



## The Role of ASNT in Supporting NDT Education and Research in the US

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**Abstract:** The speaker will present some aspects of NDT education and research in the US. To maintain impartiality, the presentation will provide historical and statistical data based on research related recognition and award programs offered by ASNT throughout the past decade. The presentation will discuss top recipient universities for each award and concentration areas of their research and engineering education. ASNT supports several programs to promote NDT engineering and research across the US. Among them are financial awards, such as the Fellowship Awards, Faculty Grants, Engineering Undergraduate Award and Student Travel Grants. Non-financial awards include Outstanding paper awards, Research Innovation Award, Sustained Excellence Awards, and the Ward Rummel Engineering Excellence Award. These programs have grown in recent years and continue to grow. In parallel, ASNT as well as other organizations are beginning to emphasize the role and responsibilities of the NDT Engineer. This will help drive future trends for new applications of NDT in the field. In fact, some technologies, like Additive Manufacturing, are being implemented prematurely in some cases, due to a competitive environment in manufacturing. These advancements are taking place faster than NDT can meet the demand. Other frontiers of NDT are driven not by academia but by industry, such as NASA with its futuristic plans for manufacturing in space, the automotive industry with their unending need for faster and cheaper mass production operations, and integration of robotics and artificial intelligence for large volume inspections of infrastructure.





# ***NDT Education and Research in the US***

***Shant Kenderian, PhD  
The Aerospace Corporation***

***29 May 2024***

## *Traditional Research*

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To report on the state of NDE research in the US, a historical review covering financial and nonfinancial awards granted by ASNT spanning a recent 10-year period is presented in this talk.

The purpose of the presentation is to report on the “state of research” and main thrust areas based on the research topics of ASNT award nominees and recipients.

# Research-Related Award

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Nonfinancial awards for research include

- *Outstanding Paper Award for Materials Evaluation*
- *Outstanding Paper Award for Research in Nondestructive Evaluation*
- *Research Recognition for Innovation*
- *Research Recognition for Sustained Excellence*

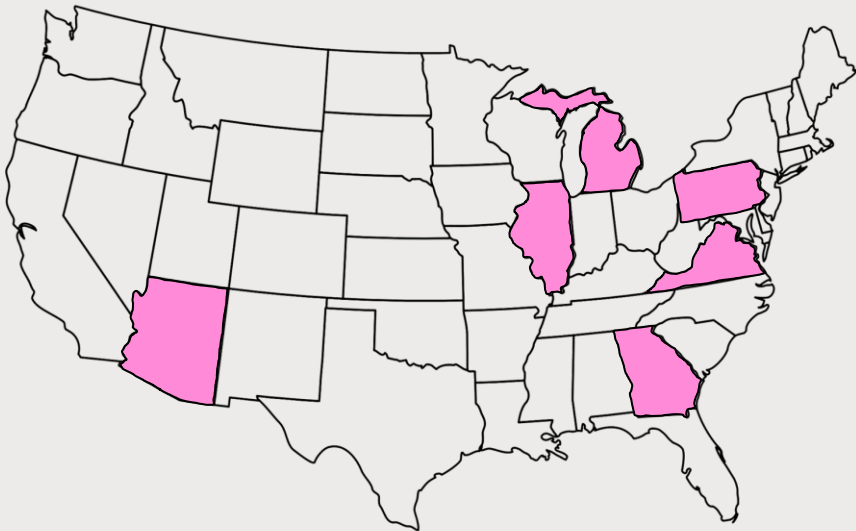
Financial awards for research total \$149k annually

- *Fellowship* (\$20k x 5 research proposals)
- *Faculty Grant* (\$10k x 2 for developing NDT curricula )
- *Engineering Undergraduate* (\$3k x 3 essays)
- *Student Travel* (\$1k x 20 travel expense reimbursement)



