GEORGIA DOT RESEARCH PROJECT 18-35

FINAL REPORT

ESTIMATING ROW ACQUISITION PROJECT TIMELINES FOR MAJOR PROJECTS BASED ON ANALYZING ROW ACQUISITION PROCESSES: PHASE I

OFFICE OF PERFORMANCE-BASED MANAGEMENT AND RESEARCH

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16. Abstract:

Prepared in cooperation with the Georgia Department of Transportation, Office Right of Way (ROW), this research found the current state of the practice in right of way acquisition among state DOTs to identify best practices with the greatest potential to improve ROW acquisition, including: (a) the organizational structures of the office of ROW, (b) the process of using consultants and performance measurements, and (c) the best practices and strategies used to expedite ROW acquisition. The research utilized the following tasks to evaluate opportunities to estimate the ROW acquisition timeline, considering unique project features and important external factors surrounding the project environment: (a) identify important factors in setting the ROW acquisition timeline, (b) collect required data, (c) conduct data mining to evaluate opportunities to estimate the ROW acquisition timeline.

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GDOT Research Project 18-35

Final Report

ESTIMATING ROW ACQUISITION PROJECT TIMELINES FOR MAJOR PROJECTS BASED ON ANALYZING ROW ACQUISITION PROCESSES: PHASE I

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EXECUTIVE SUMMARY

The main objectives of this research are to identify the best practices, with the potential to expedite right of way (ROW) acquisition, among the ones currently used by state departments of transportations (DOTs), and to develop a data-driven approach to estimate the ROW acquisition timeline considering unique project features and important external factors surrounding the project environment. The research began with an extensive analysis of the academic/professional literature with a focus on reviewing reported opportunities for expediting the ROW acquisition process and finding significant project characteristics or external factors affecting the ROW acquisition duration. The literature includes federal and state reports published by various organizations, such as the National Cooperative Highway Research Program (NCHRP), National Academies of Sciences, Engineering, and Medicine (NASEM), Federal Highway Administration (FHWA), and American Association of State Highway and Transportation Officials (AASHTO), and research publications on ROW topics. After the literature review stage, the research team performed two research tasks simultaneously: (1) conduct survey and follow-up interviews with the state DOTs' ROW agents across the nation to identify best practices with the greatest potential to improve ROW acquisition process, and (2) analyze GDOT's project records to develop data mining models to forecast the ROW acquisition timeline.

The first part of research was performed to identify opportunities to improve and expedite the ROW acquisition process by reviewing current state of the practice that state DOTs had been employing. The research team collected information through a survey questionnaire, email interviews, and telephonic meetings. The major findings from the survey questionnaire were: (1) organizational structures of the office of ROW, (2) consultant management practices, (3) use of performance measurements, and (4) importance of factors in setting ROW acquisition timelines. Within these areas, topics identified through the survey include but are not limited to:

- Overall organization and reporting structure of state DOTs' office of ROW.
- Roles and responsibilities of central and district/regional offices.
- Involvement of consultants during ROW acquisition.
- Structure of managing consultants.
- Identification of who tracks performance measurements.
- Types of performance measurements used.
- Importance of factors in setting ROW acquisition timeline.

The results of the follow-up interviews helped to find best practices that can be used to expedite the ROW acquisition process. Table ES-1 summarizes the best practices identified through the follow-up interviews.

Table ES-1. Summary of identified best practices to expedite ROW acquisition process.

Categories	Identified Best Practices
Practices in the Early Stage of Project	• Get involved early • Develop Americans with Disabilities Act (ADA) voluntary curb ramp acquisition program • Break out utility relocation
Develop ROW Plans	• Develop ROW Parcel Overlay • Use eSignature for ROW plan authorization
Prepare Appraisals	• Utilize waiver valuation • Conduct pre-NEPA (National Environmental Policy Act) acquisition tasks with state funds • Perform in-house appraisals • Use fee appraiser to review appraisals
Property Acquisition and Relocation Assistance	• Use incentive program • Use only state funds to acquire properties early • Condemn properties early
Manage Improvement Demolition	• Manage improvement demolition in a standalone contract • Manage improvement demolition in a construction contract
Training and Performance Reviews	• Train new employees in-house • Develop a peer review system
Process for Bringing ROW Consultants on Board	• Describe how Ohio, Tennessee, and Colorado DOTs bring consultants on board

The second half of the research effort was to develop a data mining model that predicts the ROW acquisition timeline. The research team conducted the following steps: (1) collect required data to analyze the ROW acquisition duration, (2) sort out the data that are appropriate for performing data analysis, and (3) conduct data mining to estimate the ROW acquisition timeline. As a result, a data-driven ROW acquisition timeline forecasting model was developed. The forecasting model was designed using Microsoft

Excel® Visual Basic for Application as a tool that ROW staff can use to help with decision-making in the practice of project planning and in the practice of estimating ROW acquisition management.

CHAPTER 1. INTRODUCTION AND LITERATURE REVIEW

INTRODUCTION

Right-of-way (ROW) acquisitions represent critical activities in the plan development process (PDP). Completing ROW acquisition in the scheduled time is desirable to avoid delays at the beginning of construction that may affect the cost and schedule of projects (Jeong et al. 2016). However, with increasing project complexity and evolving conditions surrounding an uncertain project environment, ROW administrators and project managers face a great challenge to expedite and complete the required acquisition tasks in a timely manner.

Acquiring and managing ROW is a complex process that attempts to satisfy the goal to deliver transportation projects on time and within budget while following the private property rights as required by the U.S. Constitution (NASEM 2014). The multiple tasks and entities involved in the ROW acquisition process make it complicated and prone to face unexpected situations. The tasks required in the ROW acquisition process typically include but are not limited to planning, preparing appraisals, negotiations, condemnation proceedings, relocation assistance, and property management. Performing the acquisition process involves multiple entities, including state public agencies, federal agencies, attorneys, consultants, and property owners. From the experience of state departments of transportation (DOTs) working in the ROW acquisition process over many years, various practices have been developed to mitigate the difficulties and facilitate the acquisition process. One part of this research was to review the current state of managing ROW offices and the innovative practices utilized to expedite the ROW acquisition process in

state DOTs throughout the nation, in order to inform the Georgia DOT (GDOT) Office of ROW about opportunities to expedite ROW acquisition for major projects.

