



Governor's Office of Planning & Budget and
Office of the Legislative Fiscal Analyst

Transportation Technician Training Efficiency Evaluation

*A Report for the
Utah Department of Transportation*

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SUMMARY

In accordance with Utah Code Annotated (UCA) 63J-1-904, the Governor’s Office of Planning and Budget (GOPB) and the Office of the Legislative Fiscal Analyst (LFA) conduct efficiency improvement projects with state agencies. For this efficiency evaluation, we collaborated with the Utah Department of Transportation (UDOT). We focused our review on issues related to operators of heavy equipment and snowplows, whom UDOT terms Transportation Technicians.¹

For this report, we determined that UDOT heavy equipment operators need to complete maintenance projects and remove snow from highways in a manner that is timely, safe, high-quality, and cost-effective. Multiple factors impact the effectiveness of equipment operators, including training and experience both before and after joining UDOT. This report focuses on the preparation, training, and development of operators, but we encourage UDOT to consider other approaches, such as recruitment and retention strategies, when trying to improve the effectiveness of equipment operators.

To train their operators, UDOT uses a program called the Transportation Technician Education Program (TEP).² The TEP sets a progression through three levels of Transportation Technician and outlines the requirements to move through each stage, which includes items from on-the-job training to math classes. To continue building on and enhancing this program, we recommend that UDOT consider defining the goals of their operator training program with greater specificity.

Additionally, we recommend that UDOT develop measures for identifying and targeting training needs and for evaluating new programs. We also offer five new ideas for training programs that UDOT should consider implementing, depending on what issues they would like to address and other priorities. Lastly, we recommend that UDOT develop a purposeful strategy for implementing any new training programs.

We structure this report with four recommendations:

- Recommendation 1: Develop a clear, measurable definition of a good operator for each type of equipment.
- Recommendation 2: Develop measures to find and target gaps in operator proficiency and to evaluate training programs.
- Recommendation 3: Identify training solutions to improve Transportation Technician proficiency.
- Recommendation 4: Establish an implementation strategy for new solutions.

UDOT has a relatively new internal training program, the Mobile Simulator Training Center, and is interested in expanding its utilization. We compiled this report with a broader perspective than considering only the Mobile Simulator,³ but we reference how each recommendation could be applied to the Mobile Simulator where applicable.

1 In the report we use the terms “Transportation Technicians” and “operators” to describe operators of both heavy equipment and snowplows.

2 [UDOT Transportation Education Program](#)

3 We refer to this program as the “Mobile Simulator” throughout the report.

RECOMMENDATIONS AND DISCUSSION

UDOT has a culture of outcome transparency, as evidenced on their Zero Fatalities public dashboard,⁴ and of continuous improvement. We intend the recommendations in this report to support UDOT's ongoing efforts to enhance their equipment operator training. In reviewing UDOT's reported performance measures and other data, we did not identify major concerns with current training. We heard from several employees many innovative ideas for improvement. Additionally, operating heavy equipment carries a high risk of safety incidents or other negative outcomes for operators, other UDOT employees, and the public, which presents opportunities to reduce these risks. As such, we frame some aspects of our recommendations as suggestions, options, and considerations, because we believe it is most appropriate for UDOT to determine their priorities.

Recommendation 1: Develop a clear, measurable definition of a good operator for each type of equipment.

UDOT has not developed a clear, measurable definition of a good operator for each piece of equipment, which means that UDOT does not have a complete objective for the equipment operation portion of Transportation Technician training. Employees we spoke with suggested various key aspects of a good operator but we found that there is not a standard definition adopted by the organization. The definitions we heard tended to emphasize the employee's background or area of expertise or experience. For example, those who worked in areas related to safety or risk management tended to focus on safety when defining a good operator, whereas those who worked in maintenance tended to focus on the operator's ability to use the equipment with precision. While each employee recognized that there is a broad array of important skills and knowledge that a good operator must possess, the variability in skills emphasized indicates that there is not an organizationally shared understanding of what constitutes a good operator.

UDOT uses a set of standardized checklists called "Equipment OJT (On-the-Job Training) Checklists" when assessing a Transportation Technician's proficiency. These checklists standardize the skills and knowledge that should be assessed but do not provide guidance for how to assess each item, leaving the determination of whether the operator's knowledge and performance is sufficient up to the individual administering the assessment, usually the Station Supervisor. In other words, UDOT defines what should be measured but not the standard against which it should be measured. We recommend that UDOT provide greater clarity for supervisors by defining a good operator for each piece of equipment.

We identified three skill areas that together consist of the key proficiencies a good operator must possess: safety, operation, and maintenance of equipment. These skill areas work together but are distinct. Although we generally outline the skill areas below, UDOT is best positioned to determine details and specifics that will vary by equipment type.

Proficiency in safety encompasses the ability to operate the equipment in a manner that reduces the risk of injury or death to the operator and those in the operator's environment, as well as the risk of damaging vehicles, buildings, or other objects in the environment. This includes employing best practices such as wearing a seat belt, maintaining three points of contact (two hands and a foot, or two feet and a hand) while entering and exiting the equipment, and keeping the work area clear of hazards. It includes maintaining environmental awareness at all times, of both stationary and mobile objects, and other people. It includes

4 <https://udot.utah.gov/strategic-direction/zero-fatalities.html>

knowledge of the proper way to communicate with vehicles and people, whether through verbal communication, hand signals, eye contact, radios or horns, or other means. Finally, safety proficiency includes having a basic ability with the machine's controls to avoid errors (e.g., dumping the bucket instead of lowering it) or needing to focus on the equipment controls to the detriment of paying attention to other safety concerns.

Proficiency in operation is the ability to quickly and precisely complete work with the equipment, and is typically the proficiency that is most easily observed. An example is the ability to remove dirt from the "pit" and leave the driving surface smooth and not corrugated. It also includes the ability to operate the equipment in a manner that does not cause unnecessary wear-and-tear, for example, the ability to effectively engine brake to decrease brake shoe wear, or shift in a way that minimizes clutch wear.