# Research Recognition for Sustained Excellence

## Nominations and Recipients

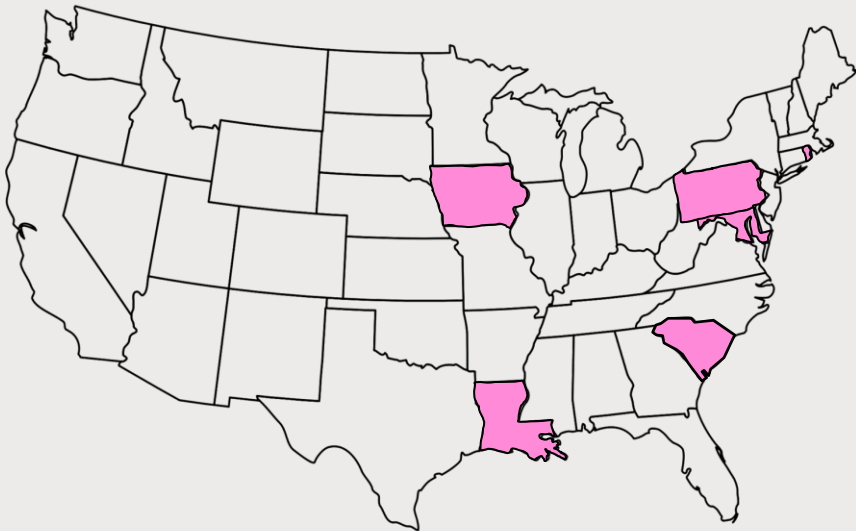


Institution	Nominated	Recipient
Michigan State University	5	1
University of Arizona	4	1
Pennsylvania State University	3	2
Southern Illinois University Carbondale	3	
Georgia Institute of Technology	1	
Indian Institute of Technology Ropar	1	
University of Illinois Urbana Champaign	1	1
University of Pittsburgh	1	
University of Windsor	1	
Virginia Tech	1	1



# Research Recognition for Innovation

## Nominations and Recipients



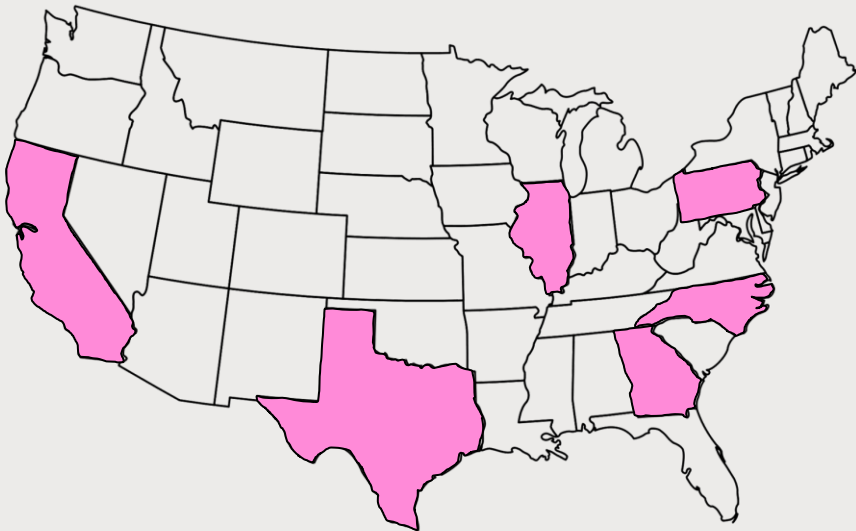
Institution	Nominated	Recipient
Clemson University, SC	3	
Drexel University	1	
Indian Institute of Technology Ropar	1	
Iowa State University	1	1
Louisiana State University	1	
National Institute for Standards and Technology	1	
University of London	1	1
University of Massachusetts Lowell	1	
University of Windsor, Canada	1	1





