Advanced Digital Construction Management Systems Cover Page	
Entity Type	**STATE DOT**
Organization Name	**MARYLAND DEPARTMENT OF TRANSPORTATION, STATE HIGHWAY ADMINISTRATION**
Project Name	**MCDOT P3DSETI PILOT EXPANSION PROJECT**
Previously Incurred Project Cost	**$ 0**
Future Eligible Project Cost	**$ 1,300,000**
Total Project Cost (*from all funding sources*)	**$ 1,300,000**
ADCMS Program Funding Request	**$ 1,000,000**
Non-Federal Share for ADCMS Program Funding Request	**$ $300,000**
Total Federal Funding (*Including ADCMS Program*)	**$ 1,000,000**

Advanced Digital Construction Management Systems
Table of Contents

Project Description

The Maryland Department of Transportation State Highway Administration (MDOT SHA) proposes to accelerate State adoption of Advanced Digital Construction Management Systems (ADCMS), improve information sharing with stakeholders, and undertake technology training and workforce development to better manage projects during their full life cycle. ADCMS can increase construction zone safety, decrease traffic congestion, improve equity, and support sustainable development. MDOT SHA will advance ADCMS adoption by supporting the Montgomery County Department of Transportation (MCDOT) in expanding its successful Precise 3D Survey and Engineering of Transportation Infrastructure (P3DSETI) pilot project. P3DSETI is an integrated platform that features storage directories, or "buckets", for housing three-dimensional (3D) scans of transportation assets, 3D models used in design, two-dimensional (2D) line drawings of facility systems, as-built drawings, and other asset data necessary to manage the design, construction, operations, and maintenance of transportation infrastructure. The pilot expansion activities proposed include establishing and validating standards, processes, and workflows that can be adopted by other jurisdictions; improving data processing, storage, and security while platform and data libraries expand; increasing scanning equipment, training more staff to use the scanning equipment, and teaching staff to process and load their scans into P3DSETI; and transferring knowledge between MCDOT and MDOT SHA.

Montgomery County is the most populous county in Maryland, with a forward-thinking local government dedicated to early technology adoption and sustainable development. MCDOT has been exploring, developing, and operating a Building Information Management (BIM) pilot program called P3DSETI since 2017. The experienced and innovative team leading the charge includes an interdisciplinary team with expertise in surveying, traffic, IT, parking, and highways.

Since 2017, MCDOT has employed 3D engineering multi-discipline design workflows that leverage BIM applications. These applications include Revit Models, and 3D scan models of transportation assets, and Infraworks models of the properties and adjacent areas. Each division of MCDOT has been running P3DSETI to ingest digital surveys, scan as-built drawings, generate line models of structures or other assets, and cooperate on CAD-like files for the design of asset improvements, operations, and maintenance activities. The files are organized by asset and linked through GIS to enable GIS-based modeling and analysis.

In 2021, MCDOT aligned its BIM goals with the 10-year plan outlined in the US DOT's policy paper "Advancing BIM for Infrastructure: National Strategic Roadmap," setting a mid-term goal of achieving BIM maturity of Level 2. Currently, MCDOT is above Level 1, having high-value data exchanges across disciplines, stakeholder BIM awareness, multidisciplinary BIM planning teams, and early pilot projects. Level 2 of maturity involves the integration of BIM models, exchange of model datasets, and management of digital assets across county, state, and federal entities. MDOT's BIM maturity level should reach Level 2 by the end of the project.

Each participating division of MCDOT has been utilizing the P3DSETI system slightly differently from one another. Though each division is seeing significant improvements in project outcomes, MCDOT now needs to undertake the process of standardizing the workflow across divisions based on pilot successes and challenges. The resulting workflow, processes, and collaborative tools will allow for deployment with the Maryland DOT, neighboring jurisdictions, and project stakeholders. The collaborative aspects of the P3DSETI system have the potential to widely expand the value of BIM across the State of Maryland.

MCDOT and MDOT SHA have committed to adopting sustainable practices that increase resilience to climate change, improve safety for transportation workers, reduce work zone congestion, and improve equity for residents who have borne disproportionate pollution and traffic burdens because of their race or socioeconomic status. Using P3DSETI can help the County and the State to make sure that their projects are easing these burdens for disadvantaged communities. Users can automatically overlay project areas on equity analysis maps, pollution burden maps, and other GIS-based resources to identify disadvantaged or overburdened populations for engagement. The 3D models of the project can be evaluated within the context of the community to better identify concerns not readily apparent in 2D drawings and maps (such as shadows that impact energy or vegetation or line of sight changes). P3DSETI also enables advanced modeling, such as hydrology models, to double check that changes to a site don't create negative downstream or upstream impacts on already at-risk communities.

