UNITED STATES DEPARTMENT OF TRANSPORTATION

STRATEGY REPORT ON THE

STATE OF ROBOTICS IN TRANSPORTATION

Developed by the Nontraditional and Emerging Transportation Technology (NETT) Council

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DOTBots

Contents

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Introduction

Purpose

This document summarizes the strategic outlook of the United States Department of Transportation (DOT or the Department) for encouraging the further adoption of advanced robotics into transportation. In furtherance of its mission, DOT promotes the use of new and emerging technologies, such as advanced robotics, with potential to improve transportation safety, efficiency, affordability, and project delivery. Today, robotics technologies are being used for numerous applications in transportation, including safety inspections, maintenance, and construction. The Department is positioned to build upon and expand investments into these and other use cases through its operations, funding, research, and other tools.

This DOT Robotics Strategy Report presents:

- Findings on the current state of advanced robotics applications across the Department and in the transportation sector.
- Challenges that might constrain the deployment of advanced robotics technologies in transportation.
- Strategic actions that will position DOT to further promote and facilitate technology adoption.

The report represents the work of the Department's Nontraditional and Emerging Transportation Technology (NETT) Council, performed through its Advanced Robotics Working Group (ARWG). The NETT Council is DOT's internal body for coordinating issues involving nontraditional and emerging transportation technologies to reduce, to the maximum extent practicable, impediments to the prompt and safe deployment of new and innovative transportation technology. The NETT Council was established in December 2018 by DOT Order 1120.34 and later authorized as described in Section 25008 of the Infrastructure Investment and Jobs Act (IIJA, Pub. L. No. 117-58) and codified at 49 U.S.C. § 313.

Motivation

Robotics have advanced significantly over the last decade, driven by rapid developments in artificial intelligence (AI), computer vision, battery performance, and other foundational technologies. Though the United States leads in the development of robotics capabilities and boasts numerous advanced robotics companies, it faces steep competition from foreign nations.

Broader adoption in the transportation industry has the potential to improve the safety, resiliency, reliability, and efficiency of construction, operation, and maintenance of the transportation system. However, public sector stakeholders are often constrained in their ability to experiment with new technology due to funding limitations and risk aversion, which slows the benefits of these technologies in reaching the public.

The Department, therefore, launched an Advanced Robotics Initiative to identify how DOT's resources and influence can be leveraged to further integrate robotics into transportation safely in a manner that supports American innovation.

Report Scope

The term "robotics" is both broad and subjective. Therefore, establishing the scope is critical to establishing and appropriately focusing a Departmental robotics strategy with an eye toward platforms and applications that are not already the subject of significant DOT attention but are nonetheless within the Department's purview.

For the purposes of this report, DOT adopted the following working definition, informed by the work of other Federal agencies and standards organizations:

Electromechanical devices that are capable of locomotion, navigation, or movement and operate at a distance from one or more operators or supervisors based on commands or in response to sensor data, or through any combination thereof.[1]

Several additional considerations informed the scope and focus of this document:

- Unmanned Aircraft Systems (UAS), where used as a platform to perform tasks that support the operation, maintenance, or safety of the transportation system, *are* within scope for this report as a form of robotics. The report *does not*, however, focus on private sector services that may leverage UAS (*e.g.*, for goods delivery) or the policy environment governing the use of UAS in the national airspace. For additional information on the integration of UAS into the national airspace, see www.faa.gov/uas.
- Driving automation systems, including Automated Driving Systems (ADS), are *not* a focus area of this document, allowing DOT's robotics strategy to highlight other promising technologies corresponding to its working definition. Automated Driving Systems, in

[1] Adapted from the definition of "Covered Unmanned Ground Vehicle System" included in the *Servicemember Quality of Life Improvement and National Defense Authorization Act for Fiscal Year 2025*, Pub. L. No. 118-159, 138 Stat. 1773 (2024).

particular, share many characteristics with robotics, and in some contexts might be considered one in the same. However, DOT already has extensive work underway focused on ADS as a standalone technology, with an emphasis on enabling commercial deployment of ADS-equipped vehicles.[2]

- This report does not focus on robotics applications where DOT's role in promoting deployment is limited. For example, the use of robots to perform local goods delivery via sidewalks is a private sector-led endeavor where oversight is generally executed at the local level.[3] Similarly, robotics are increasingly being leveraged in warehouse facilities which, though a key element of the Nation's supply chain, are generally beyond the reach of DOT's direct influence.
- Certain automated technologies may perform similar tasks as robotics, but nonetheless did not fit the working definition of robotics adopted in this document. For example, the rail and on-road logistics industries have both started to employ stationary inspection systems that can automatically scan a subject vehicle as it passes through. This concept may serve a similar function as a remote sensing robot, but its stationary nature kept it outside of the scope of this report.