Proficiency in maintenance consists of knowing what maintenance needs to be completed and when it needs to be done, having the skills needed to perform the maintenance, and being able to perform pre-use inspections. While major maintenance items must be completed by a mechanic, many items are the responsibility of the operator. These vary by machine but will typically include checking and inflating tires, greasing various parts, and checking and maintaining fluid levels. In addition to performing minor maintenance, operators need to be able to identify and act on issues that may lead to more significant problems. This includes performing pre-use or pre-trip inspections to identify issues that are a safety concern or that have the potential to damage the vehicle or increase wear if not remedied.

We recommend that UDOT define a good operator for each type of equipment using these three proficiency areas as a foundation. We recommend including enough specificity and detail in the definitions that they can be used as the standard against which operator proficiency is measured, and as the objective of UDOT equipment operator training tools and programs.

Recommendation 2: Develop measures to find and target gaps in operator proficiency and to evaluate training programs.

Once UDOT has defined a good operator, we recommend that they develop measures to (a) identify Transportation Technicians who are not meeting proficiency standards, and (b) assess the value of current and future training programs. UDOT can then use these data to determine the most effective training programs to implement with their training resources and target those programs strategically where they will have the greatest impact, thereby improving the performance of Transportation Technicians.

Identify Transportation Technicians who are not meeting proficiency standards

Currently, UDOT is tracking outcome-based measures such as injuries and equipment damage. These measures are valuable, but they are "lagging" indicators. After an incident, a Transportation Technician will receive remedial training but the incident has already occurred. We recommend that UDOT also develop and monitor "leading" indicators to mitigate future incidents, particularly major safety incidents. Additionally, outcome-based measures such as injuries and equipment damage may not be effective in identifying gaps in proficiency, due to the small number of incidents in each category and other characteristics of those data. Of note, some supervisors we talked with appreciated the idea of a leading indicator to help them manage their operators and sheds.

We recommend that UDOT consider using the methods below to track measures at multiple levels: individual Transportation Technicians, sheds, and potentially larger areas. In some cases, UDOT may find it most appropriate to identify and train individual operators, such as those who do not pass the Equipment OJT Checklist in a timely manner. In other cases, there may be patterns that are systemic to a larger organizational unit, such as issues for urban sheds but not rural ones.

We recommend UDOT consider using the following methods to identify Transportation Technicians who are not meeting proficiency standards:

1. Qualitative employee surveys
2. Proficiency assessments
3. Risk assessments.

Qualitative Employee Surveys

We recommend UDOT consider conducting a survey directed at Transportation Technicians. Due to the significant consequences of error when operating equipment, we heard that some Transportation Technicians are apprehensive about their work, particularly related to snowplows. A lack of confidence may result in high turnover rates or safety incidents. A Transportation Technician survey could include questions gauging level of confidence in performing duties or the level of comfort they have in asking their supervisor or coworkers for help or additional training. Questions could include:

1. *Do you feel confident in your ability to perform your duties?*
2. *If not, what would help you feel confident?*
3. *Do you feel the amount of training you have received is sufficient?*
4. *If not, in what area(s) do you feel you could use more training?*
5. *Do you feel comfortable asking your supervisor and coworkers for help and/or additional training?*
6. *Have you received safety training related to your job? Do you feel confident in your ability to work in a way that is safe for yourself and others, and to respond to emergencies in your workplace?*
7. *Do you feel that your coworkers are sufficiently trained (on a scale of 1-10)?*
8. *Do you feel that you are provided with sufficient opportunities to receive additional training and expand your knowledge in your field?*

Proficiency Assessments

In addition to existing Equipment OJT Checklists, UDOT could implement other proficiency testing, as described in Solution 3d, under Recommendation 3. UDOT could more easily and proactively identify gaps in operator proficiency if there were more instances of proficiency assessment and assessment of a broader range of operator skills.

Risk Assessments

To help UDOT identify, evaluate, and mitigate potential risks associated with operating heavy equipment, UDOT could consider instituting risk assessments. Measuring risk is a useful leading indicator of potential outcomes. UDOT could create a risk scoring method for

individuals and sheds to understand how to prioritize training efforts. Scoring criteria could include:

1. *Transportation Technicians*
 - a. *Length of time with UDOT*
 - b. *Transportation Technician level (I, II, III)*
 - c. *Results of Qualitative Employee Surveys*
 - d. *Status of completing Equipment OJT Checklist and any other trainings or assessments*
 - e. *Types of equipment used and level of operating difficulty*
 - f. *Prior injury and equipment damage incidents*
2. *Sheds or larger areas*
 - a. *Average amount of experience*
 - b. *Results of Qualitative Employee Surveys*
 - c. *Results of Equipment OJT Checklist and any other trainings or assessments, aggregated by shed*
 - d. *Types of equipment used and level of operating difficulty*
 - e. *Age and condition of equipment*
 - f. *Location and environment*
 - g. *Age and/or maintenance history of equipment*
 - h. *Rates of injury and equipment damage incidents*

UDOT could further consider creating a risk matrix to assess identified risks against the probability of occurrence and the consequences of realized risks. Criteria for the matrix could include:

1. Identifying the hazards present for Transportation Technicians, e.g., equipment damage due to missed maintenance.
2. Evaluating the probability of each hazard occurring, based on how frequently the task is performed or how difficult or technical the task is.
3. Estimating the consequence of each hazard occurring. For example, a fatality is an extremely high consequence, a major mechanical failure may be a moderate consequence, and minor equipment damage may be a low consequence.
4. Using the probability and the consequence of each hazard, assign a risk score to each hazard, with higher probability and/or higher consequence hazards scoring higher, and lower probability and/or lower consequence hazards scoring lower.

UDOT can then prioritize training solutions to focus on mitigating the highest priority risks first, then work their way down to lower priority risks. UDOT should regularly review and update its risk assessment tools to ensure they remain accurate and relevant.

Assess the value of training programs

In Recommendation 3 of this report, we identify several possible solutions to training issues. UDOT also has training programs that they are in the process of implementing, including the Mobile Simulator. In addition to identifying gaps in proficiency overall using the methods proposed above, UDOT could consider using the methods we identify in this section to evaluate the impact of specific training programs.

We recommend that UDOT assess not only whether a training program is effective but identify specifically what population of Transportation Technicians would most benefit from the program. For example, several UDOT employees explained to us that they think the Mobile Simulator is best targeted to new operators who do not have experience with actual equipment. UDOT could make this kind of determination about programs by analyzing the results of measures by various factors, including length of time with UDOT, rural or urban location, type of equipment, assessment results, or by responses to qualitative surveys.

