
QUESTIONNAIRE

NCHRP PROJECT 20-05

SYNTHESIS TOPIC 55-02

**PRACTICES FOR COLLECTING, MANAGING, AND
USING LIGHT DETECTION AND RANGING (LIDAR)
DATA**

Prepared by

**Michael J. Olsen, Ph.D.
Principal Investigator**

Gene V. Roe, P.E., PLS, Ph.D.

Heidar Rastiveis, Ph.D.

January 2024 (revised)

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

**TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL**

NCHRP TOPIC 55-02 QUESTIONNAIRE

JANUARY, 2024

Dear Transportation Professional,

The National Cooperative Highway Research Program (NCHRP) of the Transportation Research Board (TRB) under the sponsorship of the American Association of State Highway and Transportation Officials (AASHTO) and in cooperation with the Federal Highway Administration (FHWA) is preparing [NCHRP 20-05/Topic 55-02 synthesis on "Practices for Collecting, Managing, and Using Light Detection and Ranging \(lidar\) Data."](#)

The purpose of this survey is to document state departments of transportation (DOTs) practices on collecting, managing, and using lidar data. The results of the survey will be incorporated into a synthesis of highway agency practice, with the intent of helping DOTs evaluate and improve their processes for collecting, managing, and using lidar data.

Typically, staff within the Geospatial/Mapping office would be appropriate to fill out this survey since it asks detailed questions about using lidar data in your DOT for many applications. **If you are not the appropriate person to complete this survey, please forward it to the correct person at your DOT.** Consultation among DOT staff is encouraged to get a holistic picture, but we would prefer only one respondent per DOT. If you have supporting documentation, the survey will allow multiple uploads up to 100 MB each. **If your agency does not use lidar data, please still proceed to complete the first question and submit your survey response.**

The survey may be completed at this link:

https://oregonstate.qualtrics.com/jfe/form/SV_1RgdZ3WEL3IAGFM

The PDF version of the questionnaire is available in the following link if you wish to have a general overview of the questionnaire:

https://web.engr.oregonstate.edu/~olsen/NCHRP/lidar/NCHRPSYNTH20-05_55-02_LIDAR.pdf.

Please complete this survey by **February 20th, 2024**. It includes 27 questions, and we estimate that it should take no more than 20 minutes to complete. It is designed so that you can exit and return to the survey. If you have any questions or issues with the survey, please contact Dr. Michael Olsen at (541)-737-9327 or michael.olsen@oregonstate.edu.

Survey tips:

☐ If you are unable to complete the survey, you can return to the survey at any time by reentering through the provided survey link as long as you access it through the

same computer. Reentering the survey will return you to the last completed question.

☐ Survey navigation is conducted by selecting the “prev” (previous) or “next” button at the bottom of each page.

☐ Until you submit the survey, you may revise your answers at any time.

☐ There is no time limit once you begin the survey. However, if you begin the survey and do not complete it; your partial response will be recorded when the survey closes.

Thank you for sharing your time and expertise with the DOT community.

Michael Olsen, Ph.D.

Professor of Geomatics

School of Civil and Construction Engineering

Oregon State University

Email: michael.olsen@oregonstate.edu

Phone: (541)-737-9327

Contact Information

Would you kindly provide your name and contact? Your confidentiality is assured for the purposes of this research.

First Name: _____
Last Name: _____
State DOT: _____
Division: _____
Job Title: _____
Phone Number: _____
E-Mail: _____

Use of lidar data within your DOT:

1. When did your DOT start to utilize lidar data? (Single Response)

- ☐ Very recently (0-1 year)
- ☐ Within the last 5 years
- ☐ Within the last 10 years
- ☐ Over 10 years ago
- ☐ No lidar usage

Display This Question:

If 1. When did your DOT start to utilize lidar data? = No lidar usage

1A. If your DOT is not using lidar data, please indicate the main reasons from the list below:

- ☐ Lack of trust in lidar data quality
- ☐ Software compatibility
- ☐ Difficulties in obtaining similar results to traditional workflows
- ☐ Limited experience, training, and capabilities
- ☐ Insufficient IT infrastructure (data storage, network latency, software tools, etc.)
- ☐ Other methods provide higher ROI.
- ☐ Effort required to extract information from lidar data
- ☐ Lidar data needs to be supplemented with additional data sources to meet project or reporting requirements.
- ☐ Other (Please specify: _____)
- ☐ Other (Please specify: _____)
- ☐ Other (Please specify: _____)
- ☐ Not Sure

Skip To: End of Survey If Condition: Selected Count Is Greater Than or Equal to 1. Skip To: End of Survey.








