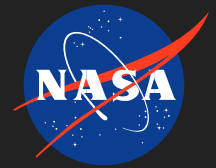
The Moon, Mars, Foundational Knowledge

## Supported Mission

### Type

Planned Mission (Pull)

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Organizations Performing Work	Role	Type	Location
● Michoud Assembly Facility(MAF)	Supporting Organization	NASA Facility	New Orleans, LA
● NASA Headquarters(HQ)	Supporting Organization	NASA Center	Washington, DC
● NASA Shared Services Center(NSSC)	Supporting Organization	NASA Facility	Stennis Space Center, MS
● Stennis Space Center(SSC)	Supporting Organization	NASA Center	Stennis Space Center, MS
● Wallops Flight Facility(WFF)	Supporting Organization	NASA Facility	Wallops Island, VA
<b>Primary U.S. Work Locations</b>			
Alabama	California		
District of Columbia	Florida		
Louisiana	Maryland		
Mississippi	New Mexico		
New York	Ohio		
Texas	Virginia		
West Virginia			

### Closeout Summary

To facilitate use of the information compiled by this project, a keyword searchable online tool is now available that can be used to search for NDE equipment, or to generate reports and graphical dashboards showing the current health and status of the discipline. For example, dashboards can be generated showing current personnel distributions, equipment utilizations and lifecycles, and capability levels at each Center and for each NDE method. Alternatively, dashboards for the entire Agency can be generated. OSMA has committed to maintaining the system with annual polling. Future plans include the exploration of synergies across structures, materials, software, and IT management within NASA.

### Dashboards



### *FTE/WYE and Systems/Infrastructure*

Includes two dashboards:

- FTE/WYE Dashboard - graphical display of FTE/WYE and Capability Level data for each Center and each Capability. Dynamically filter by numerous parameters including Center and capability
- Systems/Infrastructure Dashboard: graphical display of systems, utilization, and system life-cycle for each Center and each Capability. Dynamically filter by numerous parameters including Center, capability, and life-cycle.

### **Reports**

#### *Capability Elements Data Set*

Can see all model content for selected capabilities, Centers, and states

#### *FTE/WYE Detailed Report*

Shows FTE and WYE totals rolled up for each capability level starting from the individual Performers/Roles.

#### *Capability Measure Type (FTE/WYE/Capability Level) Data Set*

Provides a data file for selected capabilities, Centers, states, and Measure Types (FTE, WYE, Capability Level). Data set includes capability, Center, and measure type values. Note: Recommend using this data set for updating FTE/WYE data.

#### *Applications and Software*

Inventory report of NDE applications and software. Can be viewed by Center or by Capability

#### *Capability Summary Matrix*

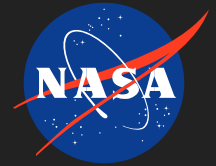
Summarized look at capability from an Agency perspective. Includes report by state. For a selected capability, the matrix shows each Center and their capability level, system utilization, FTE total, WYE total, and risk/cost values. Also includes overall Agency totals and averages for these values.

#### *Service Catalog*

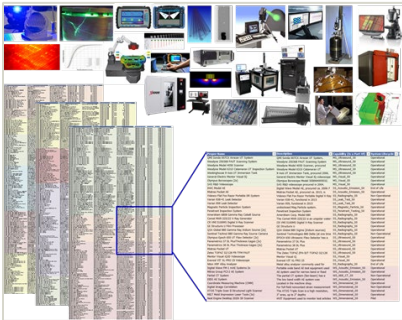
Search for a service across the Agency based on specific search parameters.

#### *Model Search*

Search across the entire model based on key word and object type. Returns objects and descriptions where the key word was found.



## Images



## NDE Enterprise Model Data

NDE Enterprise Model Data

(<https://techport.nasa.gov/image/39827>)

**Project Website:** [https://ea.ndc.nasa.gov/Reports/report/CMI/KSC/KSC\\_CNTR/NDE\\_Capability\\_Components\\_Report](https://ea.ndc.nasa.gov/Reports/report/CMI/KSC/KSC_CNTR/NDE_Capability_Components_Report)