Setting a proper timeline for ROW acquisitions is important in delivering the major project on time. However, due to the complex nature of the process, it is difficult to answer the question of "how long will ROW acquisition take?" (Gibson et al. 2006). Highway projects are different in many dimensions and, therefore, it is not appropriate to use a one-size-fits-all approach to create a baseline timeline for ROW acquisition tasks. For instance, project type (e.g., widening, bridge, intersection improvement, etc.) is an important feature to determine the acquisition timeline. Rural, suburban, and urban projects have different challenges in identifying parcels and completing the acquisition process. The local conditions surrounding the project environment also affect the timeline for completing ROW acquisition tasks. Availability of qualified and experienced resources at the project location is another factor that affects the ROW acquisition timeline. Understanding unique issues surrounding the project environment at the local level is an important factor affecting the duration of ROW acquisition tasks for major projects. On-time delivery, accuracy, and quality of required documents prepared by other GDOT Offices can impact the timeline of ROW acquisitions. Overall, it can be concluded that establishing a baseline timeline for ROW acquisition activities is challenging. This research had a unique opportunity to utilize the historical records of past GDOT projects to better identify the main project characteristics and surrounding project conditions that can be used to evaluate ROW acquisition timelines for major GDOT projects. The research team aimed to develop a data-driven model to estimate the

ROW acquisition timeline for major projects considering specific project characteristics and unique project conditions.

OBJECTIVES

The overarching objectives of this research project were to: (1) identify practical opportunities to expedite the ROW acquisition process; and (2) develop a data-driven model to estimate the ROW acquisition timeline, which can help GDOT facilitate project delivery for major projects. For the identification of opportunities to expedite the ROW acquisition process, the research team considered best practices found in other state DOTs. In the development of the data-driven model, the team took into account various project characteristics and other external conditions surrounding the major project environment. The specific research objectives were to:

- Review the current state of the practice in ROW acquisition among state DOTs to identify best practices with the greatest potential to improve ROW acquisition for major projects.
- Review the organizational structure of the ROW offices in other state DOTs, in order to better understand the relationships between the central office of ROW and the district or regional ROW offices in other states.
- Develop data mining models to evaluate opportunities for expediting ROW acquisition for major projects.
- Create a Microsoft Excel® program to properly set an appropriate timeline for expediting ROW acquisition for major projects, considering unique project

features and important external factors surrounding the development of the major project environment.

- Develop a best practices guide for expediting the ROW acquisition process for major projects.

Figure 1 describes the steps taken to achieve these objectives.