UDOT could consider using outcome-based measures such as injuries and equipment damage to evaluate training programs. Those measures are based on a small number of past incidents in each category, so the training program would have to have a substantial impact for UDOT to observe an effect.

We recommend UDOT consider using the following methods to assess the value of training programs:

1. Qualitative employee surveys
2. Proficiency assessments
3. Cost-effectiveness evaluations

Qualitative Employee Surveys

A simple way UDOT could assess a new training program is a qualitative survey of each participating Transportation Technician, or surveying a sample of Transportation Technicians. UDOT could implement the survey after the training, or do pre- and post-training surveys. UDOT contracts with L3 Harris for their snowplow simulator training and we understand that L3 Harris conducts a qualitative survey of operators after they complete the training. UDOT could use that kind of survey as a model. Questions could include:

1. *Did this training improve your proficiency?*
2. *How confident do you feel to use the skills on which you were just trained?*
3. *Was the time that you spent in this training worthwhile?*
4. *Would you recommend this training to other operators?*
5. *Which operators would most benefit from this training? (By experience level, job assignment, etc.)*

UDOT could consider targeting surveys to Station Supervisors to evaluate the impact of training programs. Questions could include:

1. *Did this training improve the operator's proficiency?*
2. *Was the operator's time spent in this training worthwhile?*
3. *Would you recommend this training to other supervisors for their operators?*
4. *Which operators would most benefit from this training? (By experience level, job assignment, etc.)*

Proficiency Assessments

If UDOT implements additional proficiency testing, as described in Solution 3d under Recommendation 3, that information could be used to assess the effectiveness of specific

training programs. UDOT could evaluate how well or how quickly operators passed those assessments after a training program, comparing them to operators who did not participate in the program or to operators overall. The assessments could be implemented only after training is complete, or with a pre- and post-test structure.

Cost-Effectiveness Evaluations

When determining the value of a new program, we recommend that UDOT consider examining its cost-effectiveness.

Figure 1. UDOT calculated and shared with us the following average training costs.

Commercial Driver License (CDL) training and other equipment training	Operator time	\$1,148
CDL training and other equipment training	Trainer time	\$2,126
Week-long training academy	Operator time	\$2,295
Week-long training academy	Facilities and meals	\$1,000
CDL course	External to UDOT	\$3,600

The amounts in Figure 1 provide some information about the costs of operator and trainee time, as well as certain other specific training costs. The list does not include pertinent costs such as fuel and wear-and-tear when new operators are learning to operate the equipment. To accurately determine the cost-effectiveness of a new program, UDOT should develop a per-operator baseline cost for current training processes, to then compare to the new program. For example, to evaluate the cost-effectiveness of the Mobile Simulator, UDOT would want to establish the time cost for the trainer and the operator (number of hours multiplied by their respective hourly rates) and the equipment cost of current on-the-job training and for the Mobile Simulator. If the amount of time required for the trainer and the operator are the same for both programs, including any travel time, UDOT only needs to compare the equipment cost: in this case, the fuel and wear-and-tear on actual equipment versus the costs to initially develop and continually operate the Mobile Simulator. There may be benefits to a program beyond cost, such as the Mobile Simulator providing a greater initial comfort level to new operators, but we encourage UDOT to consider cost as an important component in evaluating a new program.

Once UDOT has determined which measures to use to identify Transportation Technicians who are not meeting proficiency standards – whether at the individual, shed, or larger area level – they can target training programs to those populations. This targeting would allow UDOT to improve operator performance while using resources efficiently. Further, UDOT could use the measures to evaluate the effectiveness of an existing training program or a newly implemented training program. Assessing the value of training programs can help UDOT focus efforts on implementing the most effective programs, to improve performance while using resources efficiently.

Recommendation 3: Identify training solutions to improve Transportation Technician proficiency.

UDOT told us about new training programs that they are implementing, including the Mobile Simulator and a mentorship program. Through our research and analysis for this report, we identified five other training programs that we believe would improve Transportation Technician proficiency. We recommend that UDOT consider implementing one or more of these solution options. Some solutions may be relatively easy and inexpensive to implement; others may require a greater investment of resources. In addition to outlining each solution, we also highlight issues that we expect each solution would address and suggest factors UDOT should take into account when determining the value of each option.

Solution 3a: Increase detail of Equipment OJT Checklists

On-the-job training is the primary method UDOT uses to train Transportation Technicians to be safe and effective equipment operators. To determine that a Transportation Technician has achieved the desired level of proficiency, supervisors use a standardized Equipment OJT Checklist to assess the Transportation Technician and then sign off on their proficiency. According to UDOT policy 06A-15, Region Trainers are responsible for conducting testing of all equipment operators, evaluating test results, and issuing certifications.⁵ In practice, testing and evaluating test results is conducted by many different Station Supervisors and experienced operators across the state. Employees involved with UDOT's training program say that they believe there is wide variation in how Equipment OJT Checklists are administered, due to the number of individuals involved. We also observed that the Equipment OJT Checklists are relatively general, allowing for even greater variation in how they could be interpreted. If there is wide variation in the way proficiency assessments are conducted, Transportation Technicians may receive a sign-off on their skills when they have not actually met the minimum standard that UDOT desires. This could lead to problems with safety, efficiency of completing work, and wear-and-tear on equipment.

We found that some other states use more detailed proficiency assessment checklists than UDOT. For example, UDOT's front-end loader Equipment OJT Checklist includes an item for "load truck." In comparison, the loader proficiency assessment checklist that Texas DOT uses lists 11 specific steps, including "positioned dump truck for ease of loading," "carried loaded bucket without spillage," and "leveled load in dump truck."⁶ UDOT employees identified to us additional practices an operator must demonstrate that are not specifically listed on the Equipment OJT Checklist, such as coming to a complete stop before shifting between drive and reverse to prevent transmission damage. With a more detailed checklist, as in other states, there is less variation in how the skills listed on the checklist can be interpreted, even if numerous supervisors and other individuals are administering the assessments. Further, UDOT could use the results of a more detailed Equipment OJT Checklist to assess if operators struggle to attain proficiency on certain specific skills more than other skills, and target training interventions to those more challenging skills, either on an individual level or statewide.