# Outstanding Paper Awards (ME and RNDE)

Recipients

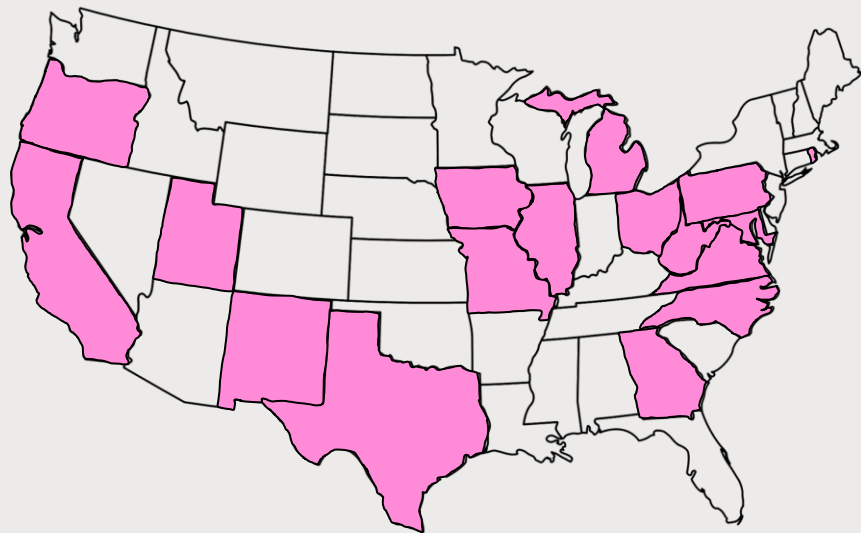


Institution	Recipient
University of Pittsburgh	2
University of Illinois at Urbana-Champaign	1
Indian Institute of Science	1
NASA	1
Southwest Research Institute	1
Pennsylvania State University	1
Free University of Brussels	1
The Aerospace Corporation	1
Saarland University, Germany	1
Georgia Institute of Technology	1
University of Bristol	1



# Fellowship Award (\$20k x 5)

## Nominations and Recipients



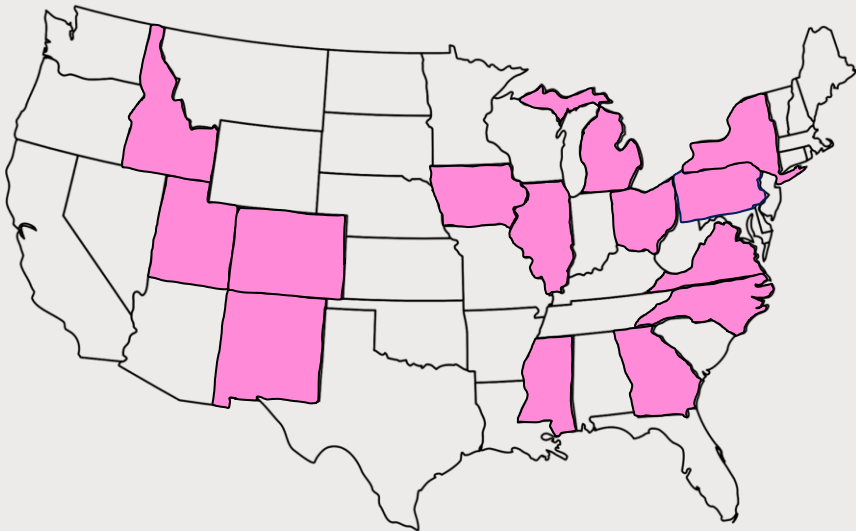
Institution	Nominated	Recipient
Iowa State University	19	10
Michigan State University	12	6
The University of Illinois at Urbana-Champaign	11	5
Missouri University of Science & Technology	12	4
Pennsylvania State University	10	4
Georgia Institute of Technology	12	3
University of Pittsburgh	7	3
Southern Illinois University, Carbondale	6	3
University of Texas at Austin	5	2
Drexel University	4	2
North Carolina State University	4	2
Texas A&M University	4	2
University of Maryland	9	1
New Mexico State University	6	1
Virginia Polytechnic Institute	5	1
University of California, San Diego	4	1
Case Western Reserve University	3	1
Brigham Young University	2	1
Northwestern University	2	1
Portland State University	2	1
West Virginia University	2	1
Massachusetts Institute of Technology	1	1