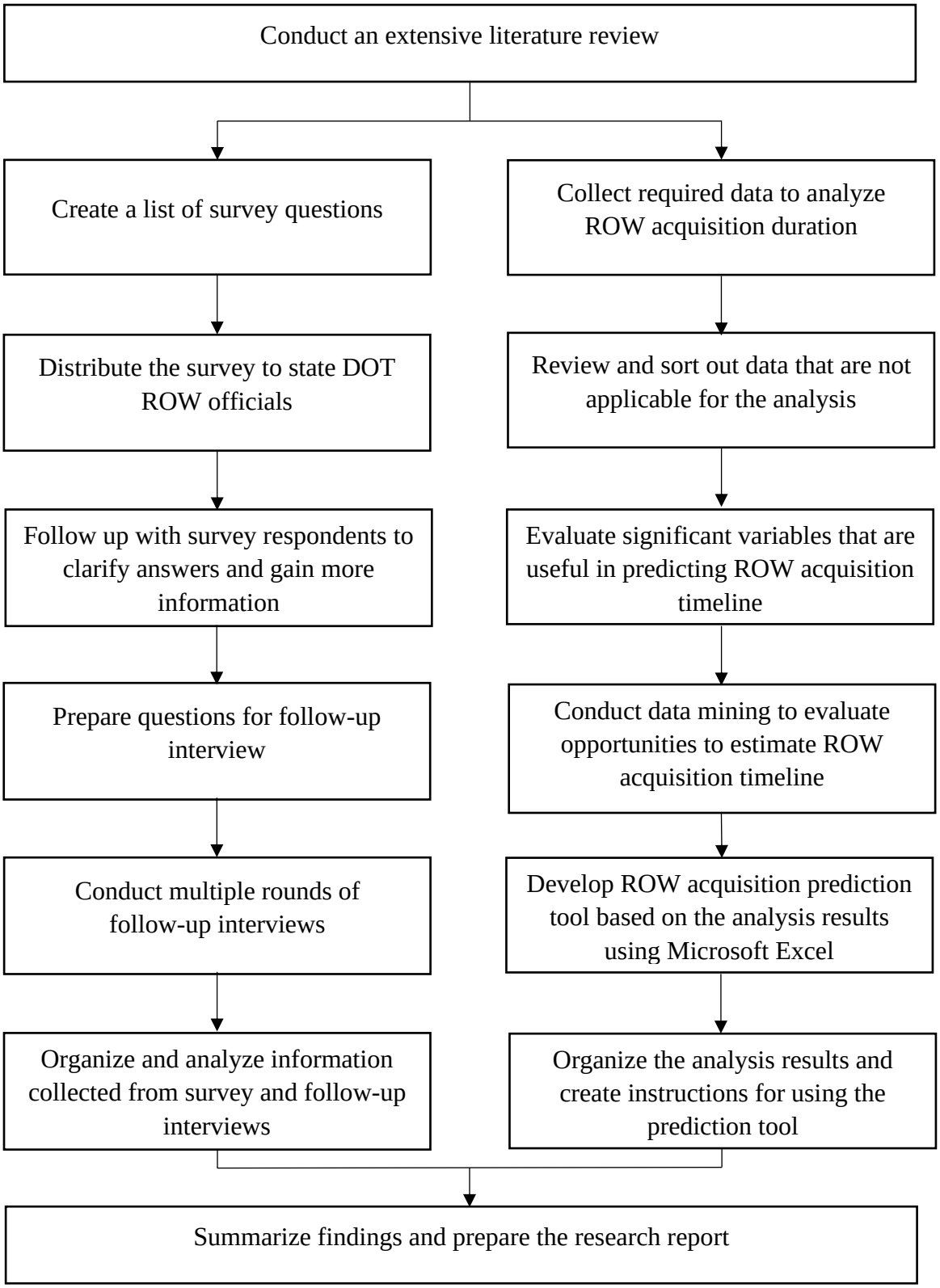


Figure 1. Research Methodology Flowchart

LITERATURE REVIEW

The research team reviewed academic and professional literature to identify: (1) strategies that are recommended for expediting the ROW acquisition process, and (2) recent trends in developing estimates for the ROW acquisition timeline. The research team reviewed literature that investigated opportunities to improve the acquisition process by conducting surveys and/or interviews and screening practices used in DOTs. Additional research was reviewed to find critical factors affecting acquisition duration and identify any developed model to estimate the timeline. The findings from the literature review are summarized under the following topics: (1) planning, (2) preparation of appraisals, (3) property acquisition, (4) training, and (5) methods to estimate the ROW acquisition timeline.

Planning

Planning is the phase when multiple disciplines collect information and conduct preliminary assessments for the proposed project. It involves development of plans and design, environmental assessment, field inspection, and more. A key to a successful planning phase is effective coordination between the various offices. FHWA (2004) suggested one way to enhance coordination is to assign a project manager to gather personnel in different disciplines to form a cross-functional project scoping team. The objective of forming the team is to ensure involvement of the disciplines in the project development process and listen to their perspectives toward the development. The ROW office is expected to provide guidance in assessing the social and economic impact of the proposed project.

Early engagement of ROW offices in the planning phase to identify potential problems was emphasized in the literature because the ROW office would be able to identify potential challenges related to real property acquisition that may not be apparent to the others. NASEM (2014) suggested ensuring that ROW agents and legal personnel experienced in real estate consistently are involved in the conceptual design meetings. FHWA (2004) suggested that ROW personnel review plans at certain completion milestones during development of the design in order to have timely access and resolve any problems in advance.

Another recommended practice is to involve property owners early in the planning phase. Sohn et al. (2014) found that involving property owners allows them to address their concern about the acquisition, which allows coordination within the DOT teams. FHWA (2002) suggested that planners consult with property owners before the completion of the project design to evaluate if revision is warranted for the proposed design. Le (2009) recommended use of different types of public involvement—including meeting with affected property owners, public meetings, and public hearings—based on the project's complexity.

Preparation of Appraisals

Appraisals are prepared to evaluate the certified value of real properties to be acquired and communicate any damage to the owners. State DOTs have been trying to simplify the appraisal procedures for low-value acquisition to reduce the effort and time required to prepare appraisals. The National Cooperative Highway Research Program (NCHRP 2000) found that many states use multiple levels of appraisal documentation to allow

simpler appraisals for noncomplex or low-value acquisition. Moreover, NCHRP (2000) found that the California DOT adopted a process by which one agent researches the title, prepares appraisals, negotiates, and settles with the property owner for low-value real properties. California claimed that this process is useful for the small takings for widening, drainage, or noise wall projects.

One of the challenges in preparing appraisals is the shortage of experienced appraisers, which makes it difficult to receive a satisfactory level of appraisals. To improve the quality of appraisals, NASEM (2014) recommended procuring services for appraisal and appraisal review based on the appraisal's *quality* rather than by selecting the *low bid*. Their research also suggested hiring appraisers from a list of preapproved or precertified appraisers to lessen the time requirements for the procurement process.

Property Acquisition

The negotiation process involves making offers to the property owners to acquire the real properties. The transportation agency needs to ensure that property owners receive a fair offer, as well as relocation assistance, if needed. Dyke et al. (2020) found the following common practices are used to build trust with property owners for successful negotiations: letting property owners accompany the appraisers, providing a copy of appraisals to the owner, and agreeing to the purchase of uneconomic remnants. Caldas et al. (2006) also stated that letting property owners accompany the appraiser during inspection allows state DOTs to receive more information about the parcel from the owners, build a good relationship, and increase the chance of successful negotiation.

Aleithawe (2013) found that the Mississippi DOT incorporated an agreement form that asks property owners to list their concerns about accepting the given offer. Through this practice, Mississippi DOT was able to enhance communication with property owners, better solve the issues raised in the negotiation process, and lessen the number of condemnation proceedings.

The pressure to acquire properties quickly is substantial for state DOTs because delay in the acquisition process can affect the schedule to begin constructing highway infrastructure (Caldas et al. 2006). Tsapakis and Quiroga (2015) noted that some states use incentive programs to facilitate the negotiation process. If incentive payments are used on a project, all property owners should receive incentive offers; however, their payments can vary based on the fair market value of the properties.

Training

From a survey conducted by NCHRP (2000), respondents ranked training as the most effective practice to accelerate right-of-way delivery. Different approaches to training and educating both new and experienced employees were mentioned in the previous research. One method suggested was to establish basic and advanced in-house training on specializations, such as surveying, appraisal, acquisition, and other (FHWA 2004). NASEM (2014) recommended states implement cross-training opportunities in which staff in headquarters and regions (or districts) could work on projects and provide each other with training across regions. Dyke et al. (2020) suggested the creation of Individual Training Accounts that would provide each employee with a fixed amount of funding that

could be used for training. This would motivate employees to pursue specialized trainings that they are interested in.

Furthermore, the importance of motivating staff to seek out training was emphasized. Dyke et al. (2020) highlighted that staff who take training to improve their performance should be rewarded for their dedication. The incentives can be offered in different ways, such as an offer of promotion or a one-time bonus, depending on individual achievements in improving their skill sets.