If UDOT is concerned about the quality of how Equipment OJT Checklists are administered and the resulting current or potential negative outcomes, they could increase the detail included on the checklists. We expect this would decrease the variation in skills among Transportation Technicians

5 UDOT Policy 06A-15: [06A-15 Certification of Vehicle Driver Operator.pdf](#)

6 [TxDOT Expressway Loader Checklist](#); See Appendix 1 for a UDOT OJT Checklist example.

at the time of sign-off, likely reducing the chance of Transportation Technicians who are not proficient receiving a sign-off. We anticipate that UDOT could implement this solution by leveraging the checklists of another state that is willing to share their assessments.

Solution 3b: Institute basic safety training and assessments

Because UDOT's primary training method for operating heavy equipment is on-the-job training, Transportation Technicians are, by definition, using the equipment before they are fully trained. On-the-job training is considered a best practice for training equipment operators, and we consistently heard that practical, real-world experience is an irreplaceable portion of operator training. However, due to the lack of standardized basic safety training and assessment prior to beginning on-the-job training, Transportation Technicians may sometimes be operating equipment without having basic and essential knowledge of safety procedures. Anecdotally, we heard from UDOT employees about accidents that occurred with operators who had not yet passed their Equipment OJT Checklist. Even as they are learning equipment operation skills on-the-job, Transportation Technicians should be aware of and adhere to safety procedures.

In 2019, a Colorado DOT employee was struck and killed by a front-end loader while performing road maintenance. Colorado implemented multiple changes in response, including instituting a requirement that every operator who uses a front-end loader maintain a safety endorsement. Operators receiving the endorsement for the first time must complete a four-hour classroom training, a pre- and post-test, and a field-based performance assessment verifying their ability to adequately perform a pre-trip inspection and operate the equipment in a safe manner.⁷ This process allows for both supervisors and administrators to know that the operator working in the equipment will at least operate it safely, if not proficiently, and allows for additional training to be provided to those operators who may otherwise pose a safety hazard to themselves or others.

This process helps ensure operators learn safety procedures first, but then have the opportunity for hands-on learning by using the equipment.

If UDOT is concerned that the current safety risk for their operators and others is too high, especially the risk posed by those who have not passed the Equipment OJT Checklist for a piece of equipment, they could consider instituting basic safety assessments. Further, if instances of equipment damage or injuries are associated with a lack of awareness of safety procedures, a safety assessment prior to on-the-job training would be valuable. Instituting basic safety training and assessment for operators would provide UDOT leadership the assurance that operators are not a safety hazard during their on-the-job training and would allow other employees to feel confident that their co-workers are not a safety risk.

Solution 3c: Create "equipment operator coaches"

Region Trainers generally do not directly provide equipment training as they have significant other responsibilities. Those responsibilities include coordinating and tracking Transportation Technician progress through approximately 100 online courses and other requirements of the Transportation Technician I and II training curriculum, as well as helping operators enroll in and complete various specialty training tracks. Station Supervisors may train equipment operators but they have many

⁷ [Colorado DOT Front End Loader Safety Endorsement Program](#)

duties of their own and may not necessarily be excellent trainers. UDOT employees explained to us that training is most often conducted on-the-job through informal mentorship with more experienced operators within a shed. There are benefits to this practice but UDOT has a large number of sheds, and the level of operator expertise with different equipment varies widely. As a result, sheds with fewer skilled operators may struggle to provide adequate training to new operators, leading to a cycle of lower skill levels. Additionally, operating heavy equipment and snowplows requires a different set of skills than teaching and mentoring others, meaning that not all highly skilled operators are equally able to teach those skills to others. UDOT employees say that they observe significant variations in operator skill levels across sheds due to these factors.

One solution is for UDOT to identify highly skilled operators who are interested in teaching and designate them as “equipment operator coaches.” These coaches would still primarily perform their usual duties for their own shed, but also serve as trainers for multiple sheds in their area. UDOT could increase their teaching abilities with “train-the-trainer” programs. “Train-the-trainer” programs would be an opportunity for UDOT to further standardize training, since fewer individuals would be conducting training. UDOT could choose to expand the program beyond training only, and have coaches conduct Equipment OJT Checklist sign-offs and other assessments. Coaches could also foster positive communication and the sharing of best practices among sheds.

If UDOT believes that the quality of training should be improved or that training should be more standardized, developing equipment operator coaches is a strategy to address those issues. The program could be tailored to meet UDOT’s desired level of standardization and could serve as an advancement opportunity for the coaches. However, it would shift training to a more centralized approach, reducing workload but also autonomy for Station Supervisors. While higher-quality training may lead to efficiency savings over time, UDOT would likely need to increase compensation for coaches to implement this program. Additionally, coaches would not be as available for current work duties while receiving their own training and administering training to others.

Solution 3d: Implement multiple assessments

UDOT currently assesses a Transportation Technician’s ability to operate each piece of heavy equipment only once, with the Equipment OJT Checklists, typically during the first 6-18 months after they are hired. UDOT may wish to consider increasing the number of assessments conducted throughout a Transportation Technician’s career. UDOT employees explained to us that Equipment OJT Checklists are intended to verify that an operator demonstrates the basic level of competence required to operate specific equipment unsupervised. In order to build that basic level of competence, operators need to use the equipment before their checklist sign-off and therefore UDOT may wish to implement a basic safety assessment prior to the Equipment OJT Checklist (see Solution 3b). Similarly, UDOT could supplement the Equipment OJT Checklist with more early-career assessments to track an operator’s progression and to identify and resolve specific skills gaps.

Additionally, UDOT does not assess a Transportation Technician’s skills beyond basic proficiency evaluated by the Equipment OJT Checklist. While UDOT provides a significant amount of additional curriculum to guide operators through the Transportation Technician II track and then specialty tracks, advanced equipment operator proficiency is not specifically trained or assessed after completion of the Transportation Technician I track. Other states offer further equipment operator training. For example, in Colorado operators with at least three years of experience operating heavy equipment can enroll in a Heavy Equipment Operator III program and receive additional training and evaluations

to become advanced operators.⁸ Additional assessments in these areas can provide information regarding the specific level of proficiency of a Transportation Technician that is not currently available to UDOT.

