Developing a Competency Model for State DOTs

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ABSTRACT

For engineers in state DOTs, current training may not be on par with current technologies in practice, or a lack of funding or resources could prolong or limit the amount of trainings offered. There may also be a gap between the competencies needed and the competencies taught in these trainings. The Louisiana Department of Transportation and Development (DOTD), using the Highway Safety Section as an example, completed a competency model to identify possible knowledge gaps.

Research began by reviewing work completed by other states and national organizations. Next, the team interviewed employees within each section to better understand their day-to-day job duties while learning about their processes and what helps or could help them do their job more effectively. A framework of action-based competencies was developed based on all information gathered, including: section-specific information, currently available and required training, and other internal and external resources. After multiple iterations of feedback and modification, final competencies were grouped as necessary.

Once competencies were defined, they were matched with appropriate training. This consisted of instructor-led courses, go-by documents, websites, manuals, conferences, and more. Next, the section supervisor decided what level of proficiency was desired, what level of proficiency the employees currently exhibited, and the criticality of each competency. Continuing this process across the department and other state DOTs may help set training priorities and the development of future training. Additional knowledge gaps may become apparent as more research is completed.

Keywords: competency, training, proficiency, criticality, safety

INTRODUCTION

Background and Setting

Employees of the Louisiana Department of Transportation and Development (DOTD) fall under specific Structured Training Programs (STPs). Current available and required training meets their job expected duties, mandated certifications, as well as other requirements specific to their role. For engineers, training topics include compliance training (e.g., ethics, sexual harassment) but may also include specific technical training (e.g., leadership, safety, CADD, maintenance, and other specific transportation topics). Funding is available for some in-house courses facilitated by third parties or travel to offsite training. However, many trainings may be lacking for Louisiana's specific needs, or in other cases are not offered in a timely manner. State DOT engineer training may not include current technologies in use, or a lack of funding or resources could prolong or limit the amount of training opportunities offered. Section supervisors, their employees, the Technology Transfer and Training Section, and other stakeholders do not always agree on proper training methodologies, the importance of the trainings, or how the allotted budget should be spent. In addition, the Federal Highway Administration (FHWA) and other governmental agencies provide various funding opportunities if certain objectives are met, including training and certifications (1-3).

Government agencies are unique in their approach to training. First, employees within DOTD of all levels are required to take yearly trainings such as ethics, sexual harassment, or other health-related trainings (4). Their STP also typically includes vital job specific trainings that private sector businesses do not offer or cannot easily access. These are high quality courses that are taught by experts and may include otherwise expensive certifications or certificates. Employees are also encouraged to register for and take trainings that fall outside of their STP. Meister (5) noted that today's adult learners increasingly insist on value with various options and flexible trainings available. Lastly, the training departments of any organization have the opportunity to develop unique trainings that match very specific needed objectives. Connecting with employees where they are with sufficient and useful training should be the goal of anyone employed with the requirement and ability to do so (6). All trainings mentioned have a set of objectives that can be mapped to specific competencies. Having a standard for trainings and competencies (statewide and possibly even nationally) is crucial in determining the importance and relevance of the training opportunities available for each area of engineering in state DOTs.

For the purposes of this study, a competency was defined as "what an employee needs to know, or know how to do, in order to be more effective at their job." This focuses on technical knowledge, skills, and abilities to help close any knowledge gaps, enhance job-related skills, and allow an employee to perform at a higher level within their role. Competencies may also include items that require the employee to comply with applicable state and governmental laws, statutes, regulations, policies, and principles. In DOTD, a "Section" is defined as a specific specialized department or area sharing similar responsibility (e.g. Highway Safety, Road Design, Location and Survey) (7).