Advances in Robotics and Applications to Transportation

The robotics field has experienced significant development in recent years, enabling new and enhanced capabilities. Progress in foundational fields has been instrumental, including:

- Artificial Intelligence. Developments in AI, including machine and deep learning, and more recently, large language models (LLMs), embodied AI, and agentic AI, have rapidly increased the ability of machines to learn new and more complex tasks. In robotics, this has led to higher levels of performance in sensing and perception, locomotion, and object manipulation.[4]

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[2] See, for example: https://www.nhtsa.gov/vehicle-safety/automated-vehicles-safety

[3] Cregger, Joshua et al., "Emerging Automated Urban Freight Delivery Concepts: State of the Practice Scan," United States Department of Transportation Intelligent Transportation Systems Joint Program Office, November 2020, FHWA-JPO-20-825, available at: https://rosap.ntl.bts.gov/view/dot/53938.

[4] https://ai100.stanford.edu/gathering-strength-gathering-storms-one-hundred-year-study-artificial-intelligence-ai100-2021-1/sq2

- **Simulations and Digital Twins.** Advancements in simulations and digital twins aid in the training of robots before and after their deployment in the real world. These advancements eliminate the need for slower and more expensive physical trial and error testing. Robots trained using digital twins and simulations have most of the necessary experience to navigate and perform assigned tasks in the real-world, though they may require some fine-tuning to bridge the simulation to real world gap.[5]
- **Hardware Cost and Performance.** Improvements in the cost and performance of critical components, such as actuators, batteries, and semiconductors, have led to the development of robots with more reliable, adaptable, and affordable capabilities.[6]

Taken together, these developments have enabled:

- **A shift from highly programmed, single-task, automated systems to autonomous systems** capable of adapting to less structured environments and more flexible tasks. Though automated robotics systems are programmed to carry out specific tasks automatically in a predefined environment, autonomous robotic systems, such as embodied AI, utilize technologies to sense the surrounding environment and react appropriately to carry out an assigned task.[7] Autonomous robotic systems have the potential to be deployed in more complex, unstructured environments and work safely alongside humans within the same space. As an example of this evolution, automated robots have long been used in manufacturing settings to perform repetitive tasks in the controlled environment of an assembly line. More recently, manufacturing plants have leveraged the adaptive capabilities of autonomous robots to move equipment and inventory around entire facilities, including in less controlled spaces alongside human workers.[8]
- **Developments in multi-purpose robotics that replicate the movement of humans (*i.e.*, "humanoid robots") and animals (*e.g.*, "quadruped robots").** Quadruped robots have started evolving from experimental devices to commercial products being applied to an array of uses, including for inspections, incident response, security, and investigation and

[5] Jad Abou-Chakra et al., "Real-is-Sim: Bridging the Sim-to-Real Gap with a Dynamic Digital Twin," *arXiv preprint*, submitted April 4, 2025, last revised July 2, 2025 (https://arxiv.org/abs/2504.03597).

[6] https://www.ey.com/en_gl/insights/innovation/three-tailwinds-for-robotics-adoption-in-2024-and-beyond; https://www.massrobotics.org/6-trends-shaping-robotics-and-ai/

[7] https://www.nvidia.com/en-us/glossary/embodied-ai/

[8] https://www.iotworldtoday.com/robotics/ai-enabled-robotic-autonomy-the-next-evolution-in-manufacturing-automation

disposal of suspicious packages.[9] The extent to which they have been deployed in the field remains limited, but is growing. Meanwhile, humanoid robots have gained significant attention in the last several years, with capabilities that are improving rapidly. At the time of publication of this report, humanoid robot developers are planning several real-world pilots over the next year, primarily in manufacturing environments and warehouses.[10]

Current Robotics Applications in Transportation

The most common applications of robotics in the transportation sector (not limited to DOT-funded or -operated examples) generally focus on tasks in the following areas:

- Inspections: A variety of robotics platforms, including UAS, climbing robots, and other specialized platforms equipped with sensing equipment, are being deployed to inspect transportation infrastructure and vehicles. The utilization of robots for inspections can reduce the inspection times, expand inspection data availability, and increase safety for human inspectors. Examples of inspection robots have emerged in aviation, surface transportation, and maritime transportation including for inspecting road and rail bridges, rail geometry and structural health, runways, aircraft, ship hulls, and pipelines.[11]
- Maintenance and Operations: Robots have been deployed to perform operations and maintenance tasks on transportation assets, including filling potholes on roads, clearing debris from runways, and cleaning ship hulls.[12]
- Construction: Specialized robots have been developed and demonstrated to perform specific and repetitive tasks in infrastructure construction, for example, tying rebar in bridge decks.[13]
- Security: UAS and quadruped robots are currently deployed in security and surveillance applications. In transportation, these capabilities have been applied to monitoring access

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[9] https://bostondynamics.com/blog/retrospective-on-boston-dynamics-spot-robot-uses; https://erp.today/ifs-boston-dynamics-bring-physical-ai-to-field-operations/

[10] For example: https://bostondynamics.com/blog/boston-dynamics-unveils-new-atlas-robot-to-revolutionize-industry/; https://www.articsledge.com/post/ai-humanoid-robots