To meet the program goals, administration goals, and project goals, MCDOT and MDOT SHA will undertake the following scope of work. Their main tasks will be to procure software licenses that support expanded access to the established P3DSETI platform, obtain additional scanning equipment, establish a standardized BIM engineering workflow for the full project lifecycle, develop training resources and procedures for scanning technicians and BIM workflow users, and transfer knowledge and resources gained from the MCDOT pilot expansion to MDOT SHA.

Scope of Work

1. Grant Administration
    a. MDOT SHA, MCDOT, and FHWA hold kickoff meeting
    b. MDOT SHA and FHWA enter grant agreement
    c. MCDOT and MDOT SHA collect data
    d. MCDOT drafts and MDOT SHA submit biannual reports
    e. MCDOT and MDOT SHA draft final report
    f. MDOT SHA submits final report
2. Procurement (all MCDOT)
    a. Prepare Request for Proposal announcements and packages
    b. Publish Request for Proposals for open competition
    c. Receive RFP applications
    d. Select vendors and contractors
    e. Execute contracts

Milestone 2e – Procurement Contracts are Executed

f. Receive equipment

Milestone 2f – Equipment is received, brought into inventory, and ready for use

3. Software and Network Enhancements (all MCDOT)
    a. Activate new software licenses for continuing or new programs
    b. Install hardware and software to support large file movement and storage
    c. Refine visual dashboards for consistency throughout MCDOT
    d. Institute cybersecurity updates and improvements
    e. Set up webservices for P3DSETI
    f. Establish Bigdata Analytics for P3DSETI
    g. Set up AI data mining for the platform
    h. Install RTK stations throughout Montgomery County
4. Develop Standardized Engineering Workflow (all MCDOT)
    a. Establish and formalize data standards for P3DSETI
    b. Record workflows from participating divisions
    c. Identify best practices
    d. Develop new standardized workflow for test run

    Milestone 3c – Initial Workflow Document is Deployed

    e. Test new workflow
    f. Collect participant feedback
    g. Update engineering workflow
    h. Deploy new engineering workflow

    Milestone 3g – All MCDOT Divisions Using Final Workflow
5. Training (all MCDOT)
    a. Develop training materials for scanning technicians
    b. Develop training materials for engineering workflow

    Milestone 4ab – Training Materials are Available for Use

    c. Train scanners
    d. Train staff on engineering workflow
6. Knowledge Transfer (MCDOT and MDOT SHA)
    a. Quarterly meetings between MCDOT and MDOT SHA
    b. MDOT SHA sends representatives to MCDOT trainings

    Milestone 5b – MCDOT Representatives are Trained

    c. MCDOT provides training materials to MDOT SHA
    d. MCDOT provides user access to a team of MDOT SHA staff for their pilot use

Technical and Management Plan

The work will be carried out primarily by MCDOT with support and technical assistance from MDOT SHA. The leaders of the project, who have been leading P3DSETI efforts at MCDOT since 2017, include Adrian Labor, Steve Long, and Sindhu Rao, who are discussed more in detail

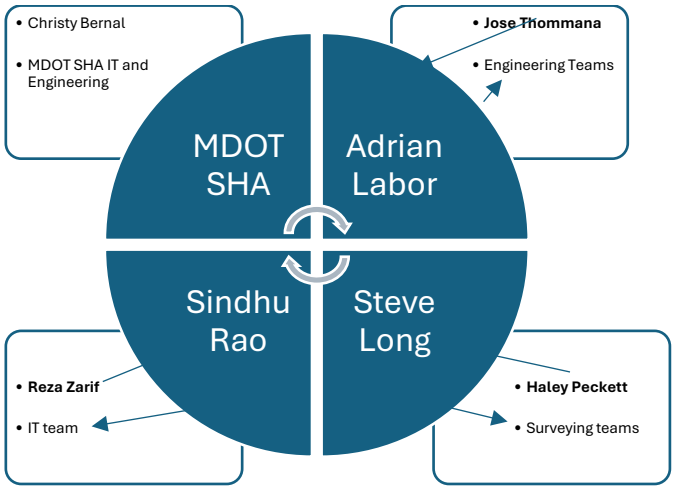
in the Project Team section below. Each of these leaders has established teams working alongside them to advance the P3DSETI workflow and prepare for its ultimate widespread deployment outside of MCDOT. The core team will meet weekly to ensure the project is advancing on pace to meet the proposed milestones and goals. The team will invite additional stakeholders and support to the meeting as they deem necessary to keep the project on track for successful completion within the project performance period.