2. Which of the following best describes the use of lidar within your DOT? (Single Response)

- ☐ Fully integrated into workflows used by several departments for a wide range of applications.
- ☐ Some departments have fully integrated it and use it regularly while others use it occasionally.
- ☐ Scattered usages, no centralized plan or oversight.
- ☐ Lidar usage is rare.
- ☐ Other (please specify): _____

3. Please indicate the frequency of usage of different lidar platforms by your DOT regardless of lidar sensor, scanning mechanism (solid-state, flash, etc.), or application (topographic or bathymetric). (Select one option for each)

System	Not Sure	Never	Rarely (Research/ Pilot Projects)	Sometimes (Occasional Project)	Routine
Airborne					
Helicopter					
Terrestrial (tripod)					
Mobile (vehicle mounted)					
UAS-mounted					
Pocket lidar (e.g., smart device)					
Other (please specify): _____					


4. Approximately what percentage of the following types of lidar data used by your DOT is collected by external firms? (Slider bar to indicate percentage)

System	Percentage of the collected data by external firms %
Airborne	
Helicopter	
Terrestrial (tripod)	
Mobile (vehicle mounted)	
UAS-mounted	
Pocket lidar (e.g., smart device)	
Other (please specify): _____	

4B. Approximately what percentage of the lidar data used by your DOT is **processed by external firms**?

Percentage of the lidar data processed by external firms	
--	--

4C. Approximately what percentage of the lidar data used by your DOT is **downloaded from public domain repositories** (e.g., USGS 3D elevation program (3DEP), lidar consortiums, opentopography)?

Percentage of the lidar data by downloaded from public domain repositories:	
---	--

5. **How is your DOT approaching the transition from 2D to 3D workflows in the context of lidar data?**

- ☐ Gradual implementation across projects.
- ☐ Specific projects focused on 3D workflows.
- ☐ Comprehensive shift to 3D workflows.
- ☐ No transition in place. Primarily 2D workflows.
- ☐ Utilizing High Definition Mapping Infrastructure (HDMI) or base maps for Autonomous Vehicles (AVs).
- ☐ Not sure.
- ☐ Other (please specify): _____

6. **How many staff members are currently allocated to lidar efforts within your DOT?**

- ☐ Not Sure
 - ☐ Limited staff (e.g., 1-2 individuals)
 - ☐ Moderate staff (e.g., 3-5 individuals, a small team)
 - ☐ Extensive staff (e.g., 6 or more dedicated personnel)
-

Lidar Data Applications within your DOT

7. For each application, indicate the approximate level of usage of lidar data by your DOT (Never, Rarely, Sometimes, Regularly, Routine)

Application		Never	Rarely (Research/ Pilot Projects)	Sometimes	Regularly (frequently but not constantly)	Routine (consistently and as part of standard practice)
○ Roadway Projects:	○ Design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	○ Environmental Analysis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	○ Construction Quality Control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	○ As-builts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	○ Other (please specify):	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
○ Operations, Maintenance, and Safety	○ Bridge Inspection	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	○ Slope Stability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	○ Hydrological Studies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	○ Road Safety Analysis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	○ Highway Performance Management System	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	○ Other (please specify):	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
○ Mapping		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
○ Asset Management		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
○ Emergency Response		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
○ Crash Reconstruction for Quick Clearance		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
○ Other (please specify):		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
○ Other (please specify):		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
○ Other (please specify):		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. For each application, please indicate the main challenges from the list below:

- a. Lack of trust in lidar data quality
- b. Software compatibility
- c. Difficulties in obtaining similar results to traditional workflows
- d. Limited experience, training, and capabilities
- e. Insufficient IT infrastructure (data storage, network latency, software tools, etc.)
- f. Other methods provide higher ROI.
- g. Effort required to extract information from lidar data
- h. Lidar data needs to be supplemented with additional data sources to meet project or reporting requirements.
- i. Other (Please specify: _____)
- j. Not Sure

Application	a	b	c	d	e	f	g	h	i	j
<input type="checkbox"/> Roadway Projects:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Operations, Maintenance, and Safety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Mapping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Asset Management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Emergency Response	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Other (please specify): _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Other (please specify): _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Other (please specify): _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Data Lifecycle (Collection, Processing, Storage, Retention)

9. How often does your DOT collect network level lidar data for asset management?

Please select the most applicable option:

- ☐ Annually
- ☐ Biannually
- ☐ Just one statewide collect has been completed.
- ☐ Data are only collected for specific projects
- ☐ My DOT does not collect network level lidar data for asset management.
- ☐ Other (please specify): _____
- ☐ Not sure

10. **How does your DOT manage the retention of lidar data?** Please select the most applicable option:

- ☐ Retain all historical lidar data indefinitely.
- ☐ Retain specific datasets based on project requirements.
- ☐ Regularly purge older lidar data and retain only the most current.
- ☐ Other (please specify): _____
- ☐ Not sure

11. **How does your agency primarily store and access lidar data?** Please select the most applicable option:

	Never	Some	Primary Storage System
<input type="radio"/> On standalone desktop computers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/> On-premises network servers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/> Cloud-based storage solutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/> External drives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="radio"/> Other (please specify): _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Data Mining:

12. **How does your DOT approach lidar data processing workflows to meet specific project requirements?** (Select all that apply)

- ☐ Using predominately commercial software without customization.
- ☐ Developing in-house customized workflows
- ☐ Utilizing third-party software with customization options (e.g. scripting)
- ☐ Collaborating with external experts for customization
- ☐ Other (please specify): _____
- ☐ Not sure.

13. **What strategies has your DOT implemented to enhance the efficiency of lidar data processing and analysis workflows?** (Select all that apply).

- ☐ Utilizing parallel processing techniques
 - ☐ Implementing automated data processing pipelines
 - ☐ Investing in high-performance computing resources
 - ☐ External entities to assist in data processing
 - ☐ Utilizing artificial intelligence.
 - ☐ Other (please specify): _____
 - ☐ Not sure
-

Data Management and governance practices

14. How does your DOT manage lidar data in terms of data access and user permissions? (Select all that apply)

- ☐ Strict access controls
- ☐ User training on data handling
- ☐ Regular audits of data access
- ☐ Collaboration platforms
- ☐ Other (please specify): _____
- ☐ Not sure

15. How does your DOT handle data privacy concerns with lidar data? (Select all that apply)

- ☐ Data masking
- ☐ Restricting access
- ☐ Not collecting data in sensitive areas
- ☐ No specific measures in place
- ☐ Independent audit
- ☐ Other (please specify): _____
- ☐ Not sure

16. What steps does your DOT take to enhance the accessibility of lidar data for diverse user groups? Select all that apply)

- ☐ User-friendly interfaces for data access or processing.
- ☐ Providing data in multiple formats
- ☐ Conducting outreach and training programs.
- ☐ No efforts in place.
- ☐ Other (please specify): _____
- ☐ Not sure

17. To what extent does your DOT share\utilize lidar data with the following departments or external entities?

Division	Never	Rarely/ Upon Request	Regularly	Routine
Local Municipalities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Planning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Environmental	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Urban development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bridge/structures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Geotechnical	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Asset management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hydrological	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Survey\GIS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
External consultants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Academic research institutions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other. Please Specify. _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Quality assurance practices

18. Approximately what level of accuracy does your DOT expect or require from each lidar platform?

System	mm (0.005 ft)	cm (0.05 ft)	dm (0.5 ft)	m (5 ft)	several meters (>10 ft)	Not Sure
Airborne						
Helicopter						
Terrestrial (tripod)						
Mobile (vehicle mounted)						
UAS-mounted						
Pocket lidar (e.g., smart device)						
Other (please specify): _____						