Statement of the Problem

Governmental agencies are expected to uphold the current state of affairs by way of funding, policies, and legislation. This has the potential to limit innovation in certain areas. There are laws, along with minimum and maximum requirements for engineering specifications and policies. As these policies may be similar across the nation, this reveals a need for a standard way of creating and organizing competencies and trainings. Because various areas of engineering require something similar, a competency model was developed for the DOTD Highway Safety section based on a previously created framework (8). While other states, namely Alabama and Washington, have started to change their safety

cultures internally across multiple sections, specialties, and programs, they share their value by putting it at the forefront of decision making, as there is always room for improvement (9-10).

Regardless of differences concerning highway safety, FHWA requires each state to implement new infrastructure-oriented proven safety countermeasures. This can be achieved by addressing up to 20 different treatments or strategies through the State's Strategic Highway Safety Plan (SHSP) as part of the Highway Safety Improvement Program (HSIP) (1, 11). To fulfill this mandate, each state's SHSP also must identify an FHWA representative or liason. However, there are no set specific guidelines for the person in this role, nor if this role is shared amongst a group or section within the given DOT. This person also becomes a member of a national committee with representatives from other states. Here, communication can flow from FHWA to the states or between the states. Each state has the opportunity to share with others what works for them and modify it as they see fit. While there may be best practices across the nation, discrepancies among states may still exist.

As every state DOT employs engineers who must be certified, licensed, and qualified (12-13), their training must also meet the ever-increasing need. This model may not be applicable in the private sector but may still be of use. Regarding safety, the Committee for a Study of Supply and Demand for Highway Safety Professionals in the Public Sector of the Transportation Research Board (TRB) shares the view that road safety professionals must possess a common body of knowledge and skills, stating the following:

> To perform competently, road safety professionals must have an understanding of the safety roles of engineering, enforcement, education, and emergency response; the institutional setting for safety management; and the data and information systems available to support safety decisions (14, p. 76).

As budgets continue to decrease while tasks simultaneously increase, departments of all types must be more fiscally responsible than ever. Departments must begin planning now due to the imperative need for the improvement of professional development opportunities. State DOTs can work on both current and future issues by developing flexible training opportunities. Organizations that focus on a systematic way of assessing competencies met through trainings can save time and effort while better preparing their engineers.

Purpose of the Study

The primary purpose of this study was to develop a competency model to be repeated across multiple sections within a State DOT. The following research objectives were developed to accomplish the purpose of the study:

1. Identify a list of suggested competencies that are necessary for the department/district/section under consideration.
2. Identify and match current available trainings for each competency.
3. Determine the perceived proficiency level and criticality of each competency.
4. Identify current training gaps of each competency.

Objective 1

To accomplish Objective 1, a list of suggested competencies included in the study was developed based on a combination of reviewed literature and expert opinion. Further investigation by the researcher included: reviewing job descriptions of those employed in the section within DOTD; personal interviews with employees of the section within DOTD and contract employees who work closely with them; training objectives listed with training courses within the employees' STPs; and training objectives from useful trainings mentioned throughout the personal interviews.

Objective 2

To accomplish Objective 2, the list of suggested competencies was matched with all training opportunities found. All methods of research were utilized, including interviews, reviewing training transcripts, and in-depth desk research.

Objective 3

To accomplish Objective 3, the Section Head was asked to choose a level (numbered 1-4) for each employee group at each competency. This included Proficiency, Proficiency-Goal, and Criticality. The researcher and Section Head met in person for a short time to explain the process and go over a few competencies. Once the researcher was confident that the Section Head understood the process, they were given the opportunity to complete the rest of the grading at their convenience.

Objective 4

To accomplish Objective 4, the list of suggested training opportunities was matched with the levels of Proficiency, Proficiency-Goal, and Criticality. Any that lacked sufficient training opportunities but had a high level of Proficiency-Goal and Criticality were marked as a high priority.

