

NCHRP Project 23-05: Guidance for Training and Certification of Construction Inspectors for Transportation Infrastructure

Technical Memorandum

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July 2022

Prepared for the National Cooperative Highway Research Program

The National Cooperative Highway Research Program (NCHRP) is sponsored by the individual state departments of transportation of the American Association of State Highway and Transportation Officials. NCHRP is administered by the Transportation Research Board (TRB), part of the National Academies of Sciences, Engineering, and Medicine, under a cooperative agreement with the Federal Highway Administration (FHWA). Any opinions and conclusions expressed or implied in resulting research products are those of the individuals and organizations who performed the research and are not necessarily those of TRB; the National Academies of Sciences, Engineering, and Medicine; the FHWA; or NCHRP sponsors.

TABLE OF CONTENTS

TABLE OF CONTENTS.....	i
INTRODUCTION	1
PURPOSE OF THE TECHNICAL MEMORANDUM	1
Guide Implementation Pathways	2
1.1 Implementation Pathway I: Recruitment	2
1.1.1 Key Implementers of the Recruitment Pathway	4
1.2 Implementation Pathway II: Core Competencies	4
1.2.1 Key Implementers of the Core-Competencies Pathway	5
1.3 Implementation Pathway III: Training and Certification/Qualification	5
1.3.1 Key Implementers of the Training and Certification Pathway	7
1.4 Implementation Pathway IV: Retention and Career Development.....	7
1.4.1 Key Implementers of the Retention and Career Development pathway.....	8
Additional Implementation Considerations and reference materials.....	9
APPENDIX A – Construction Inspector Development Flowchart.....	10
APPENDIX B – Construction Inspector Guide Implementation Pathways	11

INTRODUCTION

Construction inspectors represent the field workforce that ensures transportation infrastructure projects meet design and contract requirements and that the finished product meets or exceeds established quality standards. Quality work during construction helps increase the lifespan of transportation assets, which increases the value for state transportation agencies (STAs) and taxpayers. However, there is a growing concern in the transportation construction industry about the inspection process due to the limited and declining availability of well-trained and experienced construction inspectors.

The current challenge of limited availability of construction inspectors for transportation infrastructure encapsulates the much larger issue of workforce shortages in construction workers across the entire country. The retirement of the generation that built the U.S. interstate system, followed by periods of recession that put pressure on government budgets, resulted in a reduction of the in-house STA workforce, including inspectors. During the same period, the services the STA offered expanded as they incorporated greater public involvement in the project delivery process, a more comprehensive environmental review, and the development of multi-modal infrastructure, to name a few. The result is more STA employees with less experience than their predecessors managing more complex transportation infrastructure projects. Additionally, younger generations in the K-12 education systems may not view working in construction as a viable career path.

STAs tend to rely on the traditional approach of developing construction inspectors through intense and lengthy training and mentoring by experienced inspectors. However, given the current financial resources and overall industry workforce shortages, this has become challenging for STAs to achieve efficiently. Construction inspector training needs to be completed more quickly than ever before, while the expected learning curve is simultaneously steeper than it has been in the past. There are not enough qualified individuals, and relying solely upon on-the-job training (OJT) to meet construction inspector development needs is often not practical due to workloads and adding more responsibilities to experienced field personnel. STAs are being forced to leverage the training that already exists (e.g., AASHTO Transportation Curriculum Coordination Council), take advantage of innovative training delivery methods (e.g., online, self-paced learning), and coordinate with regional and national certification programs (e.g., American Concrete Institute). This is a national issue, and *NCHRP Research Report 1027: Guide to Recruiting, Developing, and Retaining Transportation Infrastructure Construction Inspectors* (hereafter, Guide) created from this NCHRP-managed project intends to help STAs design efficient and effective training and certification programs for construction inspectors. A training and certification program aims to provide the appropriate education and opportunities that improve individual skills at the right time and for the right people.