Based on other states' structures, UDOT could implement multiple assessments as follows:

1. A basic safety assessment, as outlined in Solution 3b.
2. An assessment within 30 days of hiring to advance individuals with prior experience.
3. A mid-training assessment to evaluate what resources are needed for a Transportation Technician to achieve proficiency.
4. An assessment to demonstrate proficiency to operate unsupervised.
5. An advanced operator assessment for operators with significant experience.

Assessments can entail a written portion and a field test, depending on the skills that UDOT wants to evaluate.

If UDOT wants to measure and monitor each operator's skill level, beyond the single point-in-time sign-off of the current Equipment OJT Checklist, they may want to institute additional assessments. Some of the assessments we listed above could use the same form, such as the Equipment OJT Checklist, even if they occur at different points in time. If UDOT wants to evaluate advanced proficiency, they could ask another state that is willing to share their assessments. UDOT would also need to acknowledge the time that would be required for operators and supervisors or trainers to spend on the assessments. If UDOT wants to use the assessment data centrally to identify the impact of training programs or target individuals or sheds for further training, as we described in Recommendation 2, they would need to develop a way of storing and analyzing the information. UDOT may wish to weigh the benefits of the additional information gathered from assessments against possible pushback from current operators and supervisors who might oppose additional time spent on conducting assessments or the increase in monitoring.

Solution 3e: Provide facilities for snowplow and heavy equipment training

Transportation Technicians have limited opportunities to practice on equipment away from a job site or roadway, particularly in urban areas. UDOT employees say that simulators are useful for teaching an inexperienced operator how to use controls but are not a substitute for real equipment. Multiple UDOT employees suggested to us that having a facility for hands-on training would allow employees to become comfortable using snow plows and heavy equipment in a low-consequence environment where potential safety risks, and associated anxieties, are minimized. Because UDOT does not have such a facility, the first time new Transportation Technicians drive a snowplow at speed is often on a public highway as part of an active snow removal effort. Likewise, it is uncommon for operators to have opportunities to gain hands-on experience with heavy equipment outside of active job sites. Job sites contain hazards such as other workers, buried or overhead utilities, and nearby traffic. Due to these risks, supervisors often use an already skilled operator to ensure the job is completed safely and quickly, which limits the opportunities for new operators to gain hands-on experience.

One option to address the lack of a practice facility is for UDOT to utilize land it already owns to provide space for hands-on heavy equipment training. UDOT owns a significant amount of vacant

8 [Colorado DOT Heavy Equipment Operator III Program](#)

land that they purchased for future use or for a project that did not utilize the full parcel. UDOT could designate certain areas for training, presumably choosing places that have limited or no utilities present, are not close to residences, and are not likely to be needed for other projects or sold in the near future.

Another option would be for UDOT to request access, or additional access, to one of the existing public vehicle training facilities, such as the Emergency Vehicle Operations range located near Camp Williams, which is used by the Utah Highway Patrol and other law enforcement agencies to teach driving skills.

A last, costlier option would be for UDOT to construct their own, similar facility. With a robust, specialized facility, UDOT could allow snowplow operators to practice at speed, with barriers, simulated bridge expansion gaps, and other obstacles. UDOT could allow heavy equipment operators to practice without real-world consequences, such as digging above buried utilities, so operators can focus on acquiring and refining the skills they need to successfully operate their equipment in the field without worrying about causing serious damage.

If UDOT believes access to a controlled environment would improve training quality and operator confidence, they may want to choose one of the above options. While operators need to be able to operate equipment effectively in a real-world environment, providing a controlled environment may be a safer starting point for newer operators. UDOT could integrate practice at the facility after operators complete training on the Mobile Simulator. Supervisors could also utilize the facility for remedial training or for developing advanced skills for especially challenging tasks. In contemplating this solution, UDOT should consider the time to transport equipment and operators to the facility. Also, a single central location could offer a wider range of simulations, but it may be less utilized if it requires more travel for operators.

Recommendation 4: Establish an implementation strategy for new solutions.

After UDOT has completed Recommendations 1 and 2, and identified any solutions they plan to adopt either from Recommendation 3 or other programs, such as the Mobile Simulator, we recommend that they create an implementation strategy for those solutions. With advance planning and given UDOT's many employees and resources dedicated to training, they should be able to avoid misunderstandings and implementation delays, and increase adoption of each new program. In this section, we offer considerations and potential approaches to inform that strategy.

Centralized or decentralized

UDOT should proactively consider how much centralization or decentralization is appropriate for each solution and the associated benefits and limitations. Currently, UDOT sets some mandatory training policies centrally, including the TEP program overall. Station Supervisors largely implement training programs, which can lead to variation by shed and makes implementation less standardized. Other training policies are not centrally mandated and are adopted or not only at the shed level, such as the Mobile Simulator. Presumably, Station Supervisors implement their own training programs as well,

such as informal mentorships. UDOT should consider, for each new solution, whether to make the policy mandatory and how standardized to make implementation. Figure 2 shows examples for each kind of implementation.

Figure 2. Implementation examples.

	Mandatory	Not Mandatory
Standardized	Commercial Driver Licenses, which UDOT requires for snowplow operators, are federally standardized and mandated	Mobile Simulator, which is optional to use but has standard simulations and assessments
Not Standardized	Equipment OJT Checklists, with Station Supervisors and others conducting sign-offs based on their individual interpretation	Mentorships between experienced and new operators, set up informally by Station Supervisors

Some solutions could be applied in multiple combinations of mandatory and standardized, such as equipment operator coaches (Solution 3c). Others may work better centralized, such as basic safety training and assessments (Solution 3b). For standardization in particular, there is a spectrum from completely standardized to completely unstandardized, and UDOT should purposefully choose their strategy.

Target solutions to key populations

As UDOT is evaluating potential training programs, they should determine if the training program is most appropriate for certain populations (see Recommendation 2). One important determination would be for UDOT to assess whether the program is most effective for new or experienced operators. For example, UDOT employees described to us that they found the Mobile Simulator most useful as a tool for new operators to learn the controls and develop muscle memory and subsequently, operators need to become familiar with the tactile feedback and visual cues experienced while training on actual equipment.