METHODS

Introduction

Before building a model of competencies and trainings, an area of engineering must be chosen. This can be done at the state DOT level through discussions with the researcher, training team, administrators and leaders, and other stakeholders (e.g., various committees). Areas, or sections within the DOT, can be chosen based on a few criteria, including: current successful working relationships, interest, volunteers, sections who utilize training opportunities, sections with high turnover, sections with a high retirement-ready rate, areas lacking current training, and sections that interact with the most [stakeholders, consultants, other DOT sections], among others.

Once a section is chosen, a timeline can be created. First, a brief meeting is scheduled with the Section Head to describe an overview of the process and request one primary point of contact (this can be the Section Head) and 5-10 core section staff members (e.g., Organizational Unit administrators) to act as support throughout the process. Next, a longer meeting, known as the Kick-off Meeting, is scheduled to meet with the staff members and the Section Head to describe the process in detail. This includes discussing the scope of the project, the expected level of participation by time and effort of the section, and the responsibilities of both parties.

Research

Moving forward with the research component, technical competencies for engineers can be identified through multiple means. Since most areas of research have something from which to begin, current competency frameworks that can be leveraged should first be researched. This includes researching other DOT best practices, universities, national organizations (FHWA, NHTSA, TRB, AASHTO, NHI), and topic-specific professional developmental organizations.

Using the DOTD Highway Safety Section as an example, “the committee believes that the statement of NCHRP Research Results Digest 302: Core Competencies for Highway Safety Professionals, released in May 2006, could begin to meet many of these needs, both in its current form and after refinement” (14, p. 77). This report, along with work completed from Alabama (9) and

Washington (10) DOTs, helped provide a foundation for a framework. However, since they are written in an instructional form, they were modified to fit under a specific competency or definition for DOTD's needs.

Next, researchers may look in depth at the section and unique opportunities offered. This includes the section history, job descriptions, duties, and tasks of those employed by DOTD. By comparing what a job looks like to what research reveals, competencies and definitions were reviewed and modified where appropriate. Then, examining the current Structured Training Programs (STPs) of these roles, additions and modifications were made. Other areas of research that help to create, modify, and define competencies include, but are not limited to:

- Data shared by employees of the section (e.g., job aides, SOPs, onboarding processes, blank performance evaluation forms)
- Organizational Structure Charts
- Internal resources (e.g., Intranet)
- External resources (e.g., other DOTs)
- Training and professional organizations

Developing the list of competencies and definitions also encompasses extensive desk research including: reviewing all previous literature; reviewing job descriptions, training objectives, and transcripts; conducting multiple interviews; and reviewing conversations and emails with those whom team members interacted throughout the project.

Note: Although the researcher or team members have not spoken in depth with any section employees at this point of the process, desk research is conducted before and continues even after the interviews take place.

Interviews

The conducted interviews included 16 approximately one-hour face-to-face conversations with people within the DOTD Highway Safety section (this number can change depending on the size of the section). These interviews also included the researcher and one or two other teammates to assist in note taking. The researcher and team conducted the interviews in a location most favorable to the section employees, whether at the DOTD Headquarters building or in the District Headquarters' offices. Interviewees represented a broad sample of the job types within the section, from new employees (6 months – 2 years) to seasoned employees (15-25 years), with a minimum of 3-5 employees from each Section's Organizational Unit. Generally, the Section Head and Organizational Unit administrators were included in the interviews, and they were able to suggest specific employees from their unit who they believed could offer valuable insight. If the section is small enough, all employees may be interviewed, but if too many people within the same section are interviewed, the time required of the employee may not provide much benefit due to an over-saturation of information.