PURPOSE OF THE TECHNICAL MEMORANDUM

This Technical Memorandum provides STAs with a summary of the key findings from a two-phased research methodology comprised of seven interwoven tasks and subtasks. An in-depth and detailed description of the tasks, subtasks, research results, and study findings can be found in the Guide and the Conduct of Research Report, published as *NCHRP Web-Only Document 337: Training and Certification of Construction Inspectors for Transportation Infrastructure*. Therefore, the specific purpose of the Technical Memorandum is to outline and provide

suggestions for implementing the Guide for any given STA. However, given variations in organizational structures, hiring of consultant inspectors, and differences in the level of funding and internal operations of STAs, the Guide is intended to be adapted, modified, and used in part, or whole, by a transportation agency given construction workloads and needs for recruiting, hiring, training, and certifying the construction inspection workforce.

The content of the Guide is presented across four chapters which follow the process of developing a skilled and proficient construction inspector, including Needs Assessment and Recruitment (Chapter 2), Core Competencies and KSA Assessment (Chapter 3), Training and Certification (Chapter 4), and Retention and Career Development (Chapter 5). The process of continuously developing a proficient construction inspector is represented graphically in the Construction Inspector Development Flowchart (See Appendix A) and provides implementation pathways, as described below, that follow the chapters of the Guide. Furthermore, the Guide contains a summary of key findings and recommendations for STAs to consider at the end of each chapter.

The first step to STA implementation of the Guide content is to decide whether to implement the Construction Inspector Development Flowchart and implementation paths as a whole or in part, based on agency needs. This step is determined by what effective workforce development programs for construction inspectors exist within the STA. If questions exist regarding the effectiveness of the existing construction inspector development programs, the STA is encouraged to review the key performance indicators (see Tables 2-2, 4-6, and 5-7) provided in the Guide.

The construction inspector development outlined in the Guide can be adapted and modified for implementation by the individual areas (recruitment, core competencies, training, certification/qualification, retention, and career development) or entirely based on the STA-specific needs. For example, suppose an STA has an established needs assessment and recruitment plan for inspectors but could use revisions to their training and certification programs. In that case, the agency could focus on the recommendations and tools found in Chapter 4 of the Guide and the accompanying Training and Certifications pathway. However, if an STA would like to review and refresh their entire construction inspector development process, then the STA should consider reviewing and implementing the entire Guide.

GUIDE IMPLEMENTATION PATHWAYS

After completing an agency-specific needs assessment, the STA can select the most relevant sections of the Guide to implement within their agency. Recommendations for Guide implementation are presented in parallel with the organization of the Guide chapters. Therefore, the recruitment pathways outlined herein follow the construction inspector development process and Chapters 2 through 5 in the Guide. The following section describes the four pathways for STAs to consider for their implementation process. Please see Appendix B for a graphic representation of the Guide implementation pathways described below.

1.1 Implementation Pathway I: Recruitment

Pathway I includes recruitment, identifying inspector needs, and establishing recruitment practices. Identifying specific inspector needs is crucial for STAs to determine whether internal or consultant inspectors will be used to meet the demand. The Guide provides a discussion of recruitment and provides relevant tools including, but not limited to the following:

- Table 2-1. Factors that help STAs recruit construction inspectors
- Table 2-2. Performance indicators for construction inspector recruitment programs

The research identified exemplary strategies for STAs to consider and adapt for construction inspector needs assessment and recruitment. For a complete list of strategies, please reference Chapter 2 in the Guide:

- If a need for construction inspectors exists, the STA advertises construction inspection positions and implements recruitment strategies suggested in the Guide to find quality candidates. Recruitment factors that help attract quality candidates include providing appealing job positions; offering education support/tuition reimbursement, health benefits, paid time off, promotion opportunities, stable employment, and retirement benefits; and using a streamlined application process.
- Younger workers tend to focus their careers on impacting society positively, so it is helpful for STAs to highlight that the construction services performed improve the surrounding community and society.
- STAs can rely on full-time, seasonal, temporary, and intern employees for in-house inspection positions or third-party consultant inspection firms qualified by the STA. Many STAs in this study acknowledged increased use of consultant inspections when lacking personnel.