Examples from the solutions in Recommendation 3 include: providing one region or shed with higher turnover rates with more frequent access to the Mobile Simulator, or choosing to use equipment operator coaches to target training on a specific type of equipment. As part of their implementation plan for new training programs, UDOT should expressly identify what populations would benefit from the program and use that as guidance for how they implement mandatory programs or how they implement mandatory programs or how they communicate about non-mandatory programs.

Communicate the value of programs and decrease barriers to supervisor adoption

Once UDOT has identified the target populations for a training program, they should explicitly communicate that information to Station Supervisors. Without that framing, supervisors are required

to assess the training program themselves to decide whether to participate, if the program is optional, and which operators to send. With that framing, supervisors would not need to invest as much time and mental effort in decision-making, which would remove a barrier to their participation.

After selecting a training program to implement, UDOT should strategically plan to encourage buy-in from Station Supervisors. Even mandatory, standardized programs benefit from supervisor support. For example, supervisors generally need to approve when their Transportation Technicians engage in a training program. For non-mandatory or less standardized programs, supervisor buy-in would be even more necessary.

UDOT should use data about the effectiveness of a training program, gathered from evaluating the metrics described in Recommendation 2, to demonstrate the program's value to supervisors. For example, if operators passed the Equipment OJT Checklist sooner than average after participating in the training program, UDOT should communicate those results. UDOT could share other sources of information as well, such as testimonials from supervisors who participated in a pilot that tested the training program. If supervisors are not convinced of the value of a program, they are less likely to devote efforts to engage with it.

UDOT should address barriers to adopting new training programs by making it easier for Station Supervisors to engage in implementing the programs and seeing their results. For example, a barrier to adopting the Mobile Simulator is requiring regions or sheds to request its use. We recommend that UDOT remove the barrier of supervisor request by centrally setting a schedule for when and where Mobile Simulator will be, and notifying supervisors of the schedule in advance. Each Station Supervisor can then decide which of their operators they will send and for which type of training. The Mobile Simulator has the advantage of being mobile, which reduces travel time and therefore time away from work for operators, which can be another barrier to adoption. UDOT could consider providing other training programs locally as well. UDOT should contemplate these and other similar strategies to make supervisor adoption of new training programs as simple and straightforward as possible.

Communicate clear expectations and align incentives for supervisors

We recommend that, as UDOT implements any new training programs, they clearly communicate training expectations and operator proficiency standards to Station Supervisors. UDOT should share their definitions for good operators with supervisors to specify the proficiency standards that they expect operators to meet and to emphasize the outcomes that UDOT wants to achieve. They should communicate specific expectations about each new training program, including describing how mandatory and how standardized UDOT is structuring the implementation. Supervisors need this information to manage performance and effectively meet those expectations.

UDOT should ensure that Station Supervisors' incentives are aligned with expectations for operator proficiency and outcomes. We understand that supervisors sometimes need to navigate conflicting expectations. For example, supervisors are expected to support employee training and development while meeting deadlines for maintenance projects. Providing opportunities for training may require employees to be absent from the job site while completing maintenance projects timely requires their presence. This conflict can make it difficult for supervisors to effectively balance competing priorities.

UDOT could better align Station Supervisor incentives with desired outcomes by facilitating periodic or as-needed conversations between area or region-level supervisors and Station Supervisors. These conversations would focus on ensuring that UDOT expectations and priorities are clearly communicated, reviewing how each Station Supervisor's shed is performing on key outcomes, and bringing more attention to those outcomes. Additionally, UDOT could leverage shed-level data to show supervisors how they are performing. These data could show the effectiveness of local efforts, allowing supervisors to build ownership of their shed's performance. If UDOT shares data across sheds, supervisors would also have visibility into the efforts of other sheds. This transparency, without any rewards or punitive actions, would likely incentivize supervisors in underperforming areas to engage in improvement efforts, including with effective training programs appropriate to their particular challenges.

METHODOLOGY

Operational Processes

For this evaluation, we met regularly with a UDOT working group and conducted interviews with UDOT employees who oversee training, risk management, equipment maintenance, and work in operational excellence. We visited four sheds (Salt Lake, Grantsville, Nephi, and Cottonwood). We also had the opportunity to use the Mobile Simulator and operate heavy equipment. Additionally, we reviewed:

- Transportation Technician Education Program (TEP)
- Equipment OJT Checklists
- Training and assessment programs of other states
- Information provided by the National Conference of State Legislatures
- Transportation Technician advancement data
- Traffic Accident Review Committee reports
- Equipment maintenance data
- UDOT Zero Fatalities dashboard

Data Analysis

UDOT tracks heavy equipment maintenance data. We analyzed those data for front-end loaders, backhoes, snowplows, and snowplow accessories between January 2017 and November 2022. The dataset included the year the maintenance occurred, the year of the vehicle, the type of vehicle, the location of the vehicle, the maintenance type code, labor hours, cost of maintenance, and other information.

UDOT employees told us that equipment operator proficiency affects the equipment and a lack of proficiency often results in added maintenance and higher costs. We attempted to use the maintenance data we received to discover if certain sheds or regions have higher maintenance costs than others. We ran various statistical models but we were not able to identify any specific sheds or regions with costs outside of the expected patterns. We also attempted a manual analysis and found high costs are typically associated with the piece of equipment and not the shed or region. Because of these results, we did not include a maintenance data analysis in this report.

Additionally, we aimed to identify a measure of operator proficiency using equipment maintenance data that could be a leading indicator of future safety issues and other adverse outcomes, but were unsuccessful. UDOT data analysts may be able to utilize equipment maintenance data more effectively and find such a measure.

APPENDIX 1 - On-the-Job Training (OJT) CHECKLIST EXAMPLE

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Checklist

UDOT TEP (Tech I - Phase I) Equipment - Front end loader OJT

Checklist Items

1. Pre-operation Check

Engine Compartment

1 2 **Not Rated**

Begin pre-operation by checking the equipment for visible leaks. This may require down on the ground.

Engine Compartment

1 2 **Not Rated**

Check filters for signs of leaking.