Each interview was informal and conversational in nature. They were designed to help the researcher better understand the employee's day-to-day job duties while learning about their processes and what helps or could help them do their job more effectively. They were asked what current trainings they have completed outside of their individual STP that provided useful information. There was also time built in to allow the employee to share other helpful but unscripted information. Upon the conclusion of the interviews, the researcher thanked the interviewee and asked if they would be willing to share anything they may think of that would be of use throughout the duration of the project. The researcher also let the interviewee know they may be contacted via email as the project moves forward. To help the researcher stay on task, a list of guided questions were used as a reference. These questions were modified from several sources and were also created in-house (15). They included:

1. Tell us a little about yourself and your background - how did you get to where you are since graduating?
2. What does a typical day look like?
3. What do you find yourself doing a lot?
4. What do you struggle with often?
5. If you have a question, where do you go for the answer?
6. What do you need to know or wish you knew to do your job more effectively?
7. What do you wish you had known in year 1 that you know now?
8. What softwares do you use often? What are the top 2-3 things you use that software for?
9. If you had to train a new employee, where would you start?
10. What is the most enjoyable training you completed?
11. What other trainings were useful?
12. What area is lacking in training for future endeavors?
13. What Professional Development groups are you a member of?
14. What conferences do you attend?
15. What other sections do you work with frequently?
16. What do you wish other sections knew about your section?
17. What do you wish you knew about other sections or the department?
18. What is the one thing your section could do to improve regardless of cost?

Competency and Definition Development

As the researcher and team began compiling a list of new and modified competencies, their goal was to look for opportunities to combine competencies or group them in similar categories. If necessary, a competency may be placed in multiple groups until final form, as well as include sub-competencies. The process was very rudimentary at first; capturing everything plausible, as it is easier to remove possible competencies than it is to add them later. During this process, easel-sized sticky notes are used and placed on the walls until all notes are captured. The researcher and team may make tally marks as something is mentioned more than once to help take note of its occurrence. However, the author would like to note the importance of documenting everything while also being aware how things may change. Employees mentioning something more than once is not always indicative of importance, which is why the interviews are just one part of the process. It is also imperative not to become attached to something early on until the big picture is closer to complete. By using software to transcribe all interviews, a word cloud can be composed to help paint a picture as well.

For practicality, using a word processing software that allows tracking changes is helpful in moving from sticky notes to a digital format. It is important to see the history of what competencies moved along with how definitions were formed over multiple iterations. Competency definitions should be written in action-based form that include measurable verbs when applicable (e.g., demonstrate, identify, understand, recognize, ability, explain, leverage, describe). There is no requirement for the length of a definition. Footnotes can be used to reference where important information was taken. Lastly, though there will be specific time to match training with each competency, if the team sees a specific training mentioned during this process, it is important to note it next to the competency. This will aid the process moving forward and give further credibility to the competency, along with helping create a definition (course objectives).

After a rough draft is complete, the researchers should send a copy to the core section staff members and ask for feedback. This draft should only include competency areas, sub-competencies, and definitions. Training, proficiency, and criticality are not part of this draft, as competencies may be added or removed. As mentioned previously, constructive criticism is welcomed at this stage, and no

competency or definition should have a high level of attachment. There are possibilities that may allow miscommunication to overshadow beliefs or thoughts on important topics, and this feedback loop helps to clarify any confusion. There are three major questions all reviewers should ask themselves at this stage in the process:

- What is correct?
- What is incorrect?
    - May include suggested modifications
    - May include changing competency locations
- What is missing?

After multiple reviews are completed, incorporating all comments and notes suggested from all involved section members, the formation of a final draft can begin. Before final submission, the draft should undergo multiple reviews, including editing for grammar and spelling. Once it is ready for final proof, the core section staff members are asked for feedback one last time, with the Section Head's feedback as final approval. Next, the competencies and definitions can be moved to another software platform to begin mapping trainings. The author suggests using a digital database moving forward. Microsoft Excel and Google Sheets work well for basic tools, but they have versioning issues when multiple people are involved, slow down with larger datasets, and do not offer as many features without having deep knowledge of the systems (e.g., pivot tables). By storing the competencies, definitions, and more in a database as opposed to a word processor or generic file or folder, future competency models can build on past models while keeping the workflow and verbiage consistent. A typical database similar to Microsoft Access may be used, although the author recommends and uses a web-based project management software (e.g., Monday.com, Airtable, Smartsheet, Asana, Notion).