Methods to Estimate ROW Acquisition Timeline

The ROW acquisition timeline is difficult to estimate due to the complex nature of the process and the existence of uncertainties that are not apparent in the early stage of project development. Several previous research projects identified the factors affecting the timeline duration and developed tools to estimate the ROW acquisition timeline.

A part of Gibson et al.'s (2006) research examined detailed records of 45 projects to find the root cause of delays in the ROW acquisition process. The records they examined include letters, faxes, appraisal reports, negotiation reports, and communications between internal and external entities. They found that the following incidents caused delays to ROW acquisition duration, listed in order of frequency: (1) disputes on compensation and pricing; (2) title curative problems; (3) third-party delays; (4) parcel characteristics, and owner-initiated and improvement delays; (5) environmental sensitivity and expert witness delays; (6) legal activity causing delays; (7) utility delays; (8) design change or revision delays; and (9) terrain features dispute causing delays.

Sohn et al. (2014) developed an Excel-based tool that estimates the durations of ROW acquisitions and utility adjustments for the Texas DOT. The four factors considered in their tool to estimate the durations were: number of parcels, location type, district ROW staff size, and district annual ROW budget. To improve the accuracy of the prediction level, those authors looked for more factors to implement in their tool. Some of the key factors they found to be useful in predicting the ROW timeline were project type, district annual ROW budget, available funds to the project, level of political pressure, and need for relocation assistance.

Aleithawe et al. (2012) analyzed previous Mississippi DOT highway construction projects to determine the factors contributing to acquisition duration. Through statistical analysis, the researchers found that the significant factors that increased the duration of previous projects were: number of parcels, number of parcels acquired by condemnation, and number of revisions. They also developed a regression model using these significant factors to estimate the ROW acquisition duration.

CHAPTER 2. OVERVIEW OF SURVEY AND FOLLOW-UP INTERVIEWS

The overarching objectives of conducting an online survey and follow-up interviews were the following:

- Identify organizational structures of offices of ROW in other state DOTs.
- Examine the process of using consultants and performance measurements.
- Identify important factors that are considered when estimating timelines for ROW acquisitions.
- Determine best practices and strategies used in other states to expedite ROW acquisition.

To achieve these objectives, the research team took the following steps:

Step 1 Conduct an extensive review of the academic and professional literature related to strategies to improve the ROW acquisition process.

Step 2 Create a list of questions to identify current practices in performing ROW acquisition and other states' approaches for estimating timelines for ROW acquisitions.

Step 3 Distribute the survey to professional associations in the ROW industry.

Step 4 Refine the survey questions by asking GDOT ROW personnel to review the questionnaire to ensure that the questions are clearly crafted, and the anticipated responses reflect the intent of the research.

Step 5 Distribute the questionnaire to representatives in state DOTs and follow up with them to achieve as high a response rate as possible.

Step 6 Determine the areas to prepare questions for follow-up phone interviews and/or emails.

Step 7 Follow up with agencies and survey respondents to conduct multiple rounds of structured interviews and/or emails.

Step 8 Collect documents from state DOTs following the interviews/emails (e.g., ROW manuals, descriptions of practices, and state legal descriptions) and analyze the contents of these documents to find useful information.

Step 9 Summarize and present in this research report the findings from all the information collected through the survey, emails, structured interviews, and document evaluations.

DISCUSSION OF STEPS FOR CONDUCTING SURVEY AND FOLLOW-UP INTERVIEWS

Each step in the survey and interview process and its implementation are further discussed below.

Step 1: Conduct an Extensive Review of the Academic and Professional Literature Related to Strategies to Optimize the ROW Acquisition Process

The main focus of the literature review task was to determine issues regarding the ROW acquisition process and potential areas to make improvements. More detail of this review is provided in chapter 1.

Step 2: Create a List of Questions to Identify Current Practices in Performing ROW Acquisition and Other States' Approaches for Estimating Timelines for ROW Acquisitions

The research team developed a list of questions that would identify current practices used in other states' offices of ROW and their approaches for estimating the timeline for ROW acquisitions. The survey was designed to focus on four main topics: (1) organizational structures of the office of ROW, (2) consultant management, (3) use of performance measurements, and (4) importance of factors in setting the ROW acquisition timeline.

Step 3: Distribute the Survey to Professional Associations in the ROW Industry

The survey targeted the professionals working in the ROW field, including members of the American Association of State Highway and Transportation Officials' (AASHTO's) Committee on Right of Way, Utilities, and Outdoor Advertising Control (CRUO), as well as state DOT representatives.

Step 4: Refine the Survey Questions by Asking GDOT ROW Personnel to Review the Questionnaire to Ensure that the Questions are Clearly Crafted, and the Anticipated Responses Reflect the Intent of the Research

The research team asked GDOT ROW personnel to review the questionnaire, in order to validate and refine the questions and confirm that GDOT's Office of ROW would benefit from the answers to the questions. The research team then used the refined set of questions to gain and collect information about the current practices of ROW acquisition in other states.

Step 5: Distribute the Questionnaire to Representatives in State DOTs and Follow Up with Them to Achieve as High a Response Rate as Possible

The email survey was sent to 50 state DOTs in the United States. Overall, 39 state DOTs, including three who did not record their state, participated in the survey (see figure 2).