Engine Compartment

1 2 **Not Rated**

Check oil level, transmission fluid, coolant level, hydraulic oil level, power steering fluid, water pump, and fuel system to make sure they are filled to the proper levels per owner's manual.

Engine Compartment

1 2 **Not Rated**

Assess the belts and hoses for loose, cracked, missing or weathered.

Engine Compartment

1 2 **Not Rated**

Inspect the air filter and clean or replace according to owner's manual.

STATUS



LEARNING PORTAL ADMIN

Status Not evaluated

Evaluator

Progress 0 % Complete

Owner:

UDOT TEP (Tech I - Phase I) Front end loader OJT

Engine Compartment

1 2 **Not Rated**

Inspect fan for cracked or damaged fins.

Engine Compartment

1 2 **Not Rated**

Inspect radiator for damaged or clogged fins.

Engine Compartment

1 2 **Not Rated**

Check battery and terminals.

Engine Compartment

1 2 **Not Rated**

Check exhaust line for cracks or broken welds.

Engine Compartment

1 2 **Not Rated**

Become familiar with any other items not on this list in the owner's manual.

Exterior

1 2 **Not Rated**

Review the exterior of the loader checking the condition of the tires, rims, lug nuts, cutting edge, cutting edge bolts, corner bit, bucket, bucket hooks, pivot points, safety link, hydraulic hoses and hydraulic rams.

Exterior

1 2 **Not Rated**

Check lights and rotos for any signs of damage.

Exterior

1 2 **Not Rated**

Become familiar with any other items not on this list in the owner's manual.

Start up / Warm up

1 2 **Not Rated**

Assess the current condition of the seat belt, parking brake, transmission, gauges, R.O.P.E.S., windows/mirrors, wipers, work lights, warning lights, hoist RAMs, and extended bucket RAMS.

Start up / Warm up

1 2 **Not Rated**

Check fire extinguisher.

Start up / Warm up

1 2 **Not Rated**

Check seat and steering column movements and adjust to his or her preference.

Start up / Warm up

1 2 **Not Rated**

Perform an active functional review of the forward and backwards movement, service brake, park brake, right and left turn, and all equipment movements. Dismount loader, check leaks, steering components, pins, backup alarm and battery.

Start up / Warm up

1 2 **Not Rated**

Locate fuel card, owner's manual, and service book.

Start up / Warm up

1 2 **Not Rated**

Check for properly mounted equipment and whether safety equipment works.

Start up / Warm up

1 2 **Not Rated**

Become familiar with any other items not on this list in the owner's manual.

2. Field Operations

Field Operations

1 2 **Not Rated**

Mount loader while maintaining 3 points of contact.

Field Operations

1 2 **Not Rated**

Wear seatbelt prior to starting loader.

Field Operations

1 2 **Not Rated**

Check overhead clearance.

Field Operations

1 2 **Not Rated**

Demonstrate he or she is aware of their surroundings and uses spotter when needed.

Field Operations

1 2 **Not Rated**

Demonstrate proper start up and safety checks listed in owners manual.

Field Operations

1 2 **Not Rated**

Load from stockpile.

Field Operations

1 2 **Not Rated**

Dump in stockpile.

Field Operations

1 2 **Not Rated**

Load truck.

Field Operations

1 2 **Not Rated**

Maintain smooth operation while loading.

Field Operations

1 2 **Not Rated**

Load truck to appropriate capacity.

Field Operations

1 2 **Not Rated**

Do not spin tires.

Field Operations

Not Rated

Attach and detaches bucket and other attachments.

Field Operations

1 2 **Not Rated**

Operate loader smoothly.

Field Operations

1 2 **Not Rated**

Perform proper shutdown according to owners manual.

Field Operations

1 2 **Not Rated**

Performs 3 points of contact when dismounting loader.

APPENDIX 2 - AGENCY RESPONSE

[Final Report: UDOT Efficiency Evaluation](#)

Key takeaways:

Based on UDOT's reported high-level outcome performance measures, we did not identify major concerns with current training. However, we did hear from several employees that there is room for improvement; logically, any safety incident or other negative outcome presents an opportunity for improvement.

UDOT personnel responded positively to working with the governor's office and were proud to demonstrate the heavy equipment work they do in the region. They provided an interactive experience for the governor's office personnel and spoke candidly about their needs and suggestions for improving training. Many of the recommendations (e.g., equipment coaches) originated from UDOT employees working in the maintenance stations.

The recommendations reiterate and call attention to known and observed gaps in equipment training. Employee Development has been working towards solutions for the equipment training challenge for quite some time. The recommendations lend credibility to internal actions underway to resolve the issues.

Recommendation 1: Develop a clear, measurable definition of a good operator for each piece of equipment.

- Update checklists to standardize the skills and knowledge to be assessed and provide guidance for assessing each behavior expectation
- Provide guidance for station supervisors to determine whether the operator's knowledge and performance are proficient and that they are prepared to operate the equipment
- Define a good operator for each piece of equipment with respect to operator safety, operation, and maintenance of equipment.
- including enough specificity and detail to use the definitions as the standard against which operator proficiency is measured and as the objective of UDOT equipment operator training tools and programs.
- Define what should be measured and the standard for operator safety, operation, and maintenance of equipment.

UDOT Response

UDOT Current State: UDOT does not have a clear, measurable definition of a *good operator* for each piece of equipment, which means that UDOT does not have a comprehensive objective for the equipment operation portion of Transportation Technician training.

UDOT uses a set of standardized checklists called "Equipment OJT (On-the-Job Training) Checklists" when assessing a Transportation Technician's proficiency. These checklists standardize the evaluation of skills and knowledge. Still, they do not guide evaluating each item, leaving the determination of whether the operator's knowledge, ability, and performance are sufficient up to the individual administering the assessment, usually the Station Supervisor.

UDOT Employee Development and UDOT policy 05-52 guide the Transportation Education Program. However, the UDOT regions implement the program locally, and the UDOT regions operate autonomously based on the business need and projects available for on-the-job training and execution of the program. Regional autonomy is a core value in the relationship between employee development and the regions; station supervisors and region leadership determine competency based on peer review.

Employee Development welcomes the opportunity to create a standard and encourage all station supervisors to adhere to the definition and training process.