[11] https://news.mst.edu/2025/10/missouri-st-researchers-robotic-bridge-inspection-system-earns-asces-2025-pankow-award/; https://www.mdpi.com/2076-3417/13/11/6484; https://www.mdpi.com/2072-4292/14/18/4472; https://www.mdpi.com/2226-4310/12/1/31

[12] https://www.mdpi.com/2412-3811/9/11/210; https://www.ukri.org/news/world-first-ai-robot-for-tackling-the-pothole-problem/; https://www.hullbot.com/

[13] https://www.constructionrobots.com/tybot

to active construction sites, sensitive infrastructure, and maintenance yards along with other facilities.[14]

See Appendix A for a list of current robotic developments, pilots, and applications of robotics in the aviation, ground, and maritime transportation modes.

Robotics Applications Within DOT

DOT's Operating Administrations—including the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), Federal Transit Administration (FTA), and Pipeline and Hazardous Materials Safety Administration (PHMSA)—are actively researching, applying directly, or funding the application of robotics to transportation use cases. Infrastructure inspection appears to be the most common use case across DOT agencies, leveraging a combination of sensor arrays and robotics platforms. UAS tends to be the most common robotics platform in use, though they may also be complemented by specialized robots designed for climbing structures or navigating pipelines or rail tracks.

- FHWA: FHWA's Nondestructive Evaluation (NDE) research program develops and advances technologies and sensing tools to assess the condition of highway infrastructure without causing damage.[15] Its work includes the application of advanced robotic platforms, including crawlers, robotic arms, unmanned ground systems, and UAS to enable safer, more consistent, and more efficient data collection in the field. The FHWA NDE Lab also uses robotics to take measurements as part of its research, as does the FHWA Hydraulics Research Program, which uses robotics to position sensors, maneuver samples, sculpt channels and generate waves to create test conditions, and collect data. FHWA Structural Steel Additive Manufacturing (AM) Research Program is developing a structural design framework that facilitates safe and effective implementation of AM technology in highway design and construction. AM has the potential to free the designer to create innovative freeform shapes while also providing a cost-effective means to fabricate complex connection details. FHWA's Exploratory Advanced Research Program and Advanced Digital Construction Management Systems Program also include a focus on robotics and the

[14] https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/research-notes/task4288-rrs-08-25-a11y.pdf; https://erp.today/ifs-boston-dynamics-bring-physical-ai-to-field-operations/

[15] https://highways.dot.gov/turner-fairbank-highway-research-center/labs/nondestructive

agency is currently funding a pooled fund study to develop UAS data collection standards for leading use cases such as surveying, construction inspection and bridge inspections.[16]

- FRA: FRA leverages robotics in numerous aspects of its track safety work, including using UAS to inspect and measure rail grade crossings for potential safety issues and purpose-built automated track inspection platforms to inspect rail geometry and other characteristics automatically.[17] Through its Automated Track Inspection Program (ATIP), FRA has developed a fleet of specialized inspection vehicles that, while in some cases based on a conventional railcar, nonetheless fit DOT's scope for robotics given their task autonomy and mobile nature. These inspection vehicles allow rail components to be inspected autonomously without disrupting operations. FRA uses ATIP data to assess the effectiveness of railroads' track maintenance and inspection processes and to inform FRA's manual inspection activities.
- FTA: Like FRA, FTA is exploring the use of robotics—including UAS—to inspect rail components and grade crossings for anomalies and potential safety issues, automatically, remotely, or both. FTA also plans to explore the potential for robotics to help improve accessibility of transit vehicles, allowing independent use of boarding/alighting and securement systems by people with disabilities.
- PHMSA: PHMSA has funded the development of numerous robotics platforms using an array of sensors to conduct inspections of both piggable and unpiggable pipelines for defects such as cracks, corrosion, and mechanical damage.[18] The robotics developed for these use cases have ranged from relatively simple four-wheeled devices to custom snake-like robots that use a variety of propulsion mechanisms to navigate a pipeline. Examples include remotely operated, semi-autonomous, and fully autonomous robotics platforms.

Findings

This section highlights opportunities, challenges, and constraints related to the deployment of robotics in transportation. Findings were informed by a review of available literature and information collected from across the Department.

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[16] https://pooledfund.org/Details/Study/1789

[17] https://railroads.dot.gov/railroad-safety/partnerships-programs/automated-track-inspection-program-atip

[18] "Pigs" are devices used by the pipeline industry to scrub, scrape, or inspect the inside of a pipeline (see https://primis.phmsa.dot.gov/comm/glossary/index.htm).

Current and Potential DOT Investments in Robotics

In general, DOT's Operating Administrations are exploring the most common and mature examples of robotics in transportation identified in the broader literature. The Department's work covers remotely operated and automated robotics and is increasingly exploring the potential for robotics with autonomous capabilities, aligned with developments in the broader robotics field. Similarly, the Department's work is focused on the most common practical and established use cases. However, opportunities remain for the Department to help expand and routinize current applications in its own work and amongst stakeholders, and to explore how new and emerging robotics capabilities could be applied to transportation.