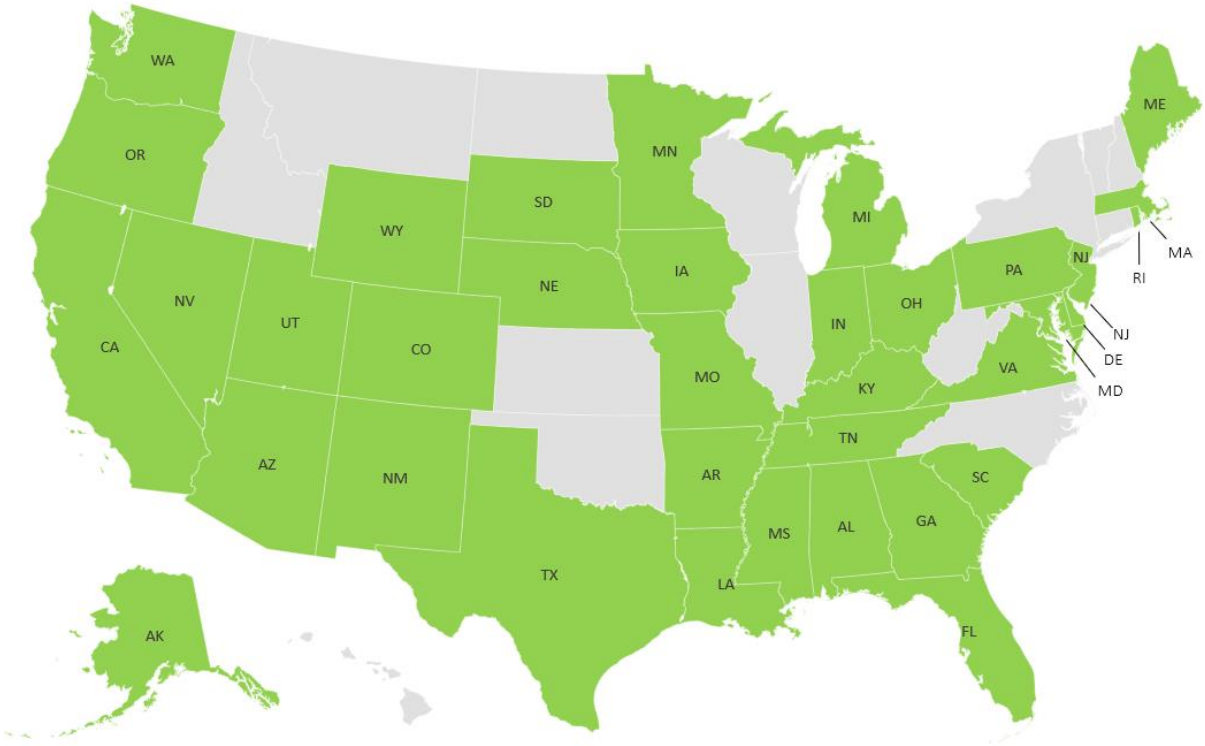


Figure 2. States responding to survey.

Step 6: Determine the Areas to Prepare Questions for Follow-up Phone Interviews and/or Emails

Subsequent to the survey questionnaire, the research team conducted follow-up interviews to seek additional information. The main purpose of conducting interviews was to gather more detailed information regarding topics that were asked in the survey, if needed, and identify practices that are currently used in other states to expedite the ROW process.

Step 7: Follow Up with Agencies and Survey Respondents to Conduct Multiple Rounds of Structured Interviews and/or Emails

The research team followed up with the state DOT representatives who responded to the survey questions. They conducted multiple rounds of structured interviews/emails with representatives who provided answers of good quality to the survey and/or interview questions and expressed interest in participating in the follow-up interviews.

Step 8: Collect Documents from State DOTs Following the Interviews/Emails (e.g., ROW Manuals, Descriptions of Practices, and State Legal Descriptions) and Analyze the Contents of These Documents to Find Useful Information

Participants in the follow-up interviews/emails provided several internal documents that contained valuable information regarding their policies or methods utilized in ROW acquisition process. These documents were evaluated to compare the identified practices of ROW acquisition processes in other DOTs with that of GDOT to assess their potential applicability for GDOT.

Step 9: Summarize and Present in This Research Report the Findings from all the Information Collected Through the Survey, Emails, Structured Interviews, and Document Evaluations

For the final step, the research team assembled all the findings collected from the survey, follow-up interviews, and materials. An organized compilation and documentation of the information gathered allows for a clear presentation of the findings. The next two chapters focus on presenting the summary of the responses and findings gathered. The reader should note that due to the presentation format, some plots and charts in chapter 4 do not contain responses from state DOTs who did not respond to the specific questions and/or who did not indicate their states.

CHAPTER 3. ORGANIZATIONAL STRUCTURES AND PRACTICES OF PERFORMING ROW ACQUISITION IN STATE DOTS

OVERVIEW OF SURVEY

A survey questionnaire was prepared and distributed to state DOT representatives across the United States who work in an office of ROW. The survey was designed to focus on four main topics: (1) organizational structures of offices of ROW, (2) consultant management, (3) use of performance measurements, and (4) importance of factors in setting the ROW acquisition timeline.

The research team distributed the survey questionnaire to state DOT representatives by sending emails through AASHTO CRUO and searching the contacts from state DOT websites. After evaluation of the responses to the survey, the research team reached out to the respondents to clarify the answers to survey questions, if needed, and gather more detailed information regarding topics that were asked in the survey.

The research team received responses from 39 state DOT representatives, including three representatives who did not indicate their states. The research team tried to obtain insights from subject-matter experts who had sufficient work experience in the ROW acquisition industry. Figure 3 shows that 81 percent of respondents have more than 10 years of experience in the transportation industry; 63 percent of participants have been working in the DOT for more than 10 years; and 30 percent of respondents have been in their position more than 5 years.