Initial Monitoring Plan

To ensure the project is meeting the program goals of saving cost, reducing project delivery time, reducing congestion, and improving safety, MCDOT will undertake a case study of recently completed projects and note the presence of known inefficiencies such as additional trips to the site for remeasurement, delays when passing drafts from one entity to the other, extended wait times for permits, excessive congestion around the work zone, traffic-based injuries in the work zone, and the work zone in place beyond the scheduled time. The team will evaluate the presence and magnitude of these inefficiencies in relation to the use of P3DSETI and BIM engineering workflow best practices. This should allow the team to confirm that P3DSETI and the BIM engineering workflow is producing cost savings, time reductions, and safety improvements.

Project Team Information

The proposed project team is a core group of MCDOT staff that have been developing P3DSETI for several years combined with grant administration and policy support from within Montgomery County and further technical and administrative support through the lead entity MDOT SHA. MDOT SHA's project lead is Barry Smith and grant administrator is Christy Bernal. The MCDOT team will be led by the three core project managers, Adrian Labor, Steve Long, and Sindhu Rao. Technical and policy support from MCDOT will come from Haley Peckett, Jose Thommana, and Reza Zarif. Additional team members are Chris Van Alstyne, Sogand Seirafi, Alexander Deley, Joseph Brannum, and Geoffrey Howard.



Key Personnel

Adrian Labor, M.ENG, M.ASCE – Mr. Labor is the Chief of Engineering & Capital Project Management of the MCDOT. He has been working on digitizing MCDOT's Capital Project life cycle management since he began scanning as-built drawings in 2017 and has worked alongside the core project managers on every aspect of developing P3DSETI since that time. Mr. Labor has a Bachelor and Master of Civil Engineering and thirty years of broad professional experience including governmental and non-governmental capital project management and design, international technical advising, project management, network administrating, and GIS analysis. Mr. Labor is skilled at a wide variety of engineering, GIS, construction management, and database software applications. His experience and education have produced a skillset uniquely qualified to pave the way for BIM for infrastructure adoption in his region.

Steve Long – Mr. Long is the Land Survey Supervisor at MCDOT. Steve has an associate in Surveying Technology and Surveying and 41 years' experience in Land & Construction surveying with increasing responsibility having held professional licenses during that time in three different states. He also has extensive GIS experience having served as an ArcGIS Administrator and deep knowledge of precise 3D surveying systems including terrestrial LIDAR technology from his time as technical factory representative for 6 years with Leica Geosystems. Mr. Long independently began advancing scanning and BIM for infrastructure in 2017 when he and Mr. Labor connected over their shared vision of what has become P3DSETI. Mr. Long's vast knowledge of surveying, GIS, scanning technologies, and databases has positioned him for success in leading P3DSETI development.

Sindhu Rao – Ms. Rao is an IT Specialist III with MCDOT in the Division of Parking Management where she has been instrumental in developing the IT structure of the P3DSETI platform including selection, licensing management, access control, security, interoperability, and maintenance of the suite of applications and database that form the BIM solution. Ms. Rao has a bachelor's in computer science and twelve years of experience in IT, software engineering, network security, web development, and system maintenance in MCDOT and federal government projects. She will continue to manage licensing, software procurement, user access, and database management for P3DSETI and assist with the workflow and training materials.

Technical and policy support will be provided by MCDOT administrators. **Haley Peckett** is MCDOT's Deputy Director for Transportation Policy and Planning. She was previously Associate Director of the Curbside Management Division and Deputy Director of the Parking and Ground Transportation Division at DDOT. She received her Master's in City Planning from the Massachusetts Institute of Technology and her B.A. from Dartmouth College. **Jose Thommana** is MCDOT's Division Chief of the Division of Parking Management. He was previously Chief Performance Officer in the District of Columbia Government Office of the Chief Technology Officer. He received his M.S. from the Virginia Polytechnic Institute and his B.S. from the National Institute of Technology Surat. **Reza Zarif** is Chief of Intelligent Transportation System (ITS) in Montgomery County Department of Transportation (MCDOT). Throughout his 15-year tenure with MCDOT, Reza has managed major IT initiatives, projects,

resources, steered and implemented policies in the realm of Information Technology within the department. Prior to joining MCDOT, Reza was a 15-year veteran developer for Time & Billing as well as Document Management enterprise level systems. Reza graduated from University of North Carolina - Charlotte majoring in Computer Science.