UDOT Actions to Improve: UDOT will take the steps outlined in the report; we will create an implementation plan for a measurable and standard definition of a “good operator.” As part of this plan, we will devise a strategy and tactics for working with region training and leadership personnel to negotiate accountability expectations necessary for measurement.

Recommendation 2: Develop measures to find and target operator proficiency gaps and evaluate training programs.

Once UDOT has established its definition of a good operator, we recommend that they develop measures that: (1) identify Transportation Technicians who need to meet proficiency standards and (2) assess the value of current and future training programs.

UDOT could create a risk-scoring method for individuals and sheds to understand how to prioritize training efforts. Scoring criteria could include

1. Transportation Technicians
 - a. Length of time with UDOT
 - b. Transportation Technician level (I, II, III)
 - c. Results of Qualitative Employee Surveys
 - d. Status of completing Equipment OJT Checklist and any other training or assessments
 - e. Types of equipment used and level of operating difficulty
 - f. Prior injury and equipment damage incidents
2. Sheds or larger areas
 - a. Average amount of experience
 - b. Results of Qualitative Employee Surveys
 - c. Results of Equipment OJT Checklist and any other trainings or assessments, aggregated by shed
 - d. Types of equipment used and level of operating difficulty
 - e. Age and condition of equipment
 - f. Location and environment
 - g. Age and/or maintenance history of equipment
 - h. Rates of injury and equipment damage incidents

UDOT should further consider creating a risk matrix to assess identified risks against the probability of occurrence and the consequences of realized risks. Criteria for the matrix could include:

1. Identify the hazards present for Transportation Technicians, e.g. equipment damage due to missed maintenance.
2. Evaluate the probability of each hazard occurring based on how frequently the task is performed or how difficult or technical the task is.
3. Estimate the consequence of each hazard occurring. For example, a fatality is an extremely high consequence, a major mechanical failure may be a moderate consequence, and minor equipment damage may be a low consequence.
4. Using the probability and the consequence of each hazard, assign a risk score to each hazard, with higher probability and/or higher consequence hazards scoring higher and lower probability and/or lower consequence hazards scoring lower.

UDOT can then prioritize training solutions to mitigate the highest priority risks first and incrementally work to lower priority risks.

UDOT should regularly review and update its risk assessment tools to ensure they remain accurate and relevant.

UDOT Response

UDOT Current State: UDOT tracks outcome-based measures such as injuries and equipment damage. These measures are valuable, but they are “lagging” indicators. <https://udot.utah.gov/strategic-direction/zero-fatalities.html>

The regions use a peer review process to determine if Transportation Technicians are proficient; each region determines its norms and practices for the peer review process. The peer review process is part of the TEP program and unique to each region based on the region's business needs.

UDOT uses some surveys when necessary but limits surveys to avoid survey fatigue.

UDOT Actions to Improve: Employee Development will partner with UDOT Risk Management and Employee Safety to implement the appropriate measures and controls and prioritize risks related to proficiency gaps.

While the peer review process is unique to each region based on the region's business needs, there is room to work with the region trainers and leadership to document common, expected standards in the peer review process. Documenting the commonalities provides a consistent baseline (for peer review measurement) among the regions without prescribing practices or criteria.

Reviewing the recommendations will help Employee Development make progress in determining proficiency standards in our training programs and assessing training needs from a risk perspective.

Recommendation 3: Identify training solutions to improve Transportation Technician proficiency.

We recommend UDOT consider implementing the following measures: 1. qualitative employee surveys, 2. proficiency assessments, and 3. cost-effectiveness evaluations.

1. Did this training improve your proficiency?
2. How confident do you feel to use the skills on which you were just trained?
3. Was the time that you spent in this training worthwhile?
4. Would you recommend this training to other operators?
5. Which operators would most benefit from this training? (By experience level, job assignment, etc.)

UDOT may also consider targeting surveys to Station Supervisors to evaluate the impact of training programs. Questions could include:

1. Did this training improve the operator's proficiency?
2. Was the time that the operator spent in this training worthwhile?
3. Would you recommend this training to other supervisors for their operators?
4. Which operators would most benefit from this training? (By experience level, job assignment, etc.)

Based on other states' structures, UDOT could implement multiple assessments as follows:

1. A basic safety assessment, as outlined in the “safety training and assessments” solution.
2. An assessment within 30 days of hiring to advance individuals with prior experience.
3. A mid-training assessment to evaluate what resources are needed for a Transportation Technician to achieve proficiency.

4. An assessment to demonstrate proficiency to operate unsupervised.
5. An advanced operator assessment for operators with significant experience.

UDOT Response

UDOT Current State: For the classroom and knowledge portion of the TEP program, course completion, along with approval from region trainers, supervisors, and region leadership determines proficiency for each transportation technician. The regions use the peer review process to determine if Transportation Technicians are proficient. The peer review process is part of the TEP program and unique to each region based on the region's business needs.

UDOT uses some surveys when necessary but limits surveys to avoid survey fatigue.

UDOT Actions to Improve: UDOT Employee Development will collaborate with region trainers and leadership personnel to develop a feasible proficiency assessment protocol that serves Central's needs for metrics while providing valuable, actionable information for region trainers.

Recommendation 4: Establish an implementation strategy for new solutions.

Determine: Centralized or decentralized

Determine: Target solutions to key populations

Communicate: Communicate the value of programs and decrease barriers to supervisor adoption.

Communicate: Communicate clear expectations and align incentives for supervisors.

UDOT Response

UDOT Current State: UDOT has a TEP Statewide Workgroup, which includes Trainers, Maintenance, and Construction personnel from Employee Development, the Regions, and the sheds. We run all changes and improvements to the training programs through the TEP Statewide Workgroup.

To communicate expectations and training requirements, UDOT has in place the following: TEP Policy, TEP Procedures, TEP guide, Equipment checklist, and TEP working group composed of Central maintenance, Central Construction, district engineers, Area Supervisors, Transportation Technicians I, II, III from across the state.

UDOT Actions to Improve: We will seek changes in the Workgroup utilizing the recommendations to develop an implementation plan. We do many of the items listed here at the central level and need to figure out how to communicate better and ensure collaboration with station supervisors.

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This report was written as part of a joint collaboration between the Utah Governor’s Office of Planning & Budget and the Office of the Legislative Fiscal Analyst.

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