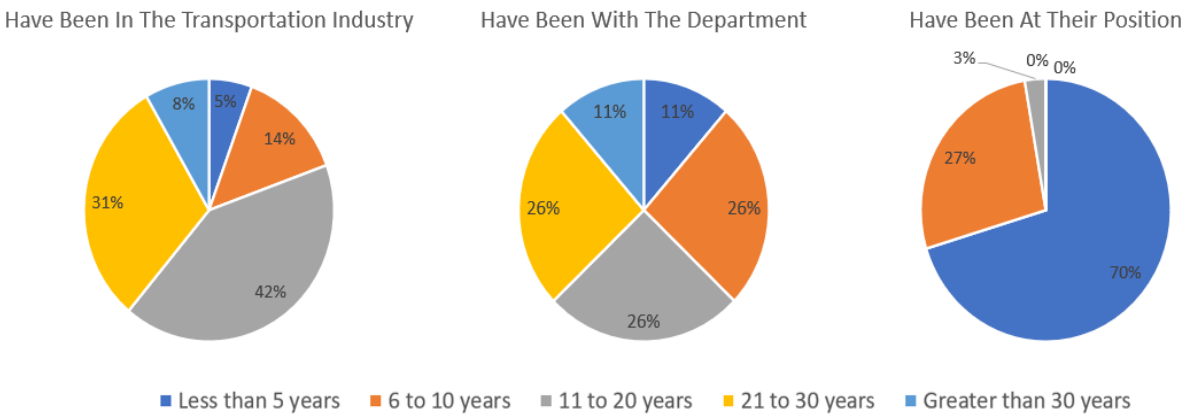


Figure 3. Years of respondents' experience.

ORGANIZATIONAL STRUCTURE OF OFFICES OF ROW

The first part of the survey examined the organizational structure of offices of ROW and the responsibilities of the central office and district or regional office. Because the organizational structure of the office of ROW is the key factor that promotes efficient performance of ROW acquisition (NASEM 2014), a review of how other state DOTs' organizations are structured and compare to the current structure of GDOT's Office of ROW is worthwhile. The survey questions focused on the roles and responsibilities of the state's central and district or regional office and their lines of reporting to identify how the ROW acquisition process is executed for major projects with complex ROW needs. The research team asked six specific questions to retrieve this information:

- How would you describe the overall organization of your Department in managing ROW acquisition?
- Which units are typically in charge of the following ROW tasks?
- Where is the ROW acquisition team leader (or ROW project manager), who is responsible for managing ROW acquisition tasks, located?

- To whom does the ROW acquisition team leader (or ROW project manager) report?
- How many ROW acquisition team leaders (or ROW project managers) work in your Department?
- Typically, at any point in time, how many projects are assigned to a ROW acquisition team leader (or ROW project manager)?

Centralized and Decentralized Structure of State DOTs

Figure 4 shows the states with centralized structure, decentralized structure, or a mix of both. Centralized structure refers to a dedicated unit located in the central office, which handles the majority of processes involving planning and decision-making related to ROW acquisition. Decentralized structure refers to dedicated units located in the district or regional office having the authority to make most ROW acquisition decisions while working on a project.

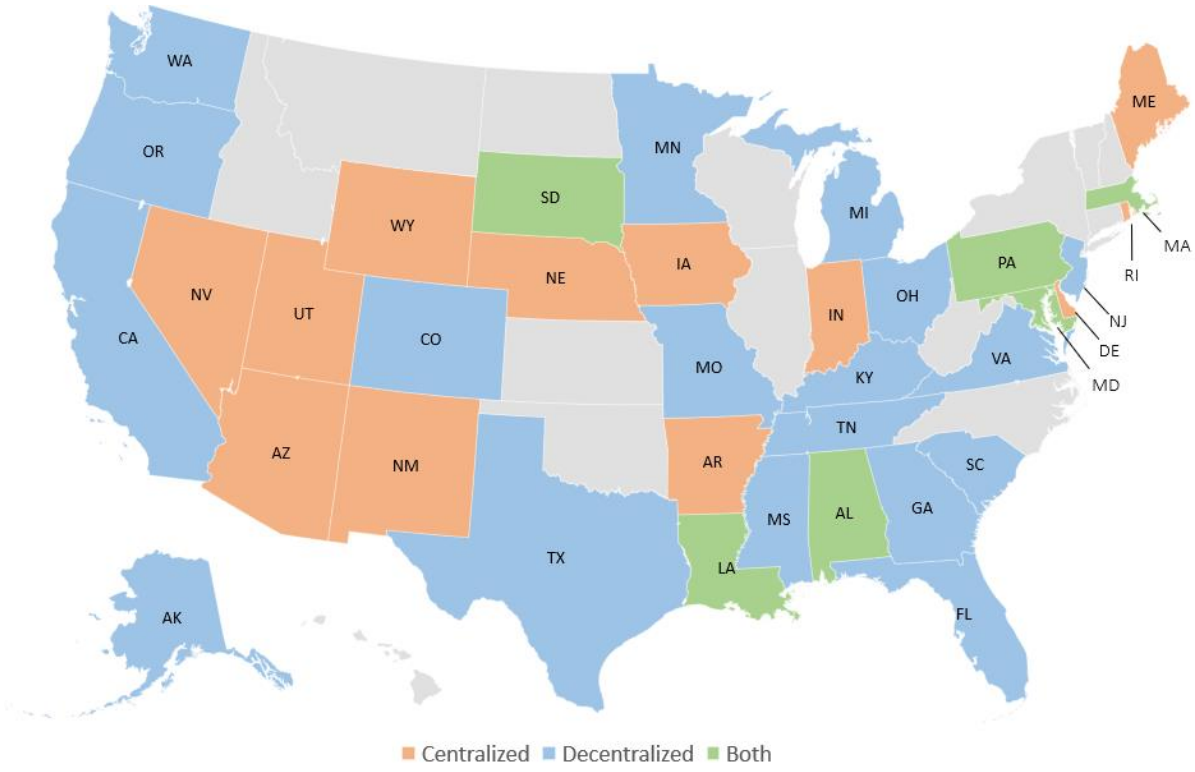


Figure 4. Office of ROW organizational structure.

The survey revealed that 20 states have decentralized organizational structure, 13 states have centralized structure, and 6 states have a mix of both centralized and decentralized structure. The states with relatively larger population, including Georgia, California, Colorado, Florida, and Texas, have decentralized structure, while states with relatively smaller population, such as Iowa, Nevada, and Wyoming have centralized structure.