Project Readiness

Technical Feasibility

MDOT SHA has planned this ADCMS project to advance BIM for infrastructure leveraging the vast experience and investment already producing success for MCDOT. MCDOT is graciously sharing their knowledge and user access to P3DSETI with MDOT SHA, which will advance Maryland's ADCMS and BIM adoption without the State having to expend the same time and money that MCDOT has already invested.

MCDOT established a BIM360 Collaboration hub on Autodesk Document Management platform and a library of 3D scans and models of transportation assets that were initially separated from one another and required manual data transfer between the two systems. The conversion of 3D scans to Revit and Infraworks models was also labor intensive. Overtime, the MCDOT team has repeatedly migrated software applications until they achieved the capacity to securely process, store, access, analyze, search, share, transfer, and query the large and complex data. As of the fall of 2023, MCDOT has been successful at integrating the modeling applications and the BIM360 document platform, so they are automatically synchronized to update models, drawing sets, and views from the modeling software to the Autodesk Construction Cloud. This ensures that models and drawing sets generated in Revit or Infraworks serve as a central source of truth for ongoing operations and maintenance using P3DSETI.

The Infraworks modeling platform allows for the representation of both engineering precision-level Revit models and GIS data on environments spatially. The GIS Area of Interest data can be limited to within the transportation asset or extended to adjacent properties and major streets. GIS data on the environment helps build conceptual projects and scenarios based on data-driven algorithms. The Infraworks modeling platform is designed for the convergence of these spatial models, GIS data, 3D Scans and geolocated dataset.

The benefits of the Revit, Infraworks, and 3D scan model developments as integral tools in capital project management are convincing when evaluated in the capital improvement life cycle costs. They provide simple insights that aid in planning improvements and preventive maintenance. The most obvious benefit is the reduction in design development and construction document phases periods for CIP improvement projects. The models and document management platform and GIS database are now allowing for consistent and connected datasets to be kept on the capital assets and their management. This benefit is cumulative over the years. The process cuts down on staff and consultant hours needed to complete the design process by automating steps. For example, construction cost estimates are formed by taking measurements directly from the drawings and matching them engineering cost averages to produce a project budget

automatically. This also removes the likelihood of transcription errors when people must manually transfer the data and produce cost estimates themselves. The models improve asset life cycle management by allowing condition assessments to be reflected on the model to inform maintenance decisions in a simple and accessible way. Asset managers can readily see previous maintenance information entered into the models, condition assessments visually represented on the models, and as-built information to develop their maintenance and improvement strategies leading to optimal operations and maximum useful life.

As the pilot expands, there will be more very large datasets to manage and transfer, which will require additional storage and security both physically and in cloud-based systems. MCDOT's IT team will acquire, install, and validate the increased in-network and cloud-based storage and security to confirm that P3DSETI's automated and manual features are maintained, and data keeps both its integrity and accessibility. To assist with data access, MCDOT will establish and integrate webservices, AI data mining, and Bigdata Analytics with the existing P3DSETI solution. This will improve the search functions and help engineers and consultants to more easily find files associated with a transportation asset or a nearby building that will be impacted. Establishing these advanced data tools now will ensure that P3DSETI stays manageable and easy to use even as the pilot expands. Waiting until a later maturity level when there is even more data would be more cumbersome and complicated than adding these important resources now. MCDOT would also like to establish the advanced tools now to ensure the data standards and engineering workflow optimize the use of Bigdata Analytics, AI data mining, and webservices.

Another necessary improvement for P3DSETI pilot expansion and long-term success is to install Real-Time Kinematic (RTK) stations at strategic locations throughout Montgomery County and its surrounding counties. These stations are a surveying technology that measures relative positions using two Global Navigation Satellite System (GNSS) antennas in real-time with better accuracy. They can enhance the precision of position data derived from the in-field 3D scans to the centimeter level. These devices can easily be attached to existing infrastructure such as utility poles, traffic light poles, or buildings to correct GNSS data and remove uncertainties, leading to a very accurate, high-quality point cloud that in turn requires less processing to become a reliable 3D model with high integrity. Training for staff in using the new reality capture surveying equipment procured in the project will include advice on choosing scanning positions to optimize scans leveraging RTK stations, minimize time spent by staff or consultants on the side of active roads, and prevent the closure of lanes, roads, or intersections for surveying. In keeping with the flexibility and interoperability priorities of the P3DSETI project, any brand of LiDAR-based reality capture equipment could be selected via the County's competitive procurement process. Following procurement and training, MCDOT and MDOT SHA staff will begin adding transportation asset scans to P3DSETI's central source of truth as fast as possible. This will allow them to more intensely test the proposed workflows and validate the established data standards while also building up an extensive centralized library of transportation asset models.