Opportunities for Deploying Robotics in Transportation

Advancements in robotics offer potential benefits to the transportation industry, including in the areas outlined below.

Enhanced Worker Safety

Robotics can be used to reduce risks to workers in the transportation industry. For example, using a UAS or climbing robot to inspect a bridge component or other tall structure can allow an inspection worker to remain on the ground while still collecting necessary inspection data. Robotics used in construction, operations, and maintenance tasks may similarly allow transportation workers to remain out of harm's way on a construction site or in a roadway work zone. In security applications, robotics can help to perform surveillance tasks (for example, on a construction site or around sensitive transportation infrastructure) without requiring a patrol officer to enter dangerous environments.

Expansion of Data Availability

Robotics, particularly when used to perform inspection tasks, can vastly expand the amount of data collected compared to conventional inspection tools and practices. Robots can offer a more expansive vantage point (*e.g.*, directly over a rail grade crossing); reach difficult or dangerous-to-reach locations; operate continuously; and deploy a multitude of sensors simultaneously. This expansion in data availability can allow transportation stakeholders to identify safety and operational concerns faster, more comprehensively and proactively, and with greater precision and accuracy. Wider data availability can also form the foundation to develop and apply other technologies, such as digital twins. In many cases, this expansion in data collection capability can complement, rather than replace, insights offered by up-close inspection by an experienced professional.

Enabling New and More Accessible Capabilities

In addition to improving and expanding how existing tasks are performed, robotics can enable the development of entirely new capabilities or substantially reduce the cost of capabilities that are prohibitively expensive or high-risk if performed through other methods. For example, the cost of data collection frequency, precision, and extent enabled by some forms of inspection robotics could be difficult to justify using other approaches. In the case of inspections performed in high-risk environments, such as low-oxygen conditions, risk mitigation measures add cost and complexity that can be reduced or eliminated through the use of a robot.

Deployment and Application Challenges

The following challenges may limit the Department's ability to invest in and encourage the deployment of advanced robotics by transportation stakeholders. This list is not comprehensive but instead represents the most notable and specific issues that arose from DOT's initial work in this area.

Regulatory and Policy Constraints

Existing requirements and guidance, developed prior to the recent advances in robotics, may limit the extent to which robotics can be used. For example, FHWA's National Bridge Inspection Standards (NBIS) require a hands-on inspection (defined as: "Inspection within arm's length of the member. Inspection uses visual techniques that may be supplemented by nondestructive evaluation techniques") of Nonredundant Steel Tension Member (NSTM).[19] Similarly, FRA requires visual track inspections, optionally supplemented by other methods.[20] These types of requirements may either preclude the use of robotics to conduct inspections (including remotely operated examples), or require redundant inspection practices, even if they can be proven to provide equivalent inspection results, accuracy, and reliability. Further exploration is necessary to determine the degree to which this creates barriers to deployment and what action, if any, would be appropriate, while remaining compliant with regulatory requirements.

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[19] Cheyne, David et al., Use of Small Unmanned Aerial Systems for Bridge Inspection [Tech Brief]. Federal Highway Administration (2019), available at: https://www.fhwa.dot.gov/uas/resources/hif19056.pdf; 23 CFR Part 650 Subpart C.

[20] 49 CFR Part 213 Subpart F

Funding Availability and Eligibility

Several issues constrain how DOT funding can support the application of robotics by transportation agencies. Though DOT maintains numerous programs with funding eligibilities that can cover applications of robotics (See Appendix B for examples), they are relatively limited and come with constraints. Most notably:

- Most available funding sources can support initial deployments or pilots, but funding for ongoing operations, system upkeep, and related overhead is far more limited.
- The Department currently has no standalone funding source for robotics. Therefore, proposals to pilot, test, or deploy robotics must compete for funding with other technologies.
- The application of robotics can result in a net cost reduction in operations and maintenance activities. However, because agencies may procure robotics as a capital expenditure but accrue cost savings in operations and maintenance (*i.e.,* different funding sources), they may face constraints in formally justifying the investment.

Technology Availability and Limitations

DOT agencies that are actively investing in robotics applications cited challenges in identifying and accessing robotics platforms and providers with sufficient performance for their needs. Underlying reasons included:

- *Limited number of firms and awareness of qualified firms*: Though the robotics industry is currently expanding, many of the companies involved are new and small, and therefore more difficult to identify and vet than large, established companies. Robotics providers and needs alike may be highly specialized. And lastly, many robotics providers are not U.S.-based, presenting domestic sourcing challenges. As a result, DOT and its funding recipients may have a hard time identifying qualified, eligible robotics suppliers.
- *Technical limitations:* Despite advances in the capabilities of robotics in recent years, technical limitations still exist, particularly in the demanding environments that some transportation applications will entail. For example, battery life and hardiness to varied weather conditions may constrain how robots can be deployed, due to range and other operational needs that are potentially significant. Reliability and availability of communications networks needed to operate and monitor robotic devices also present potential constraints, particularly in remote areas. Though not a limitation, applications of robotics

must also take into account cybersecurity risks, including and beyond those related to AI.[21]

Downstream Constraints and Challenges

Though not a direct constraint limiting the use of robotics in transportation, some agencies may be limited in their capacity to leverage increased data outputs, particularly in remote sensing applications. For example, robotics can enable a significant expansion in the amount of inspection data an agency can collect, but funding eligibility and organizational capacity may constrain an agency's ability to handle or leverage that data and therefore extract the full value of deploying robotics.