Many STAs recruit in-house construction inspectors based on their educational background and work experience. However, standard criteria specifically designed to recruit in-house construction inspectors are limited. Most hiring practices are used holistically for all positions, not just construction inspectors. Some STAs require a high school education, whereas other STAs require college coursework or a degree in a construction-related discipline. Field experience generally plays a more prominent role in the position level a construction inspector is hired, and what position an inspector can achieve for advancement in their career. Inconsistent hiring practices and reductions in internal STA staff have led to the use of third-party consultant firms to perform a portion of, or all, inspection work in some states. With the influx of consultant inspectors, it has become harder for STAs to hire and retain in-house inspectors as private firms sometimes can offer a higher salary. However, STAs generally offer incentives that typically outmatch private firms, such as better health care, retirement, and paid leave benefits.

Focus group discussions revealed the following exemplary factors that challenge the recruitment of construction inspectors. For a complete list of factors, please reference Chapter 2 in the Guide:

- Lower civil service pay than private industry;
- Difficulties with the online application process in rural areas;
- Lack of clear career paths;

For recruitment of construction inspectors, the following are exemplary strategies that state STA should consider and adapt when seeking entry-level employees. For a complete list of strategies, please reference Chapter 2 in the Guide:

- Instating, or reinstating for some STAs, a short-term employment program (i.e., temporary, seasonal, internships) where potential full-time employees can learn about construction inspection employment in a low-stakes environment.

- Organize hiring and outreach events to raise awareness about the work, benefits, and impact that STAs make to gain public interest in what an STA accomplishes.
- Seek to develop a system that produces connections with technical schools, community colleges, veteran communities, and universities to encourage careers in transportation construction inspection.

1.1.1 Key Implementers of the Recruitment Pathway

The staffing and hiring practices of in-house construction inspectors vary from state to state. However, research participants indicated that the key implementers of the recruitment pathway should include more than just the human resources (HR) department of a given STA. Focus group discussions identified that some STAs had experienced success in recruiting younger candidates by bringing field personnel who complete construction inspection tasks to career fairs. Allowing potential employees to talk directly with front-line workers about their job showed promise in attracting potential future construction inspection employees.

1.2 Implementation Pathway II: Core Competencies

STAs with an adequate number of construction inspectors on staff to meet their project workload can begin with implementing pathway II, which focuses on core competencies. Pathway II includes identifying appropriate construction inspector core competencies and establishing evaluation and assessment metrics to determine proficiency. STAs should determine the inspector-specific Knowledge, Skills, and Abilities (KSAs) that inspectors need to perform inspection duties for a given project type and at the appropriate level of proficiency. The progression of increasing responsibilities from one inspection position level to another is apparent as advanced-level inspectors have more responsibilities than intermediate-level inspectors and many more responsibilities than entry-level positions. The responsibilities and associated KSAs required for an entry-level construction inspector build the foundation for, and continue through, intermediate- and advanced-level inspector career development.

Given the complicated nature of KSAs within workforce capabilities, it should be noted that some KSAs overlap with categorical groupings of core competencies. However, core competencies and the associated KSAs are grouped and defined within the Guide as follows:

- *Academic Competencies* – Knowledge, skills, and abilities learned in an educational setting, typically through K-12 schooling and higher education.
- *Technical Competencies* – The specific knowledge, skills, and abilities needed to perform construction inspection tasks.
- *Personal Effectiveness Competencies* – Knowledge, skills, and abilities that represent an individual's personal attributes.
- *Workplace Competencies* – General knowledge, skills, and abilities to perform essential work duties.

The Guide provides an in-depth discussion of core competencies and assessment in Chapter 3 as well as relevant figures and tables including, but not limited to, the following:

- Table 3-2 Construction inspector core competency categories and associated KSAs
- Tables 3-5, 3-6, and 3-7 contain the Core Competency and Responsibility Matrix for Entry-level, Intermediate-level, and advanced-level inspection positions (respectively), which maps out the core competencies needed to perform construction inspection responsibilities

For core competencies of construction inspectors, research participants identified the following exemplary strategies for STAs to consider and adapt. For a complete list of strategies, please reference Chapter 3 in the Guide:

- Determine and align the roles and responsibilities for all construction inspection positions with specific KSAs. KSA alignment is crucial for evaluating whether an inspector possesses the KSAs at the required proficiency to perform the inspector-level specific responsibilities effectively. If not, training is warranted.
- Each inspector should be provided necessary training based on the core competency assessment and identifying gaps in KSAs. The proficiency of each KSA is based on their current knowledge and skills, along with the STA providing training to address the gaps.