# Faculty Grant (\$10k x 2)

## Nominations and Recipients

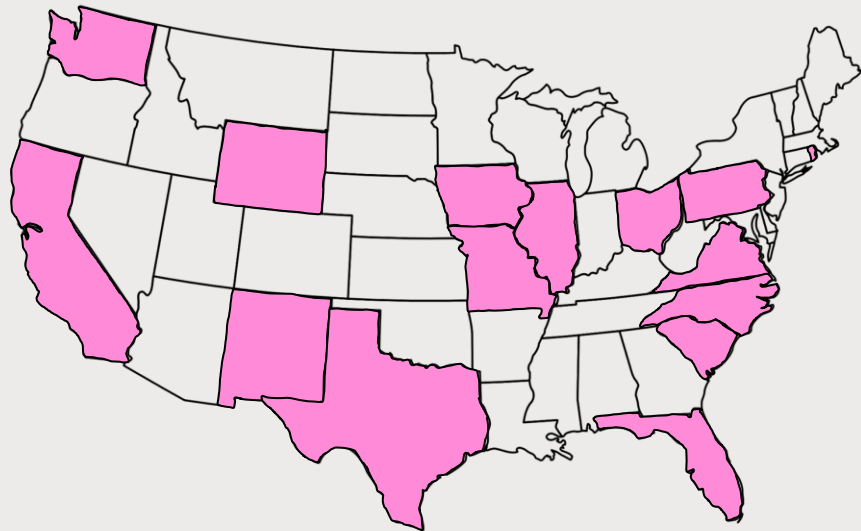


Institution	Nominated	Recipient
Southern Illinois University Carbondale	4	3
Georgia Southern University	3	2
Iowa State University	3	2
University of Idaho-Idaho Falls	2	2
Drexel University	3	1
New Mexico State University	2	1
New York University	2	1
University of Alabama at Birmingham	2	1
University of Utah	2	1
Michigan State University	1	1
North Carolina State University	1	1
Northern Illinois University	1	1
Ohio Northern University	1	1
State University of New York at Buffalo	1	1
University of Colorado Denver	1	1
University of Illinois at Chicago	1	1
University of Illinois at Urbana-Champaign	1	1



# Engineering Undergraduate Scholarship (\$3k x 3)

## Nominations and Recipients

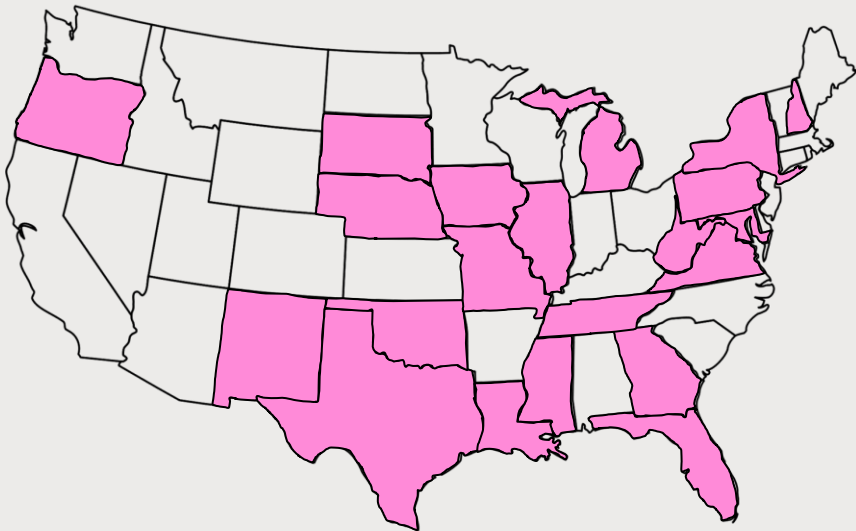


Institution	Nominated	Recipient
Southern Illinois University Carbondale	7	4
Missouri University of Science and Technology	3	3
Drexel University	2	2
Embry-Riddle Aeronautical University	4	2
Pennsylvania State University	2	2
University of Massachusetts Lowell	2	2
Baylor University	1	1
Clemson University	1	1
Iowa State University	4	1
James Madison University	1	1
North Carolina State University	2	1
Ohio State University	2	1
Old Dominion University	1	1
University of California - Berkeley	2	1
University of New Mexico	1	1
University of Texas at El Paso	1	1
University of Toledo	1	1
University of Wyoming	2	1
Washington State University	1	1



# Student Travel Grant (\$1k x 20)

## Nominations and Recipients



Institution	Nominated	Recipient
Missouri University of Science and Technology	35	26
Southern Illinois Carbondale	27	21
Georgia Institute of Technology	11	9
Pennsylvania State University	9	7
University of Nebraska - Lincoln	8	7
New Mexico State University	6	5
University of New York at at Buffalo	6	5
University of Alabama at Birmingham	6	5
University of Pittsburgh	6	5
University of Texas at Austin	5	5
Virginia Tech	7	5
Iowa State University	10	4
University of New Hampshire	5	4
West Virginia University	5	4
Michigan State University	4	3
University of Tennessee	4	3
Florida International University	2	2
Louisiana State University	2	2
Oklahoma State University	4	2
South Dakota State University	4	2
Portland State University	2	2
University of Maryland	3	2

Total 116  
Universities  
in the last  
10 years

Institution	Nominated	Recipient
Missouri University of Science and Technology	50	33
Southern Illinois University Carbondale	46	30
Iowa State University	37	18
Pennsylvania State University	27	16
Georgia Institute of Technology	27	13
Michigan State University	24	11
University of Pittsburgh	16	10
University of Illinois at Urbana-Champaign	15	8
New Mexico State University	15	7
Virginia Tech	15	7
University of Texas at Austin	11	7
University of Nebraska - Lincoln	9	7
Drexel University	13	6
University of Alabama at Birmingham	8	6
North Carolina State University	8	5
West Virginia University	7	5
University of New York at Buffalo	6	5
University of New Hampshire	5	4
University of Maryland	12	3
University of Texas at El Paso	8	3
University of Toledo	6	3
University of Tennessee	5	3
Portland State University	4	3