Project Schedule

The schedule has been developed to allow ample time for the thoughtful and data-driven development of the project's milestones and deliverables to meet program goals. The scope of work has been translated into a Gantt chart (see below) to represent the timing of each task. The project will take place over 12 months with an additional 90 days for the project close out tasks consistent with the NOFO. Once awarded, MDOT SHA and MCDOT can begin work immediately. This might cause minor shifting on the biannual reporting subtask to align with the guidance in the NOFO in the event the first month is not January 2025. The biannual reports will be submitted in July and in January unless otherwise specified in the grant agreement.

Task Name	Duration (months)	Project Year 1												Final Reporting		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Grant Administration	15															
Hold kickoff meeting	1															
Enter Grant Agreement	1															
Collect Data	12															
Submit Biannual Reports	2															
Draft Final Report	2															
Submit Final Report	1															
Procurement	6															
Prepare RFP	2															
Publish RFP	2															
Select Vendors	1															
Execute Contracts	1															
Receive Equipment	1															
Software and Network Enhancements	11															
Activate Software Licenses	1															
Install Equipment & Software for Large Files	2															
Refine Visual Dashboard	1															
Security Updates	2															
Set up webservices	1															
Set up Bigdata Analytics	1															
Set up AI Data Mining	1															
Install RTK Stations	4															
Develop Standardized Engineering Workflow	11															
Establish Data Standards	3															
Record workflows from participating divisions	2															
Identify best practices	2															
Develop new standardized workflow for test run	2															
Test new workflow	3															
Collect participant feedback	2															
Update engineering workflow	3															
Deploy new engineering workflow	2															
Training	10															
Develop training materials for scanning technicians	5															
Develop training materials for engineering workflow	7															
Train scanners	3															
Train staff on engineering workflow	2															
Knowledge Transfer	12															
Quarterly Meetings	4															
Representative Training	1															
Share Training Materials	1															
Grant User Access	3															

Project Risks and Mitigation Strategies

MDOT SHA and MCDOT have evaluated potential risks to project completion and have developed mitigation strategies to prevent cost overruns or schedule delays.

Risk	Mitigation
Increased Procurement Costs	MCDOT has watched the pricing of the scanning equipment necessary and software licenses over the past decade. The pricing has been relatively consistent despite nationwide and worldwide price fluctuations. MCDOT has used historic pricing with a slight markup in estimating budget needs for the project. There will be a competitive procurement process which is likely to produce more favorable pricing than budgeted.
Delay in Equipment Delivery	Equipment delivery lead time has been estimated at 1 month but if more time is needed, there is an additional four (4) months in the project period after training on the scanners is supposed to end. The training can be pushed back into this time buffer, if needed. MCDOT has some equipment already that can be used to support the test runs of the workflow if the new equipment is not yet in hand so workflow processes and collaboration tools can still be advanced while awaiting delivery.
Delay in Launching Workflow Test	If the initial workflow is not established in time for the test launch, MCDOT project leaders will meet to determine if the test period will be shortened, if the revision period based on test feedback will be expedited, or if the final launch will be pushed back one month to enable all project goals and deliverables to be completed on time and within budget. Project leaders can also bring in leadership support from across MCDOT and MDOT SHA to meet milestones and ensure participation.

Responsiveness to Merit Criteria

Merit Criterion #1 – Technical and Management Approach

(1) The P3DSETI PilotPilot Expansion Project proposed by the Maryland Department of Transportation State Highway Administration (MDOT SHA) is based on an existing framework developed and tested on a pilot scale by Montgomery County's Department of Transportation (MCDOT) since 2017. MCDOT has integrated existing off-the-shelf software packages to host 3D scans of intersections, multi-level parking garages, road segments, and other transportation assets (P3DSETI); collaborative design files including models, as-built plans, and designs (BIM 360); and associated big data storage and evaluative tools that allow for coordination and

information sharing that revolutionizes the design, engineering, and construction workflows for transportation assets. Currently, each division of MCDOT is using P3DSETI somewhat differently, or what might be called “in silos”. The project will develop a standardized transportation engineering workflow that advances BIM for infrastructure following the guidance of the National Strategic Roadmap and takes MCDOT to readiness level 2 by the end of the project. MCDOT will undertake information sharing with MDOT SHA during and after the project to prepare to scale up the MCDOT P3DSETI. The project is consistent with recommendations within Maryland’s Statewide Information Technology Master Plan to promote IT as a Strategic Investment and support data-centric enterprises. The project is also consistent with MDOT’s Asset Management Plan because it will develop consistent standards for collecting asset information and provide detailed data to support data-driven decision making.