Matched Trainings

Once a final draft of competencies and definitions is approved, each competency can be matched with appropriate training. It is important to note that "Matched Training" does not have to be a physical face-to-face training class. The appropriate training may include any of the following:

- Face-to-face, virtual, or hybrid instructor led courses
- Go-by documents
- Web-based training (internal or external)
- Website links
- Manual (Standard Operating Procedures [SOPs], software, in-house designed)
- Workshops
- Conferences
- Mentorships/peer-to-peer training

The use of a database to store the training information is important to include further information for each training opportunity. This may include answers to the following questions:

- Is the course currently offered?
- When is the course offered? How often? What days/times?
- Who provides the course?
- How much is any registration fee?
- How long is the course?
- What is the method of delivery?
- Who are the eligible participants?
- Can it be developed internally?

- Is it currently required in STP?

If there are notes documenting earlier research on training opportunities, they provide a great head start. This includes looking at information found through desk research, answers provided by employees during interviews, viewing current employees' training transcripts, and STPs. Next, further research can be completed by looking at other state agencies, national organizations, professional development groups, third-party training organizations, universities, and more.

The researcher and team should be cautious in the time they devote to searching, as a training solution may not be available for every sub-competency or be the ultimate solution. As mentioned previously, simply having knowledge and access to a website may suffice in many cases. There is no set rule for how much time it should take to find a training for a given competency. Spending 10 minutes will not be enough time, but 10 hours is far too much.

As this project is completed across a given section, and more importantly multiple sections, themes may begin to emerge. One training course may be shown to serve as a solution for multiple listed competencies. On the other hand, some competencies may not have any solution available. Both examples help the effort move forward. The training solution that shows up multiple times could be given priority (in regards to time and costs), possibly made available more often, and examined for content to verify the applicability and appropriateness. For those competencies with no solution, the organization has an opportunity to consider developing something, either in-house or contracted, purchasing training, or even disregarding the competency if it is not shown to have high proficiency and/or criticality further in the process.

As this document is reviewed, the core section staff members and Section Head may give feedback on the listed solutions. This can include comments on a training's usefulness, if something is outdated, additions to listed trainings, and fill-in gaps where solutions are not listed. Even so, not all competencies will have a matched training for the first draft, and some may not have one for the final draft.

Proficiency and Criticality

For the purposes of this study, Proficiency (P) is defined as at what level an employee group is currently capable or experienced in the given technical competency. This can include a level of current knowledge possessed or an ability to apply the skills learned to achieve a level of output or performance. Proficiency should be chosen from one of four levels. While the explanation of each level is detailed per the specific competency, the overall premise should stay the same for each proficiency. The four levels of Proficiency are defined as:

- P1 = Developing
  - Does not possess a basic understanding of [competency] and therefore cannot apply it in a meaningful way.
- P2 = Progressing
  - Possesses a basic understanding of [competency] but does not yet possess an ability to apply it effectively.
- P3 = Accomplished
  - Possesses an advanced understanding of [competency] and can apply it effectively.
- P4 = Distinguished
  - Possesses an advanced understanding of [competency] and its application. Considered an expert by peers. Participates in processes (forums, working groups) to advance the definition and structure of [competency].

For the purposes of this study, Proficiency-Goal (PG) is defined as at what level the Section Head desires an employee group to be capable or experienced in the given technical competency. This can include a level of knowledge or an ability to apply the skills the employee should strive to achieve for a given level of desired performance. Proficiency-Goal should be chosen from one of four levels. While the explanation of each level is detailed per the specific competency, the overall premise should stay the same for each proficiency, and the defined proficiency-goals should mirror the appropriate defined proficiency levels. The four levels of Proficiency-Goal are defined as:

- PG1 = Developing
  - Does not possess a basic understanding of [competency] and therefore cannot apply it in a meaningful way.
- PG2 = Progressing
  - Possesses a basic understanding of [competency] but does not yet possess an ability to apply it effectively.
- PG3 = Accomplished
  - Possesses an advanced understanding of [competency] and can apply it effectively.
- PG4 = Distinguished
  - Possesses an advanced understanding of [competency] and its application. Considered an expert by peers. Participates in processes (forums, working groups) to advance the definition and structure of [competency].