Units in Charge of Specific ROW Tasks

The questionnaire asked which office is responsible for specific ROW tasks in order to identify roles and responsibilities for the central office and the district or regional offices. Figure 5 illustrates which office is responsible for specific ROW tasks. The review process, record retention, condemnation coordination, ROW certification, and tasks

involving financial approval are more often the responsibility of the central office. The appraisals, relocation assistance, and cost estimation are about equally the responsibility of both the central and district office. Giving offers to the owners or tenants and preparing relocation packages are more the responsibility of the district or regional office.

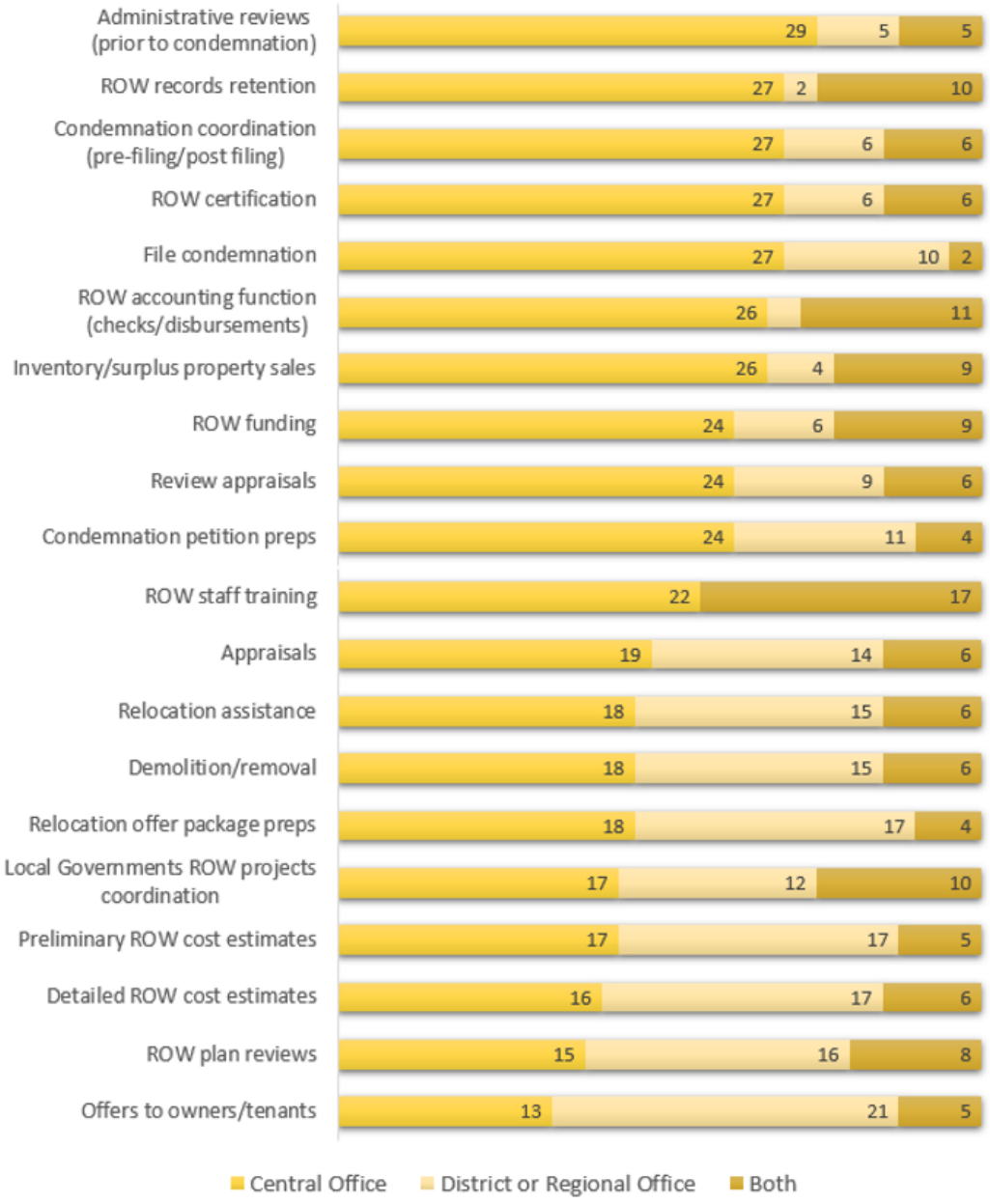


Figure 5. Offices that are responsible for specific ROW tasks.

Responsibility for Team Leaders

Figure 6 shows the percentages of where the team leaders (or ROW project manager) are located and to whom the team leaders report. It was found that the team leaders located at the district or regional office report to the head of their office, whereas the team leaders located at the central office or at both the central and district or regional office directly report to the head of the central office.

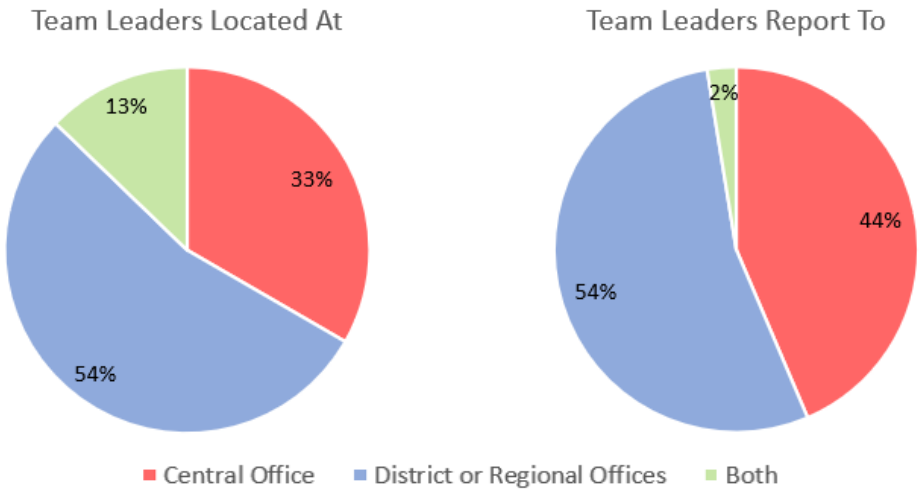


Figure 6. Where team leaders are located (left), and to whom team leaders report (right).