19. How does your DOT typically ensure the accuracy of your lidar data? (Select all that apply)

- ☐ In-house validation protocols.
 - ☐ Third-party validation
 - ☐ Utilizing tools in manufacturer's software
 - ☐ Following industry standards such as ASPRS, ASTM, and others
 - ☐ Not sure
-

20. How does your DOT typically manage and maintain lidar data documentation and metadata? (Select the most applicable answer)

- ☐ Automated documentation processes
- ☐ Standardized metadata templates
- ☐ Periodic manual updates
- ☐ Detailed reports
- ☐ Document data requirements and data standards
- ☐ Links to data standards from each entity
- ☐ No metadata are tracked.
- ☐ Other (please specify): _____
- ☐ Not sure

21. What were the methods used to establish data requirements?

- ☐ Statewide data standards
- ☐ Agency-wide data standards
- ☐ Business unit/office specific data standard
- ☐ Other (Please specify) _____

DOT policies and standards

22. What role do standards play in your DOT's lidar data practices? (Select the most applicable answer.)

- ☐ Adherence to national standards (e.g., TRB Mobile lidar guidelines, ASPRS, ASTM, etc.)
- ☐ Development of internal standards
- ☐ Combination of internal and national standards
- ☐ Ad hoc procedures in place.
- ☐ Other (please specify): _____

Kindly provide access links to these documents or upload copies, if feasible. You may kindly email the files to Michael.olsen@oregonstate.edu

23. What methods do personnel in your DOT typically use to stay informed about the latest advancements in lidar technology? (Check all that apply)

- ☐ Regular training programs
- ☐ Internal, Ad hoc training/mentorship
- ☐ Membership in lidar-related organizations
- ☐ Collaboration with educational/research institutions
- ☐ Subscriptions to industry magazines and journals
- ☐ Continuing education opportunities
- ☐ Tradeshows and national conferences such as GeoWeek
- ☐ Professional certifications
- ☐ Other (please specify): _____

Future needs.

24. How does your DOT assess the return on investment (ROI) in lidar data projects?
(Select all that apply)

- ☐ Cost savings
- ☐ Time efficiency
- ☐ Improved decision-making
- ☐ Enhanced project outcomes
- ☐ Safety
- ☐ Other (please specify): _____
- ☐ ROI is not assessed.
- ☐ Not sure

25. Regarding costs for lidar programs, what specific cost components are prioritized or considered essential in term of improving ROI?

- ☐ High focus on collection costs
- ☐ Emphasis on processing costs
- ☐ Significant attention to storage costs
- ☐ Other (Please Specify)

26. If your DOT assesses ROI for lidar technology, what is the approximate level of return seen in recent years?

- ☐ substantial positive ROI
- ☐ Average ROI
- ☐ poor ROI
- ☐ unclear
- ☐ My DOT does not assess ROI for lidar technology.

Innovative and Interesting Case Examples

As part of this synthesis, we will be including case study examples with at least 5 DOTs to highlight lidar data usage including benefits and challenges. We are looking for case studies that reflect a wide range of technology usage levels.

27. We would like to interview selected DOT respondents for use in developing case examples. Case examples will be included in the final synthesis report. The case example DOTs will be identified, but the interviewees will remain anonymous. DOTs will have the opportunity to review their case examples for accuracy. Case example interviews typically last for one hour. Are you willing to participate in a case study interview?

- ☐ Yes ☐ No

Display This Question:

If 27. We would like to interview selected DOT respondents for use in developing cas... = Yes

Who will participate in the interview?

☐ Myself

☐ Someone else in our DOT

Display This Question:

If Who will participate in the interview? = Someone else in our DOT

Would you kindly provide their name and contact?

First Name _____

Last Name _____

Phone Number _____

E-Mail _____

Start of Block: End of Survey

End of Survey

The survey is complete. Thank you for your participation! Please contact the Synthesis Project Principal Investigator **Dr. Michael Olsen** at (541)-737-9327 or michael.olsen@oregonstate.edu for any questions or additional comments. Please hit the "Submit" button to finalize and submit your responses.