1.2.1 Key Implementers of the Core-Competencies Pathway

Identifying construction inspection core competencies involves numerous stakeholders and departments within a given agency. Depending on the organization of the STA, the initial identification of required KSAs for hiring may fall under the purview of HR. However, experienced field personnel, who perform or oversee construction inspection duties, can provide a critical perspective on what KSAs inspectors need at the time of hire and what KSAs can be acquired and refined through formal training, field applications, and experience. For KSA proficiency assessment, this process can occur at the time of employment by HR staff but should also be considered throughout the annual performance review and promotion process. Defining KSA proficiency targets and providing employee feedback is a critical component in developing a career path for construction inspectors. Research participants identified career progression pathways as an essential component for consideration in the long-term retention of construction inspectors for STAs and consultant inspection firms.

1.3 Implementation Pathway III: Training and Certification/Qualification

Pathway III includes identifying and implementing training and obtaining certifications/qualifications as required, following the recognition of gaps or deficiencies in an individual's core competencies and associated KSAs. This process is continuous for initial training and certification and for promotions and advanced training. It is important to note that some STAs use qualifications while others use certification for their inspectors. Some STAs use a combination of both qualifications and certifications. The Guide uses the terms certification and qualifications synonymously, and STAs can adapt the information based on their construction inspection certification/qualification process.

Training for construction inspectors should address the needed KSAs to perform comprehensive inspection responsibilities during construction. Training should be required, and making more training available offers inspectors more opportunities to gain essential KSAs. An inspector's core competency gaps can be alleviated through training. However, as previously noted in Pathway II, deficiencies should be based on KSA proficiency targets established by the STA. Proficiency targets must be consistently applied and linked to periodic performance reviews and the specific roles and responsibilities of the inspector position level. If training is required, an agency determines whether to use either internal or external training sources. The inspector may be placed without additional training if adequate proficiency is achieved. If deficiencies exist, training should

occur to help the construction inspector reach the required proficiency level given the construction inspection position-specific roles and responsibilities.

Training materials are developed and administered from various sources, including STAs, local transportation assistance programs (LTAPs), universities and colleges, and third-party training organizations. Construction inspector training can result in a recognized certification or qualification. However, this study found that transportation agencies' certification/qualification requirements vary. In general, STAs have two options to consider when determining the certification requirements for construction inspectors across various materials and work requiring inspection on any transportation infrastructure project. Certification programs are either internally developed, agency-specific programs, or external certification programs developed and managed by STA-approved third-party organizations. Research results revealed that in-house training and certification programs are the most common training source for STAs. At the same time, consulting firms rely more on training and certification programs offered by third-party organizations but attend training provided by STAs when available or required.

The Guide provides information for training and certifications/qualifications in Chapter 4 as well as relevant figures and tables including, but not limited to, the following:

- Table 4-2 Barriers to training and strategies to overcome barriers
- Table 4-3 Third-party construction certification organizations for construction inspectors

The survey of STAs indicated that agencies typically rely on OJT for construction inspectors to gain core competencies to perform inspections. However, other methods are used as well. Figure 1 provides the training methods used by STAs, and the frequency of using each method, collected from survey responses from 46 STAs and 26 consultant inspection firms. Having in-person training and self-paced learning opportunities is vital to understanding the knowledge needed to perform as a transportation construction inspector.