# Missouri University of Science and Technology

Professors	Areas of Research
Reza Zoughi	Microwave Millimeter Wave
Kristen Donnell	
Mohammad Tayeb Al Qaseer	



# Southern Illinois University, Carbondale

Professor	Areas of Research
Tsuchin Philip Chu	Thermography Image Correlation Ultrasonics Neural Networks Biomechanics Fracture Mechanics Composites





# Iowa State University

Professors	Areas of Research
Reza Zoughi	Microwave Millimeter Wave NDT Modeling
Steve Holland	Ultrasonics Thermography Composites Aerospace applications



# Penn State University

Professors	Areas of Research
Joseph Rose	Guided Waves Nonlinear Ultrasound GHz Ultrasound Radiography Thermography Modeling Additive Manufacturing Composites Biocomposites
Bernhardt Tittmann	
Clifford Lissenden	
Andrea Argüelles	
Christopher Kube	



# Georgia Institute of Technology

Professors	Areas of Research
Lawrence Jacobs	Ultrasound Guided Waves Nonlinear Ultrasound X-ray & Neutron Scattering Electromagnetic Testing Near IR Photoelasticity Modeling Additive Manufacturing Composites Health Monitoring
Jennifer Michaels	
Rosario Gerhardt	
Yang Wang	



# Michigan State University

Professors	Areas of Research
Lalita Udpa	Computational Models Signal and Image Processing Neural Networks Magnetic Field Imaging Microwave NDT
Satish Udpa	Electromagnetic NDE Methods Solution for Inverse Problems Aerospace Applications Biomedical Imaging



# University of Pittsburgh

Professor	Areas of Research
Piervincenzo Rizzo	Ultrasonics Nonlinear Ultrasound Civil Structures Railroad Inspection



# University of Illinois, Urbana-Champaign

Professor	Areas of Research
Henrique Reis	Sensor Development Concrete and Infrastructure Nonlinear Ultrasound Acoustic Emission Machine and Process Condition Monitoring Structural Health Monitoring Composites





# New Mexico State University

Professor	Areas of Research
Ehsan Dehghan-Niri  (now with Arizona State University)	Ultrasonics Nonlinear Ultrasound Biomimetics – Tap Testing Additive Manufacturing Civil Structures



# Virginia Tech

Professor	Areas of Research
John (Jack) Duke	Structural Health Monitoring Ultrasound Guided Waves Composites Additive Manufacturing Probability of Detection

# Gap Between Academia and Industry

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Academic institutions are addressing NDE research needs and advancing the frontiers of technology.

NDE Frontiers for industry are only partially met by academia, if at all

- In-situ monitoring of AM parts

Academia is making some progress.

- NDE with drones
- AI/ML

More is happening in non-NDE academic fields

- Robotics

More is happening in non-NDE academic fields

- NDE is space

# In-situ monitoring of AM and Manufacturing



The exploitation of AM processes continues to accelerate, driven by production schedules and cost saving.

However, these parts are being implemented into our structures faster than we can be ready for them.

Parts are often complex, and are more difficult to inspect. They also require very long build times.

The ultimate goal is to use in-situ NDE for “part health” not only “process” monitoring and provide a closed-loop control feedback to adjust parameters and “save the product”

# In-situ monitoring of AM and Manufacturing



When performed ex-situ on AM parts, it is old fashioned NDE

When performed in-situ

- The part is usually very simple
  - Cylinders or bars
  - Small in size, a few inches
- Measurements sometimes have ambiguous purpose
  - Melt pool size and temperature
  - Surface roughness
- Mostly, in-situ NDE is a concept not a deployable tool
  - Eddy current of a point on the surface
  - UT velocity measurements of part with changing temperature and layer thicknesses



## *Material Evaluation July 2023 Technical Focus Issue on AI/ML in NDT*

“Tips for Effective Machine Learning in NDT/NDE”

– *NDT Tutorial: Joel Harley, Suhaib Zafar, and Charlie Tran*

“Application of Machine Learning Techniques for Acoustic Data Processing in Additive Manufacturing Process Monitoring”