For the purposes of this study, Criticality (C) is defined as the level of importance an employee group needs to know, be familiar with, and exemplify understanding of a given competency. Criticality should be chosen from one of four levels. The four levels of Criticality are defined as:

- C1 = Not critical
- C2 = Needed
- C3 = Critical
- C4 = Highly critical

For proficiency, proficiency-goal, and criticality, the levels should be chosen in aggregate for an employee group or job function, rather than for an individual. The Section Head may choose to have multiple groups measured separately as well. There will be employees that fall below or above the aggregate score. This employee group may encompass the entire section, or be specific enough to only cover a small number of roles. The importance of this distinction is to help with planning and forecasting future training initiatives and efforts. If multiple people (25 or more in this example) are low on proficiency, while the criticality is high, this can help the given section and the Training Section dictate offered training, if the solution found is a training need. However, if only one person is low on proficiency while the rest of the group are at higher levels, training may not need to be offered. This is not intended to punish an individual, but rather to be a good steward of finances, time, and use of training or meeting room space. In this case, funds could potentially be used to send the individual to training alone. On the other hand, in a certain scenario, coworkers could provide mentoring and peer-to-peer training until the training course is needed by more employees (even across the department).

Proficiency, proficiency-goal, and criticality have the same levels and definitions across all competencies to verify consistency, as the model is used throughout other Sections of the Department.

When the Section Head defines the levels of proficiency, proficiency-goal, and criticality, they should be aware their decisions may include a level of subjectivity. In some cases, there may be certification tests, degrees held, or other measurable factors that would dictate a perceived level, goal, or importance, but those are not always necessary. For some, the measured proficiency and goal may be the

same. That is important to note because this will help with training mapping and the importance of future trainings. Proficiency and criticality should not be viewed as related. If a proficiency level is high, that should not automatically dictate a high level of criticality. An employee group may need to be highly educated or skilled at a specific competency, but the level of criticality may be low. Alternatively, the employee group may have a high level of criticality of a specific competency but do not need to fully understand the application or be the subject matter expert.

Close Out

As the Section's model nears completion, a Close-Out Meeting should be scheduled with the same team members that attended the Kick-Off Meeting. This meeting will allow the team to formally deliver the models (Competencies, Definitions, Trainings, and Proficiency and Criticality), none of which should be a surprise since the team has been involved throughout all iterations of these findings. However, with all members together, looking at the project as a whole, decisions can be made on how to move forward. Based on major proficiency and criticality differences, the team may compare available trainings listed. For example, if a competency has a current Proficiency level of 1, a Proficiency-Goal of 4, and a Criticality level of 4, that competency should be given the highest priority. The team can discuss if the current listed trainings suffice to move the employees from the current Proficiency level to the Proficiency-Goal. The current training may be sufficient, but not offered enough, or it may need updating. If there are no current trainings listed, a decision may be made to develop a training or purchase something that is already available.

Lastly, it should be noted, and possibly discussed during the Kick-Off Meeting as well, that no piece of the competency model should be used to rewrite current job descriptions or penalize employees. While the results of the project may be used to form new job descriptions, set expectations, and inform hiring, the ultimate goal is to close knowledge gaps in needed training.