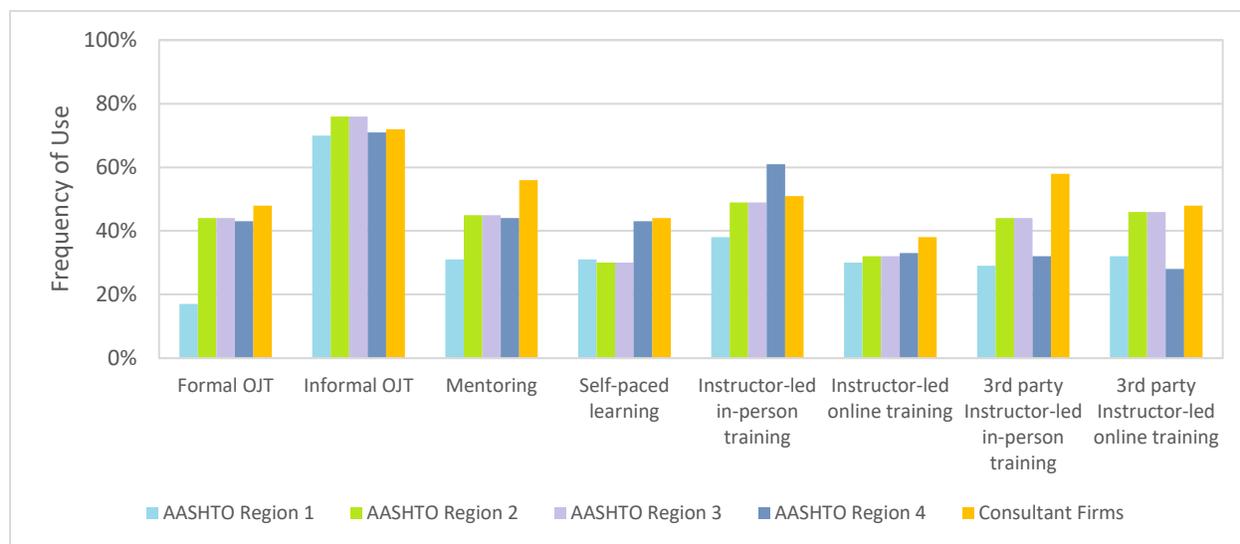


Figure 1. Frequency of training methods used by STAs for construction inspectors

For the training of construction inspectors, research participants identified the following exemplary strategies for STAs to consider and adapt. For a complete list of strategies, please reference Chapter 4 in the Guide.

- Each inspector should develop a training path based on their position level, experience, and proficiency in inspection competencies.
- A logical and well-defined training path promotes a specific progression of desired and required training. Training tied to career paths clearly shows inspectors how they advance in their inspection career at the STA.
- STAs need to ensure that trainers are appropriately skilled to facilitate construction inspection learning (e.g., 'train the trainer' programs)

For *certification/qualification of construction inspectors*, research participants identified the following exemplary strategies for STAs to consider and adapt. For a complete list of strategies, please reference Chapter 4 of the Guide:

- Development of regional certifications for inspection reciprocity is possible but challenging. STAs and their neighboring states should compare their certification programs to find commonalities and make changes to align their construction inspection standards and certifications.
- Sharing of inspectors across the STAs regions and districts should be considered. Sharing inspectors from other STAs through reciprocity is possible, but most STAs rely on hiring consultant inspection firms rather than borrowing from neighboring states.
- Re-certification programs should consider conducting annual audits of the inspector's KSAs; implementing short or abbreviated course(s) and exam(s); using condensed training and examinations based on performance; and consider requiring less frequent re-certification intervals.

1.3.1 Key Implementers of the Training and Certification Pathway

Identifying, implementing, and recognizing construction inspector training and certifications requires buy-in and participation from numerous stakeholders within and outside of the STA. Since continuity between appropriate training content and certification programs is paramount to achieving the ultimate goal of ensuring construction inspector proficiency, identification of required KSAs, KSA proficiency targets, training, and certifications must work in concert across many, if not all, administrative levels of the STA. The research results provide evidence that STA training opportunities for inspectors are currently limited due to constraints such as the lack of SMEs to conduct training, schedule conflicts for inspectors as they are needed to be working at the project site, lack of funding, and lack of time required to organize training events. A successful training and certification program requires key implementers across all levels of an agency, from construction inspectors in the field to those making high-level decisions regarding funding distribution and human resources to meet workforce needs and development.

1.4 Implementation Pathway IV: Retention and Career Development

Pathway IV encompasses the career development of transportation construction inspectors through STA-provided retention and advancement opportunities. Retention is the process of maintaining an adequate workforce to meet the commitments of the STA. Development is the process of progressing individuals through career promotion that benefits both the individual and the agency. Retention and development entail job-specific training and opportunities for construction

inspectors to gain and sustain the KSAs needed to perform and excel in their current position and seek subsequent promotions.