Workforce and Labor Considerations

As an emerging and continually evolving technology, transportation agency staff may require training, upskilling, and hiring into new roles to leverage the capabilities fully and apply robotics to agency use cases. Moreover, in certain contexts, the application of robotics may raise concerns about job loss, requiring careful coordination with labor stakeholders.

Strategic Actions

Based on the findings outlined above, DOT will consider taking the following steps to further support the application of advanced robotics in transportation.

Review Policy and Regulatory Barriers

A more comprehensive analysis would help to identify policy and regulatory provisions that might constrain how advanced robotics are deployed in the transportation sector, either by DOT or by its funding recipients. This analysis would enable DOT to identify potential actions, where appropriate, to remedy while remaining in compliance with the law.

Prioritize Investments and Enhance and Institutionalize Internal Coordination

Identifying priorities for investing in robotics would help DOT shift from ad-hoc opportunistic investments in robotics, to a more routinized, strategic, and coordinated approach. Enhancing and

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[21] https://www.cisa.gov/resources-tools/resources/principles-secure-integration-artificial-intelligence-operational-technology

institutionalizing mechanisms for DOT Operating Administrations and personnel to share information and collaborate on robotics deployments would also help to formalize robotics as an area of investment for the Department. Encouraging DOT Operating Administrations to collaborate on robotics applications with overlapping needs and performance requirements would help to economize DOT's investments and support shared learning.

Conduct Targeted Research, Pilots, and Demonstrations

Developing dedicated, standalone funding opportunities focused on robotics would help to identify, pilot, and advance new use cases and support American innovators. The Office of the Secretary of Transportation (OST) is well-positioned to develop funding opportunities that prioritize under-developed robotics platforms and use cases that are multi-modal or mode-agnostic in nature, promoting robotics applications that could be adopted into multiple transportation modes. Prize competitions, in particular, would allow DOT to pose a broad set of objectives and parameters, potentially yielding an array of solutions. Moreover, prize competitions can be more accessible for smaller, earlier-stage innovators than other funding mechanisms, and can serve as a platform to showcase multiple applicants, not just those that are selected to receive funding.

Alongside OST-led programs, additional mode-specific funding opportunities, research, and pilots would further advance the application of robotics in specific areas of the transportation sector.

Engage with and Develop Resources for Stakeholders

Targeted, purpose-driven stakeholder engagement can further inform DOT's work in robotics, help the Department to address challenging issues like workforce preparedness, and elevate and showcase robotics providers and capabilities to DOT staff. The development of informational resources, including best practices, case studies, technical assistance, and guidance, could also support public sector transportation agencies in applying robotics to their work.

Appendix A: Example Applications of Robotics in Transportation

Use Case	Robot Type	Transportation Mode	Description	References
Aircraft Inspection	Multirotor UAS	Aviation	Technicians and inspectors use an autonomous, semi-autonomous, or remote-controlled UAS equipped with optical sensors to capture detailed images of the aircraft and perform a visual inspection for any defects.	• https://news.delta.com/industry-first-faa-accepts-deltas-plan-use-drones-maintenance-inspections • https://www.koreanair.com/contents/footer/about-us/newsroom/list/250715-2025-World-Smart-City-Expo • https://pilotjohn.com/blog/how-ai-is-transforming-aviation-maintenance-and-mro-operations
Aircraft Inspection & Repair	Surface-Mounted, Articulated Arm	Aviation	The semi-autonomous robot scans the damaged area on the aircraft, calculates and cuts out the damaged section, then patches the section.	• https://www.lufthansa-technik.com/en/caire-repair-robot
Aircraft Engine Inspection	Insect-Like	Aviation	Technicians and inspectors use palm-sized swarm robots to capture images inside the aircraft's engine which are stitched together to form a detailed and comprehensive picture of the internals of the engine.	• https://www.rolls-royce.com/media/our-stories/discover/2019/meet-the-robots.aspx