– *Technical Review Article by Hossein Taheri and Suhaib Zafar*

“Real-time AI-driven Interpretation of Ultrasonic Data from Resistance Spot Weld Process Monitoring for Adaptive Welding”

– *Technical Article by Ryan Scott, D. Stocco, A. Chertov and Roman Gr. Maev*

“Acoustic Emission Source Localization using Deep Transfer Learning and Finite Element Modeling-based Knowledge Transfer”

– *Technical Article by Xuhui (Josh) Huang, Yiming Deng et al.*

“Validated and Deployable AI/ML for NDT Data Diagnostics”

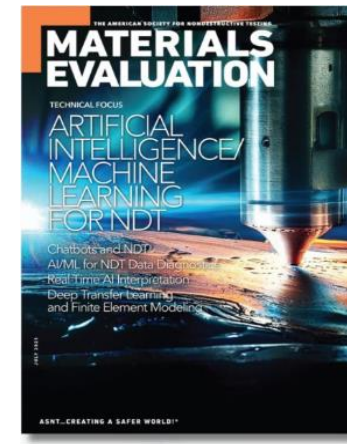
– *Feature Article by Eric Lindgren*

“Benefits and Risks of Using Emerging AI Chatbots with Work in NDT”

– *Feature Article (with Interviews) by John C. Aldrin*

“Nurturing Generative AI – Balancing Innovation and Responsibility”

– *NDT Outlook Article by Ripi Singh and Vaibhav Garg*



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<https://source.asnt.org/1vofmq8/>

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# Drones



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With technology advancement in cameras, visual inspection is the primary inspection method using drones. The method however is limited in finding internal damage or small defects.

Other noncontact methods were easily integrated with drones, such as thermography.

Later developments include contacting probes, such as temporarily attach piezoelectric transducers onto a specific regions, and are equipped with data acquisition systems for data storage and processing.

# Space



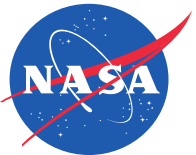
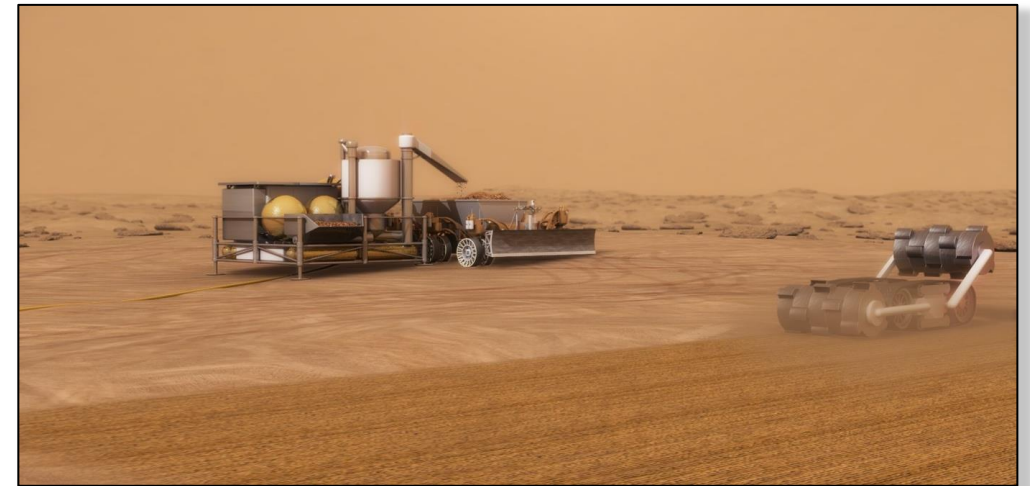
## Initiatives to establish outposts on the Moon and Mars

- **In-Space Manufacturing (ISM)**
- **In-Situ Resource Utilization (ISRU)**

NDE Tools are required for

- ISRU resource assessment for ISM
- Compositional analysis of raw materials
- Integrity of ISRU AM-printed structures

ISRU system concept for autonomous robotic excavation and processing of Mars soil



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# Space

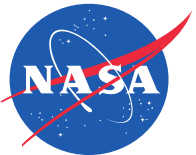


## NASA will need to support these initiatives with NDE inspectability in mind

After 60 years of rocket building, we still don't know how to fly one without NDE

There is already an inherent need to inspect, verify and validate complex systems prior to flight (on earth).

There is a emerging need to inspect future ISM and ISRU hardware in its fabrication and service environment...space.



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Thank You