The career development of construction inspectors depends on the STA's ability to promote and provide continuing education opportunities in which an individual can gain new and improve existing skills. Continuing education provides opportunities for construction inspectors to learn and grow within the transportation construction profession. From the agency perspective, continuing education ensures that the human capital within the STA gains exposure to new industry trends and better positions the STA to respond to future change. For the construction inspector, continuing education provides the opportunity for personal advancement and keeps individuals mentally engaged and refreshed.

Examples of informal continuing education include, but are not limited to, the following:

- Conducting informal peer-to-peer exchanges on new methods, technologies, and tools such as a "lunch and learn" program
- Cross-training inspectors in various areas of transportation construction
- Providing access and encouraging the reading of trade publications

Examples of formal continuing education include, but are not limited to, the following:

- Conducting peer-to-peer exchanges organized by regional and national groups such as the AASHTO Peer Exchange Program;
- Offering advanced certification courses in technical and managerial skills; and
- Networking through regional and national organizations for continuing education and attending workshops

For *retention and career development of construction inspectors*, research participants noted the following exemplary strategies that state STA should consider and adapt. For a complete list of strategies, please reference Chapter 5 of the Guide:

- Review and evaluate STA implementation of the factors that help retain construction inspectors; including, but not limited to, education support, mentoring programs, professional development, recognition of work completed, reimbursement for certification exams, relocation assistance, rotational programs,
- Provide informal and formal continuing education opportunities and promote construction inspector networking through regional and national organizations for continuing education.
- Establish clear career path progression for construction inspection positions. If career paths exist, STAs need to ensure that construction inspectors know these paths and the requirements for promotion and advancement.

1.4.1 Key Implementers of the Retention and Career Development Pathway

Much like training and certifications, the identification, implementation, and recognition of construction inspector retention and career development require buy-in, and participation, from numerous stakeholders from within and external to the STA. Career development encompasses, to some degree, components of Implementation Pathways I, II, and III because career development and retention should span the entire career of quality construction inspectors.

Research findings indicated that better salary opportunities, promotion opportunities, and flexible work schedules are primary factors for STAs and consultant firms to retain construction inspectors. Providing clear salary/pay structures and career paths for advancement will help STAs keep quality construction inspectors. Flexible work schedules are challenging for inspectors since they need to be present when the work occurs, which can happen outside normal working hours, such as at night or on weekends. However, as an inspector progresses in their career, more flexible work schedules should be made available. While these findings were universal across research participants, implementing effective retention strategies may require budgetary decisions that rely on changes to operations or policies.