(2) The project’s primary outcome will be the advancement of MCDOT’s P3DSETI BIM maturity from 1 to 2 using the National Strategic Roadmap’s readiness scale. By advancing this pilot project’s maturity level, MDOT SHA is facilitating the deployment of an advanced BIM for infrastructure solution that can be easily adopted by MDOT, other counties, local jurisdictions, and special districts and authorities. P3DSETI can also be accessed by other involved stakeholders such as contractors and federal agencies to allow all design, permitting, operations, and maintenance activities to take place in the digital collaboration space.

Currently, the divisions of MCDOT are realizing success with P3DSETI but in their own ways. The next step, per the National Strategic Roadmap, would be to identify the best practices and convert them into a standardized workflow and training program that will establish the foundation for skill enhancement and collaboration. This standardization and training step is essential to prepare for the next step of the overall project, which is to deploy the extended pilot at the State and in other interested jurisdictions. While deployment could in theory take place earlier, moving forward without establishing a standardized workflow and training program would likely create model-based data management problems in the near future.

(3) The staff assigned to the project have the education, experience, and skills necessary to lead the State toward BIM deployment. MDOT SHA’s **Name** will provide technical support and project oversight to MCDOT’s already established team leading P3DSETI. Christy Bernal of MDOT SHA, or her designee, will perform grant administration activities to include distributing funds, invoicing, and reporting. Much of the technical work will be performed by MCDOT’s existing team with Adrian Labor leading the engineering workflow development, Steve Long spearheading the survey scan and model ingestion methodology, and Sindhu Rao leading the Information Technology portion of the activities. This technical team has been developing P3DSETI together since 2017. Additional support for strategic, relational, and policy matters for the MCDOT team will come from Haley Peckett, Deputy Director for Transportation Policy and Planning; Jose Thommana, Division Chief of the Division of Parking Management; and Reza Zarif, Chief of Intelligent Transportation Systems.

(4) In addition to the wealth of experience brought by the project's managers and administrators, there are additional qualified MCDOT staff members that will continue to work on the P3DSETI project. There are an additional three surveyors that assist Mr. Long with collecting, cleaning, and publishing scans; creating CAD models from the scans; and other model input tasks. Mr. Labor leads a large team of engineers as the Division of Parking Management's Chief of Engineering and Capital Project Management. In this project, he is also working with engineers from other divisions as they improve, expand, and standardize their BIM workflows. Ms. Rao is part of a three-person team managing the IT side of the project including user permissions, access role management, technical support, and licensing management. These staffing levels are sufficient for the scope of work proposed in this year of the project. Future phases will likely require some additional staffing but is not needed for the success of this phase.

(5) As MDOT SHA moves to adopt BIM for infrastructure, they will leverage MCDOT's progress and expertise gathered over the past several years. Both MDOT SHA and MCDOT have the staff, experience, skill, and other resources to fully implement the project, which is a vital part of progressing BIM adoption throughout Maryland. MCDOT continues its commitment to the project as guided by its mission and vision to be forward-thinking, embrace technology and innovation, and develop creative solutions to transportation challenges that will serve well into the future.

(6) MDOT SHA and MCDOT have evaluated the risks to project completion including technical challenges, budgetary risks, and schedule risks and have developed mitigation strategies to minimize the possibility of going over budget, beyond schedule, or not producing the intended outcomes during the project performance period. These risks and mitigation strategies are discussed in detail in the Project Readiness section of this Technical Application. The primary risks are procurement and delivery times and pricing fluctuations. To minimize the potential impact of these risks, MDOT SHA and MCDOT will undertake equipment procurement at the beginning of the project performance period to provide a buffer of time for the delivery of the proposed equipment acquisition. The procurement process will follow established procedures aligned with federal regulations which should both prevent delays and ensure the most competitive pricing is obtained. The equipment necessary for the grant is typically readily available from multiple vendors with relatively stable pricing. Using off-the-shelf equipment and software is an important design feature of P3DSETI that makes it more accessible and flexible.

Merit Criterion #2 – Promotes efficient information sharing among stakeholders

(1) P3DSETI has revolutionized the way MCDOT designs projects on its transportation assets. Instead of using a paper-based system, the County, its contractors, and stakeholders have been able to simultaneously access the same CAD file for design along with as-built drawings, line diagrams of various asset systems (mechanical, electrical, plumbing, etc), a digital 3-D model of the site that allows for remeasurement, and the original scan's point cloud. The workflow solution so far has saved significant time and money during both design and construction because it has reduced necessary trips to the site while increasing and improving information

available to the engineers, project managers, and construction managers. No longer are people reporting to a meeting with their paper copies to discover it isn't the most current draft and then having to make copies of the current iteration delaying the meeting. Allowing all parties simultaneous digital access to viewing the file saves significant amounts of time while ensuring the designs and construction documents are accurate.