RESULTS AND DISCUSSION

Research

First, researchers chose a section to evaluate for appropriate competencies. For the example included in this paper, the author chose to test the process described above with the Highway Safety Section of Louisiana DOTD. The team began by conducting a literature review of outside sources. This included researching previous studies in a similar area along with currently available trainings and information from the following national organizations: The National Cooperative Highway Research Program (NCHRP); The National Transportation Career Pathway Initiative (NTCPI); AASHTO's Standing Committee on Highway Traffic Safety; The TRB Committee on Transportation Safety Management Systems (ACS-10, formerly known as ANB-10); National Highway Traffic Safety Administration (NHTSA); Committees within the American Society of Civil Engineers (ASCE); the National Highway Institute (NHI), the National Network for the Transportation Workforce (NNTW), and the American Traffic Safety Services Association (ATSSA); among others.

Two outside sources which provide much of the legal and ethical structure are the Federal Highway Administration (FHWA – as part of the US Department of Transportation) and state and local law enforcement officers (LEOs). The FHWA requires each state to implement a Strategic Highway Safety Plan (SHSP) as part of the Highway Safety Improvement Program (HSIP) (11). Here, they share

methods of improving roadway safety – infrastructure-oriented countermeasures (e.g., highway road departure, intersections) and behavioral countermeasures (e.g., speeding, driving under the influence). The Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) provides set minimum standards where applicable and ensures uniformity across the nation (16). LEOs provide assistance on enforcing current laws and road user behavior.

Other outside sources include universities and other DOTs. For example, Clemson University offers a master's degree in the transportation safety field (17). Additionally, Washington State DOT built a performance-based approach to meet the needs of their Highway Safety Manual (HSM) utilizing data, tools, and performance measures (18). Finally, Alabama DOT, with the assistance of Auburn University and Cambridge Systematics, developed a training matrix for safety engineers (9).

Interviews

Researchers conducted private (face-to-face or telephone) interviews with each employee of the DOTD Highway Safety Section and discussed their day-to-day job duties, which may include nuances outside of their formal roles. They were also asked what current trainings they have completed outside of what may be listed on their transcript, as well as what trainings they found most and least useful. A handful of contract employees of the Highway Safety Section were also interviewed, as they work closely with the rest of the staff. All Section Supervisors were also intereviews to help determine needs.

Competency and Definition

Using the research from all sources, the team was then able to modify any competencies to fit DOTD's specific needs where warranted. It is important to keep competencies similar across the nation – especially when it applies to government-mandated policies – but there is still flexibility in how a state may approach it. By utilizing current job descriptions, employee training transcripts, and in-depth personal interviews with the employees of the Highway Safety Section, other competencies could be added as necessary. In total, the team concluded the study with five competency areas, each having a varying amount of sub-competencies. Fifty competencies in total were created. For brevity, three competencies will be highlighted. All have the same scores: Proficiency-Goal = 4, Current Proficiency = 2, and Criticality = 4. These also had the largest gap between current and goal proficiencies while having the highest criticality score available. They are listed and defined below (8).

From the Safety Theory/Discipline competency area, the sub-competency of Road Safety Theory is defined as: Understand the elements of successful road safety programs. Identify contributing crash factors and how they interact. Understand and apply road safety data collection, analysis, and evaluation.

From the Highway Safety Data competency area, the sub-competency of Data Integrations with GIS is defined as: Understand how to accurately combine data from different sources into GIS. Identify strategies to consolidate disparate sources of data into one definitive source.

From the Highway Safety Data competency area, the sub-competency of Alternative Sources of Data is defined as: Understand alternative sources of data and how to use them (e.g., focus group and driver survey data, observational survey data).