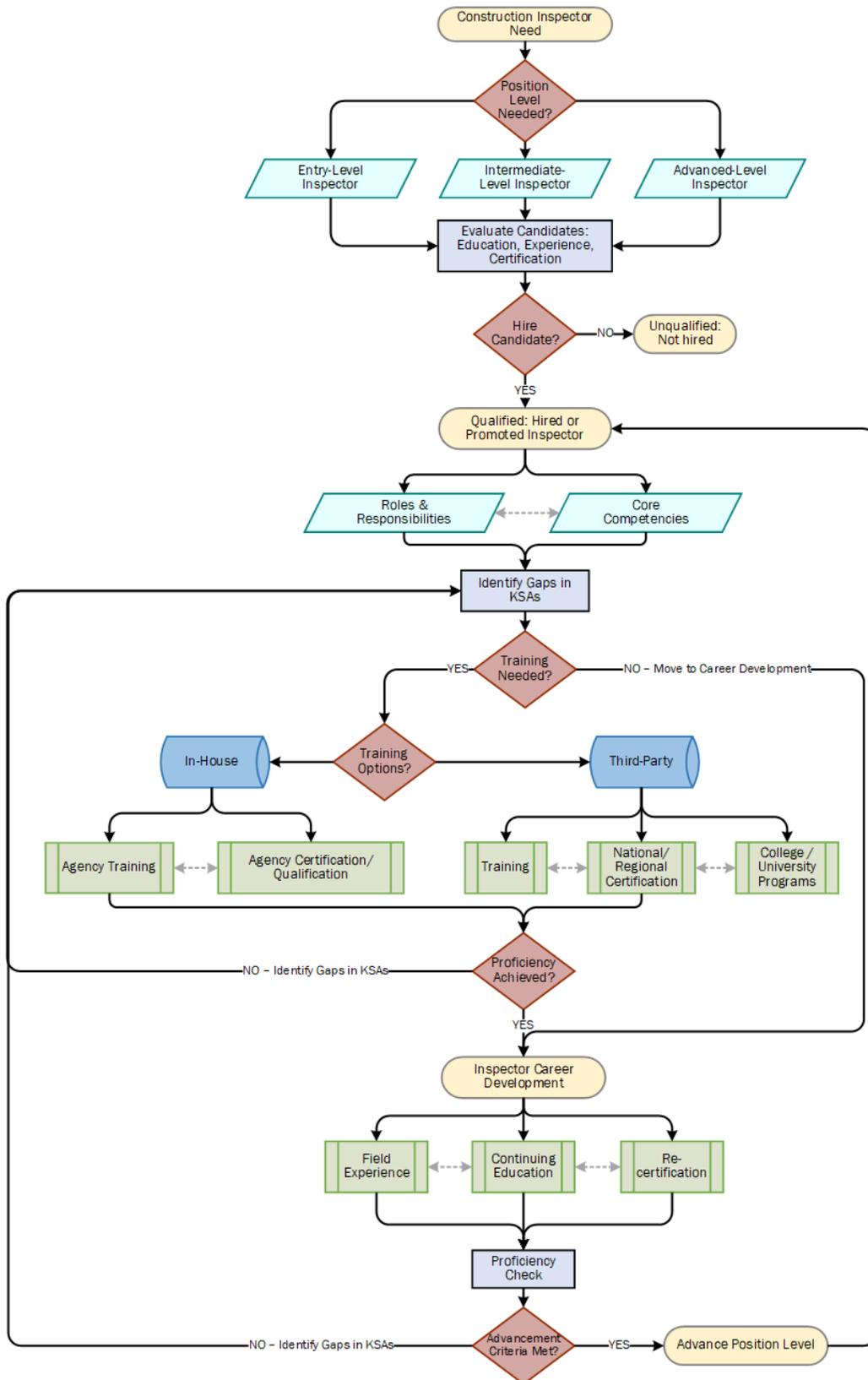
ADDITIONAL IMPLEMENTATION CONSIDERATIONS AND REFERENCE MATERIALS

While the Guide defines tactical processes for developing an inspector workforce, STAs should consider other implementation factors and references external to this study. Additional activities needed to support workforce development include workforce planning and knowledge transfer. While outside the scope of the Guide, both are critical. As defined here, workforce planning includes analyzing, forecasting, and planning workforce supply and demand and assessing gaps in meeting project or system-wide agency demand. For more information on workforce planning related to highway construction, please refer to the results of *NCHRP Research Report 923: Workforce Optimization Workbook for Transportation Construction Projects*. This report contains information on various transportation construction positions, including inspectors.

Knowledge management refers to the practical, efficient, and timely transfer of existing knowledge from transitioning employees to the entry and mid-career workforce. At most STAs, a significant portion of the inspection workforce will be eligible for retirement within a few years. Therefore, STAs must establish protocols to retain institutional knowledge when individuals depart from the STA. For more information on knowledge management and transfer, please refer to *NCHRP Report 813: A Guide to Agency-Wide Knowledge Management for State Departments of Transportation*.

Finally, findings confirm the existence of underlying challenges in attracting individuals into nearly all construction-related occupations due to the general poor perceptions of the construction industry. The challenge associated with hiring construction inspectors parallels the primary challenge today of recruiting individuals into all types of construction-related occupations. Stakeholders in the highway construction industry should play a role in helping re-establish and strengthen career awareness and education opportunities in highway construction, including the role of highway construction inspectors. Working with other industry stakeholders, including engineering and construction firms, K-12 schools, and higher education, STAs can work toward establishing and expanding collaboration between industry, education, and government to help promote industry involvement and investment in the nation's secondary and postsecondary construction technology programs. For more information about how agencies can become involved in supporting construction technology programs, please refer to the Construction Industry Institute Report (*CII RT-335*): *Restoring the Dignity of Work: Transforming the U.S. Workforce Development System into a World Leader*.

APPENDIX A – Construction Inspector Development Flowchart



APPENDIX B – Construction Inspector Guide Implementation Pathways