Use Case	Robot Type	Transportation Mode	Description	References
Aircraft Engine Inspection & Maintenance	Serpentine	Aviation	Technicians use a long, thin, remote-controlled robot equipped with a virtual reality-integrated camera system and repair capabilities for internal engine inspection.	• https://www.rolls-royce.com/media/our-stories/discover/2019/meet-the-robots.aspx
Aircraft Engine Repair	Serpentine	Aviation	Technicians use a pair of slender robots, which work in tandem, to repair the thermal coatings within the engine.	• https://www.rolls-royce.com/media/our-stories/discover/2019/meet-the-robots.aspx
Aircraft Paint Removal	Wheeled Mobile Platform, Articulated Arm	Aviation	An autonomous robot equipped with a 20-kilowatt laser to strip paint off an aircraft's surface.	• https://www.xyrec.com/technology/
Aircraft Painter	Wheeled Mobile Platform, Articulated Arm	Aviation	A wheeled robot utilizes an articulated arm to apply livery to aircraft surfaces.	• https://www.xyrec.com/technology/
Aircraft Towing	Wheeled Mobile Platform	Aviation	A pilot-operated, semi-autonomous robot to taxi an aircraft without the use of the aircraft's engines.	• https://taxibot-international.com/concept/
Runway Inspection	Multirotor UAS	Aviation	A semi-autonomous or remote-controlled UAS equipped with sensors to inspect visual and radio aids and detect foreign object debris (FOD) on runways.	• https://canarddrones.com/solution/ • https://senseaeronautics.com/product-fod/

Use Case	Robot Type	Transportation Mode	Description	References
Runway Inspection	Wheeled Mobile Platform	Aviation	An autonomous, semi-autonomous, or remote-controlled robot equipped with optical sensors for runway FOD detection and ground-penetrating radar to assess the structural condition of the runway.	• https://blog.aci.aero/safety-and-operations/how-digital-and-intelligent-solutions-can-support-the-life-cycle-maintenance-of-airport-pavement/ • https://www.roboxi.com/ • https://www.fbtechnology.com/our-products-agl-photometric-maintenance/marc-one-agl-maintenance-robot/
Wildlife Deterrent	Quadruped	Aviation	An automated or remote-controlled robot with the ability to be disguised as a predator, such as a coyote or fox, to deter wildlife from runways.	• https://www.euronews.com/2024/04/02/pigs-drones-and-robots-disguised-as-foxes-inside-one-airports-fight-to-prevent-bird-strike
Cargo & Baggage Transportation	Wheeled Mobile Platform	Aviation	An autonomous robotic vehicle or cart capable of carrying, loading and unloading passenger baggage, and towing or transporting unit load devices (ULDs) and/or heavy freight payloads to and from the aircraft.	• https://aurrigo.com/auto-cargo/ • https://aurrigo.com/auto-dollytug/ • https://www.groundhandlinginternational.com/content/news/aurrigo-to-deploy-its-first-auto-dolly-tug-in-the-us • https://aurrigo.com/autodolly/

Use Case	Robot Type	Transportation Mode	Description	References
Baggage Handling	Wheeled Mobile Platform, Articulated Arm	Aviation	An autonomous robot with the ability to track, load, and unload passenger luggage within airport baggage handling systems.	• https://www.azalearobotics.com/
Jet Bridge	Fixed Articulated	Aviation	A semi-autonomous robot utilizing sensors to align and dock with the aircraft automatically at the press of a button.	• https://oshkoshaerotech.com/products-and-services/jetdock
Passenger Mobility Support	Wheeled Mobile Platform	Aviation	An autonomous wheelchair equipped with sensors provides transportation for passengers with limited mobility throughout an airport terminal.	• https://whill.inc/us/autonomous-service/
Vehicle Refueling	Modular Platform, Articulated Arm	Aviation & Surface	An autonomous robot with the ability to refuel or recharge vehicles and transfer hazardous liquids.	• https://www.stratom.com/rapid-stratoms-autonomous-refueling-recharging-and-liquid-transfer-system/
Infrastructure Inspection	Multirotor UAS	Aviation, Surface & Maritime	A semi-autonomous, remote-controlled UAS utilizes optical sensors to evaluate structures including bridges, buildings, and yards for structural defects.	• https://skyebase.be/sectors/sector-infrastructure/
Track Inspection	Multirotor UAS	Surface (Rail)	An autonomous UAS utilizes optical sensors to conduct a visual inspection of switch point gaps, joint bar issues, rail gaps, and track gauge problems.	• https://www.flytbase.com/case-studies/csx-autonomous-drone-rail-inspection • https://www.railexpress.com.au/downer-revolutionising-rail-maintenance/

Use Case	Robot Type	Transportation Mode	Description	References
Track Inspection	Rail-Mounted Mobile Platform	Surface (Rail)	An autonomous or remote-controlled robot equipped with various sensors to inspect track geometry, rail wear, track bed, structure clearance, fastener defects, and rail surface defects.	• https://www.shenhaorobotics.com/railway-inspection-robot/
Track Inspection & Maintenance	Rail-Mounted Mobile Platform, Articulated Arm	Surface (Rail)	An automated robot that utilizes sensors to scan for defects in the track and an articulated arms to mill, preheat, weld, and grind tracks for repair.	• https://railautomation.com/en/products/robot/
Train Inspection	Wheeled Mobile Platform, Articulated Arm	Surface (Rail)	An autonomous robot equipped with optical sensors, such as cameras and/or LiDAR, performs an external inspection of rolling stock.	• https://www.shenhaorobotics.com/train-bottom-inspection-robot/ • https://www.railexpress.com.au/downer-revolutionising-rail-maintenance/
Rail Infrastructure Inspection	Multirotor UAS	Surface (Rail)	An autonomous or semi-autonomous beyond-visual-line-of-sight (BVLOS) UAS used to conduct inventory checks and collect intermodal yard operations data. The UAS also perform bridge inspections, tower inspections, encroachment monitoring, and vegetation management.	• https://www.progressiverailroading.com/RailPrime/details/BNSF-opens-Flight-Operations-Center-to-boost-drone-performance--75911