One new policy that MCDOT will launch and recommend for MDOT SHA is a mandate that underground utilities be scanned and uploaded into P3DSETI when encountered during construction. Unfortunately, unmapped underground utilities are a common cause of delays and unexpected costs during transportation construction and renovation projects. The equipment procured will facilitate immediate scanning in the field when underground infrastructure in uncovered in MCDOT projects. This will allow underground utilities to be mapped by all current and future participants in P3DSETI leading to fewer incidents when unknown lines are discovered during excavation.

(2) When combined with existing software for procurement, invoicing, and other general administrative activities, P3DSETI has been able to nearly eliminate the use of paper documentation in the design, construction, operations, and maintenance of MCDOT's transportation assets. Upon further pilot and then full deployment, P3DSETI will allow all participating jurisdictions to eliminate or at least minimize their use of paper dependent on their own procedures and processes. P3DSETI is hosted in the cloud and accessible to those with user access on any browser. This permits users to access files on their computers, tablets, or smartphones making paper copies of documentation unnecessary.

(3) The information available through MCDOT's pilot of P3DSETI is more plentiful and accurate than previous paper-based methods and even more so than contemporary hybrid methods using CAD software without BIM. As the P3DSETI platform and workflows mature and the library of facilities grows, even more information will be readily available for use during design and construction. New scans are performed at the close of construction or improvement projects, ensuring that the most current condition is reflected in the stored models. The building's historic models and as-builts can also be saved or archived for easy retrieval if needed later. Even now MCDOT has access to as-built designs, line drawings of asset systems, surveys, and scans in addition to the models. The scans and designs are GIS-linked to allow further evaluation of design and construction impacts such as hydrology changes or project induced traffic congestion. The breadth and depth of information that becomes available and accessible for decision-making using P3DSETI is substantially more than ever before.

(4) The MCDOT initial pilot of P3DSETI allows new measurements and measurement confirmation to be taken from the 3D scan point cloud and/or 3D model within meetings or during independent work. As the pilot expands, this feature will remain and will save time for all participants. Eliminated trips to the field saves the time and travel to the site as well as prevents exposure to traffic or other safety concerns encountered on site visits. Simultaneous electronic access allows further time efficiencies, which also produce cost savings. Ideally, when P3DSETI

is fully rolled out statewide, permitting and environmental compliance activities will also be accomplished digitally, saving time and allowing more in-depth evaluation with less effort. Costs of printing and mailing are also eliminated or minimized since users can access the files anytime and anywhere.

Merit Criterion #3 – Accelerate technology adoption and deployment

(1) One of the most appealing characteristics of P3DSETI is that it uses off-the-shelf software and equipment that are compatible with numerous other programs and equipment. This makes P3DSETI exceptionally flexible and easy to adopt by most jurisdictions. It allows jurisdictions to maintain control over their own procurement/purchasing and their own processes. The proposed project's pilot expansion does feature the important step of standardizing procedures and training staff. However, the resulting workflow, procedures, processes, and training materials will be able to be modified by other adopting jurisdictions to be able to accommodate their own equipment, software, and community needs.

(2) Scale up of P3DSETI to state and statewide adoption will require minimal capital expenditures. Most jurisdictions already use digital design software for working with CAD files or similar. They also have digital scanning equipment that is quickly replacing conventional surveying equipment and techniques. If they do not yet have digital 3D scanning equipment, there are affordable scanning applications that can work with an iPad, other tablet, and some smart phones. These scanning applications may not capture as much information as the more sophisticated lidar scanners, but they are able to collect enough data for the BIM engineering workflow and P3DSETI to provide substantial benefits in time and cost savings.

(3) The project will help address missing electronic data connections by linking identified scanned images and digital PDF documentation in archives to web-based scan clouds of the appropriate facilities. Other existing portions of assets that are already GIS-linked can be brought into a transportation asset's archive. P3DSETI will enable contract enforcement and construction validation using ongoing date stamped scans during the construction process.

(4) P3DSETI uses an open data format to facilitate easy adoption and collaboration.