Matched Trainings

Regarding these three competencies, the following trainings and resources have been identified to help educate highway safety engineers on these topics:

Safety Theory/Discipline–Road Safety Theory

- Road Safety Fundamentals via FHWA
- Road Safety 101 via UNC
- Road Safety 365 via LTAP
- Road Safety Champion Program via NCRRS

Highway Safety Data–Data Integrations with GIS

- DOTD GIS – ArcGIS at DOTD
- DOTD GIS – Advanced ArcGIS Pro
- DOTD GIS – Editing in ArcGIS Pro
- DOTD GIS – Intermediate ArcGIS Pro for Transportation
- (among many other ArcGIS training offerings)

Safety Theory/Discipline–Alternative Sources of Data

- (currently missing)

Proficiency and Criticality

Regarding these three competencies, the Section Head provided a level of current proficiency, the proficiency-goal, and level of criticality for each employee group. Employees were separated into six organizational units. Three of these units are shown in Table 1, along with the scores given for the proficiency and criticality levels for the above-mentioned competencies.

TABLE 1 Proficiency and Criticality

Group	SHSP			Safety Data			Project Development		
Competency	**P**	**P-G**	**C**	**P**	**P-G**	**C**	**P**	**P-G**	**C**
Road Safety Theory	3	2	3	4	4	4	4	2	4
Data Integrations with GIS	2	2	2	4	2	4	1	1	1
Alternative Sources of Data	4	2	4	3	3	3	1	1	1

Based on the completed model and findings, two of the three listed competencies with gaps in current proficiency and proficiency goal were found to have adequate matched trainings to help close any possible knowledge gaps. Of these, the Training and Technology Transfer Section can work closely with the Highway Safety Section to prioritize offered trainings (in regard to timing and funding as appropriate). If some listed matched trainings do not meet the requirements for the section, the two may work together to find an alternative, or explore the opportunity to create a custom training.

The third listed competency did not have any matched trainings currently listed. This allows for a greater opportunity. First, the research team must discuss the importance of this competency and training with the Section Head and Organizational Unit administrators. There may be something available the research team was unaware of – either in-house or externally. This may also allow the sections to work together to create a training. If funding allows, the Training and Technology Transfer Section may procure something available if found. However, if this is a niche competency only affecting a few employees, the Training and Technology Transfer Section may require the Highway Safety Section to purchase any necessary training.

Moving forward, this process can be completed across all sections within DOTD to find major gaps that may exist within a specific section, but more importantly, across the department. For the sub-competency of Alternative Sources of Data discussed in the results, it may only be a competency found in the Highway Safety Section. If no other section within DOTD finds this sub-competency within their model, training efforts, in time and money, may be better invested in other competencies, especially those found in multiple sections' models that have no listed matched trainings.

CONCLUSION

A set of core competencies and trainings were identified in this study that are essential to the Highway Safety Section of the Louisiana DOTD. By pairing the competencies' current available trainings with proficiency and criticality ratings, the department can focus on important training areas while other training gaps are identified. This conclusion and the findings on which this study is based are consistent with the current body of knowledge found during the research process.

As seen within the research and interviews, those involved in the Highway Safety Section example have a vast background of knowledge and experience they bring to the highway safety field. This includes experts from other areas within the DOT: traffic, environmental, public transportation, railroad, and right-of-way, as well as other sections or consultants handling certain processes or information. It is imperative that as this field moves forward, all perspectives are welcomed in order to help make the country's roadways as safe as possible.

While this model was tested using the Highway Safety Section, it will be expanded to other Sections within DOTD. Other states should complete an in-house competency model to further validate this model, implement it, and modify it to fit their needs and unique characteristics. Perceived importance from each state changes based on the researcher, team, the section administration, the section team, DOT administration, and the unique characteristics and demographics of the state. Alternatively, since each state's organizational charts vary, the process and model may differ. All states will benefit from sharing the findings within their DOT.

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AUTHOR CONTRIBUTIONS

The authors confirm contribution to the paper as follows: study conception and design: Garrett Wheat, Mary Leah Coco; data collection: Garrett Wheat; analysis and interpretation of results: Garrett Wheat, Mary Leah Coco; draft manuscript preparation: Garrett Wheat, Mary Leah Coco. All authors reviewed the results and approved the final version of the manuscript.

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