Use Case	Robot Type	Transportation Mode	Description	References
Rail Infrastructure Inspection	Quadruped	Surface (Rail)	Quadruped robots equipped with advanced sensors perform inspections of rail infrastructure including culverts, rolling stock and depots, and for track defects, vegetation encroachment, and other issues.	• https://www.networkrail.co.uk/stories/inspecting-our-railway-with-the-help-of-robots • https://belvoir-rail.com/robotics-for-rail • https://www.anybotics.com/industries/robotic-inspection-railway-transportation/
Rail Infrastructure Maintenance	Humanoid, Rail Mounted Mobile Platform	Surface (Rail)	A remote-controlled robot with the ability to apply coatings to overhead line support, trim vegetation, work on power lines, fix damaged structures, and inspect track.	• https://www.electricaltechnology.org/2024/09/japan-humanoid-robot.html
Shunting	Rail-Mounted Mobile Platform	Surface (Rail)	An autonomous robot that utilizes an electric, diesel-electric, or diesel-hydrodynamic drive system to move, push, and pull freight cars of various sizes and weights.	• https://www.vollert.de/en/products-systems/solutions-for-shunting-and-loading-processes/shunting-vehicles
Rolling Stock Sanitization	Wheeled Mobile Platform, Articulated Arm	Surface (Rail)	An autonomous sanitization robot utilizing optical sensors to navigate passenger cabins to clean the floors, walls, windows, and seats.	• https://www.railway.supply/autonomous-train-cleaning-robots-a-breakthrough-in-rolling-stock-maintenance/
Bridge Inspection	Multirotor UAS	Surface (Rail)	UAS that utilizes optical sensors, such as cameras, infrared cameras, and LiDAR to inspect bridges visually with the additional capability of attaching to and crawling bridge girders.	• https://news.mst.edu/2025/10/missouri-st-researchers-robotic-bridge-inspection-system-earns-asces-2025-pankow-award/

Use Case	Robot Type	Transportation Mode	Description	References
Bridge Construction	Rail-Mounted, Gantry Platform	Surface (Road)	An autonomous (optionally remote-controlled) robotic platform capable of installing and tying horizontal rebar.	• https://www.constructionrobots.com/tybot
Roadway Repairs	Wheeled Mobile Platform	Surface (Road)	An autonomous ground vehicle that utilizes sensors to detect road defects, such as potholes or cracks, and performs real-time repairs by filling the damaged area.	• https://www.local.gov.uk/case-studies/hertfordshire-county-council-ai-road-maintenance-robot • https://www.ycombinator.com/launches/MmN-pave-robotics-robots-that-repair-roads • https://cordis.europa.eu/article/id/461223-ai-powered-robots-transform-road-repairs-in-europe
Roadway Construction	Wheeled Mobile Platform	Surface (Road)	Autonomous and semi-autonomous construction platforms with the capability to pave or resurface roads with minimal to no human supervision.	• https://dynapac.com/us-en/news/the-future-has-begun-autonomous-paving-in-real-world-road-construction • https://www.sparknify.com/post/when-robots-pave-the-road-the-new-era-of-infrastructure-video
Roadway Cleaning	Wheeled Mobile Platform	Surface (Road)	A fully autonomous, all-electric robotic street sweeper utilizing optical sensors, such as LiDAR, and other sensors to navigate areas industrial districts or municipal environments.	• https://trombia.com/products/trombia-free/

Use Case	Robot Type	Transportation Mode	Description	References
Pipeline Inspection	Soft Internal-Pipe Platform	Surface (Pipeline)	An autonomous robot that uses inflatable fabric actuators to move through narrow twisting pipes to detect cracks and corrosion.	• https://roboticsandautomationnews.com/2025/11/20/asu-researchers-develop-advanced-robotics-and-ai-system-to-inspect-pipelines-and-prevent-blockages/96737/
Pipeline Inspection	Serpentine	Surface (Pipeline)	A remote-controlled, tetherless robot capable of inspecting active natural gas or empty liquid pipelines to collect visual and magnetic flux leakage (MFL) data.	• https://www.intero-integrity.com/services/unpiggable-mfl-robotic-inline-inspection
Pipeline Inspection	Magnetic Wall-Climbing Crawler Platform	Surface (Pipeline)	A remote-controlled robot with the flexibility to navigate pipes, elbows, and industrial infrastructure, utilizing ultrasonic sensors to detect corrosion or defects.	• https://inspectioneering.com/news/2021-03-31/9580/gecko-robotics-unveils-latest-inspection-robot-the-toka-flex
Pipeline Maintenance	Internal-Pipe Crawler Platform	Surface (Pipeline)	A remote-controlled robot capable of traveling inside active gas mains to seal jute and mechanical joints.	• https://ulctechnologies.com/services/cisbot-robotic-cast-iron-joint-sealing/
Hazardous Material Handling	Fixed Articulated Arm	Surface (Hazardous Materials)	A remote-controlled robot with the capability to handle and pack nuclear waste.	• https://www.kuka.com/en-us/industries/solutions-database/2017/08/nuclear-decommissioning