(5) The proposed BIM engineering workflow and P3DSETI will improve project budgeting by minimizing unknowns at the construction site. Terrestrial LiDAR (3DScans, also known as 3D Laser Scanning or High-Definition Survey) technologies have matured to provide 3D survey data that is more accurate and economical than information from surveys using traditional techniques. This enables more accurate budgeting because measurements are more accurate. Measurements and existing conditions can also be rechecked many times using the 3D scan and resulting model in combination with the as-built drawings.

Merit Criterion #4 – Safety

(1) The 3D Scans are not only more accurate and economical than traditional surveys, but they are also safer. A technician scanning an intersection with one of the 3D scanners acquired as part

of the project will need roughly twenty (20) minutes to complete the scan. They would not have to stop traffic, stand in a travel lane, or wait for people or cars to move because the scans can be digitally scrubbed prior to uploading. This cleaning or scrubbing also takes minimal time but delivers a high-quality scan from which to produce the model for engineering. Traditional methods do require traffic control, waiting outside in the elements, and sometimes standing in the street or intersection. These all expose the technicians to safety hazards that are no longer necessary with the adoption of lidar 3D scanning technologies and the P3DSETI solution. Engineering staff and contractors will also be spared from going to the side of active roads to gather data as they can glean the information from the scans and model.

(2) Construction times are also shortened by minimizing the number of unknowns prior to establishing the work zone. With the accurate and thorough information available using modeling from 3D scans and line diagrams from as-built scans, engineers can mitigate most risks if any persist. In the long term, the certainty of current conditions, underground utility locations, and as-built plans will continue to eliminate unknowns in construction zones helping to produce more accurate scheduling and also prevent delays.

Merit Criterion #5 – Workforce Development, Job Quality and Wealth Creation

(1) The proposed program will train additional MCDOT staff members on making 3D scans of transportation assets using LiDAR scanners. This will not only expand the labor pool available to collect project site data, but also provide a new skill to workers. The ability to perform an accurate and complete 3D scan of transportation assets will be a marketable skill for these individuals. The new skill will serve them well in their current positions but also give them more opportunities for other employment should they seek to change jobs. Engineers trained on the BIM workflow for P3DSETI will also develop the new skill of using models in a paperless design process. They may also gain experience in using GIS-based modeling to better understand and evaluate the comprehensive impacts of their designs. These additional or enhanced skills will serve them as they continue with their engineering careers.

The proposed training program at MCDOT will not only benefit the individuals being trained but will also support the survival of the proposed engineering workflow using P3DSETI by making sure that enough staff are using it for the process to become ubiquitous across MCDOT. Training multiple people in each division to be able to utilize P3DSETI and the BIM engineering workflow will produce workforce continuity and ensure that the knowledge and skills generated in the pilot and its expansion will not be lost to turnover.

(2) The skills learned by the scanning technicians and the engineers will be transferrable to other positions within the same field as well as to some other career paths. While some of training will be specific to the technologies, software, and procedures of the P3DSETI pilot, much of it will also teach spatial evaluation, comprehensive site analysis, digital 3D modeling, and other skills that are useful in other careers outside of transportation infrastructure construction, operations, and maintenance.

Merit Criterion #6 – Environment, Climate Change and Sustainability, and Equity

(1) P3DSETI will reduce ROW by capturing every detail at proposed construction sites and reducing the uncertainty that leads to overstated ROWs enlarged to limit liability of appeals or legal challenges.

(2) The storage directories, or digital "buckets", filing system that P3DSETI uses will allow environmental compliance documentation, including preliminary design information that features environmental and equity commitments, to be stored alongside the models and other files associated with the transportation asset. This gives an additional opportunity to communicate these commitments to all involved engineers and project managers so the commitments can more easily be kept throughout the full lifecycle of the project.

(3) The GIS linkage of the 3D scans, models, and plans makes it easy to overlay the project location and potential impact areas into existing GIS resources that identify environmentally sensitive areas. Current practices in the industry can still check for environmentally sensitive areas but this is either done manually by examining maps by the Department of Fish and Wildlife or EPA or by making a separate project location map and then using that to overlay on the same maps. With P3DSETI and the engineering workflow proposed here, the 3D BIM is already GIS-linked so it can be extracted easily without having to build another map making identification of sensitive environments easier.

(4) With fewer unknowns in the work area, the very detailed 3D model, and access to extended analysis tools, construction planning and management and traffic management can be more effective. P3DSETI and the engineering workflow proposed in the pilot expansion naturally result in a file that can easily be used in existing GIS-based evaluation tools to predict traffic flow, which will allow designers and traffic managers to evaluate alternatives for work zone design to minimize congestion on the roadways.

(5) There will be some minor reductions in equipment operating time by removing unknowns and improving the pre-planning process.