Use Case	Robot Type	Transportation Mode	Description	References
Hull Inspection & Maintenance	Magnetic Underwater Crawler Platform	Maritime	A remote-controlled robot that magnetizes to the ship's hull and utilizes optical sensors to inspect the hull and brushes to remove biofouling from the ship proactively.	• https://www.jotun.com/ww-en/industries/solutions-and-brands/hull-skating-solutions/overview • https://newatlas.com/marine/hullskater-hull-cleaning-robot/
Hull Inspection & Maintenance	Free-Swimming Underwater Mobile Platform	Maritime	An autonomous underwater robot utilizing optical sensors to inspect the ship's hull with brushes to remove biofouling from the hull proactively as well as in hard-to-reach areas such as the propellers.	• https://www.hullbot.com/ • https://greenseaiq.com/news/everclean-contributes-to-major-biofouling-rd-forum-at-the-international-maritime-organization-headquarters-london-uk/
Offshore Asset Inspection	Uncrewed Surface Vessel	Maritime	A semi-autonomous, remote-controlled surface vessel utilizing optical sensors and sonar to perform visual inspections of offshore assets.	• https://www.fugro.com/expertise/case-studies/ensuring-sustainable-offshore-wind-farm-maintenance-hollandse-kust-zuid-inspection
Ship Mooring	Fixed Arm	Maritime	A shore-mounted, automated mooring robot system that utilizes vacuum pads to secure docked ships.	• https://www.cavotec.com/products/moormaster
Straddle Carrier	Wheeled Gantry Platform	Maritime	An autonomous robot utilizes sensors to navigate the port terminal to straddle, move, and stack shipping containers.	• https://www.kalmarglobal.com/equipment/straddle-carriers/autostrad-automated-straddle-carrier/

Appendix B: Example DOT Grant Programs that Include Eligibility for Robotics Applications

Agency	Grant Program Name	Description	For Additional Information
Federal Highway Administration	Advanced Digital Construction Management Systems (ADCMS)	ADCMS are digital technologies and processes for management of construction and engineering activities, including systems for infrastructure planning and coordination, design, construction, maintenance, modernization and management, and asset management including hardware, mobile devices, software, 'internet of things' (IOT), and personnel. It also includes the development and support of systems to enhance and share data across an asset's lifecycle and between organizational silos, also referred to as maximizing interoperability.	https://www.fhwa.dot.gov/construction/adcms/
Federal Transit Administration	FTA Public Transportation Innovation (49 U.S.C. 5312)	The Secretary may make grants and enter into contracts, cooperative agreements, and other agreements for research, development, demonstration, and deployment projects, and evaluation of research and technology of national significance to public transportation, that the Secretary determines will improve public transportation.	https://www.transit.dot.gov/funding/grants/public-transportation-innovation-5312
Pipeline and Hazardous Materials Safety Administration	Core Research	PHMSA partners with research entities to develop near solutions focused on knowledge development and technology to improve pipeline safety. PHMSA is allowed to conduct applied safety research in areas such as materials, corrosion, leak detection, geohazards, data analytics, integrity inspection, damage prevention, and emerging fuel transport safety—as long as the research advances pipeline safety, is collaborative, and complies with the Pipeline Safety Improvement Act of 2002.	https://primis.phmsa.dot.gov/rd/core-program/

Agency	Grant Program Name	Description	For Additional Information
Pipeline and Hazardous Materials Safety Administration	Competitive Academic Agreement Program (CAAP)	The CAAP initiative is intended to spur innovation by enabling an academic research focus on pipeline safety challenges. It will help deliver solutions that can be transitioned to PHMSA's Core Research program of demonstration and deployment in many respects. The goal is to validate proof of concept of a thesis or theory all the way to commercial introduction into the market.	https://www.phmsa.dot.gov/grants/pipeline/competitive-academic-agreement-program-caap
Pipeline and Hazardous Materials Safety Administration	Small Business Innovation Research (SBIR)	PHMSA's Pipeline Safety Research Program provides research funding through our participation in the Department of Transportation SBIR program. This funding assists American owned and operated small businesses in developing and commercializing innovative technology.	https://primis.phmsa.dot.gov/rd/sbir-program/