Having a sufficient number of team leaders is necessary to distribute the workload and manage the on-going projects with fewer problems. Inadequate staffing is reported as a common problem affecting ROW delivery among state DOTs (NASEM 2014). Figure 7 shows the number of team leaders working in each department and the number of projects assigned to a team leader at any given time. Not always, but generally, the burden on a team leader is higher in states with a relatively lower number of team leaders.

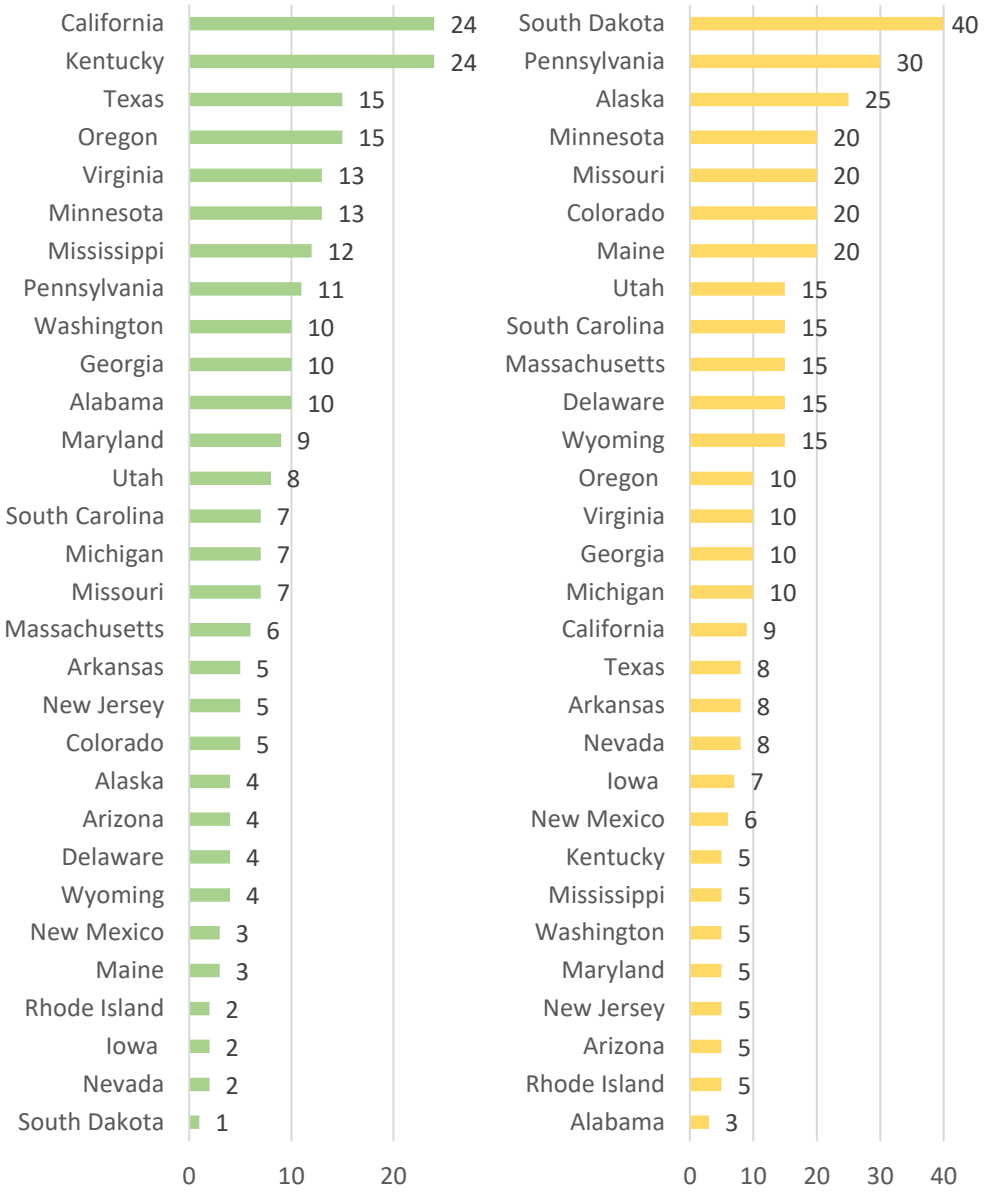


Figure 7. Number of team leaders (left), and number of projects assigned to a team leader (right).

CONSULTANT MANAGEMENT

The purpose of the second part of the survey was to identify the general system of managing and working with consultants to support the ROW acquisition process. Use of consultants is necessary when the internal resources are not enough to accommodate the

heavy workload (NASEM 2014). Establishing an effective system for managing consultants is required to work with consultants in efficient ways. The research team asked five specific questions to observe how state DOTs manage consultants:

- How often does your Department use outside resources from consulting firms to assist in the following ROW acquisition tasks? (the tasks are listed in Figure 8)
- Who selects ROW consulting firms and assigns them to projects in your Department?
- To whom do the ROW consulting firms report?
- On average, how many total number of parcels do your Department ROW staff (all districts, or regions and central office, if any combined) typically acquire for all projects each year?
- On average, how many total number of parcels do your ROW acquisition consultants (all districts, or regions and central office, if any combined) typically acquire for all projects each year?

Involvement of Consultants During ROW Acquisition

The research team asked the respondents to gauge how often they hire consultants for specific ROW acquisition tasks by using a four-point Likert scale: Always, Often, Occasionally, and Never. To determine the overall trend of hiring consultants, the research team gave a quantitative score for each response and took the average score for each task. Figure 8 shows the list of specific ROW tasks and corresponding average scores within a scale of 0 to 5, with 5 meaning *always hire consultants* and 0 meaning *never hire consultants* for the corresponding specific task. It was found that consultants

are most often hired for preparing appraisals, giving offers to owners/tenants, and assisting with relocation.

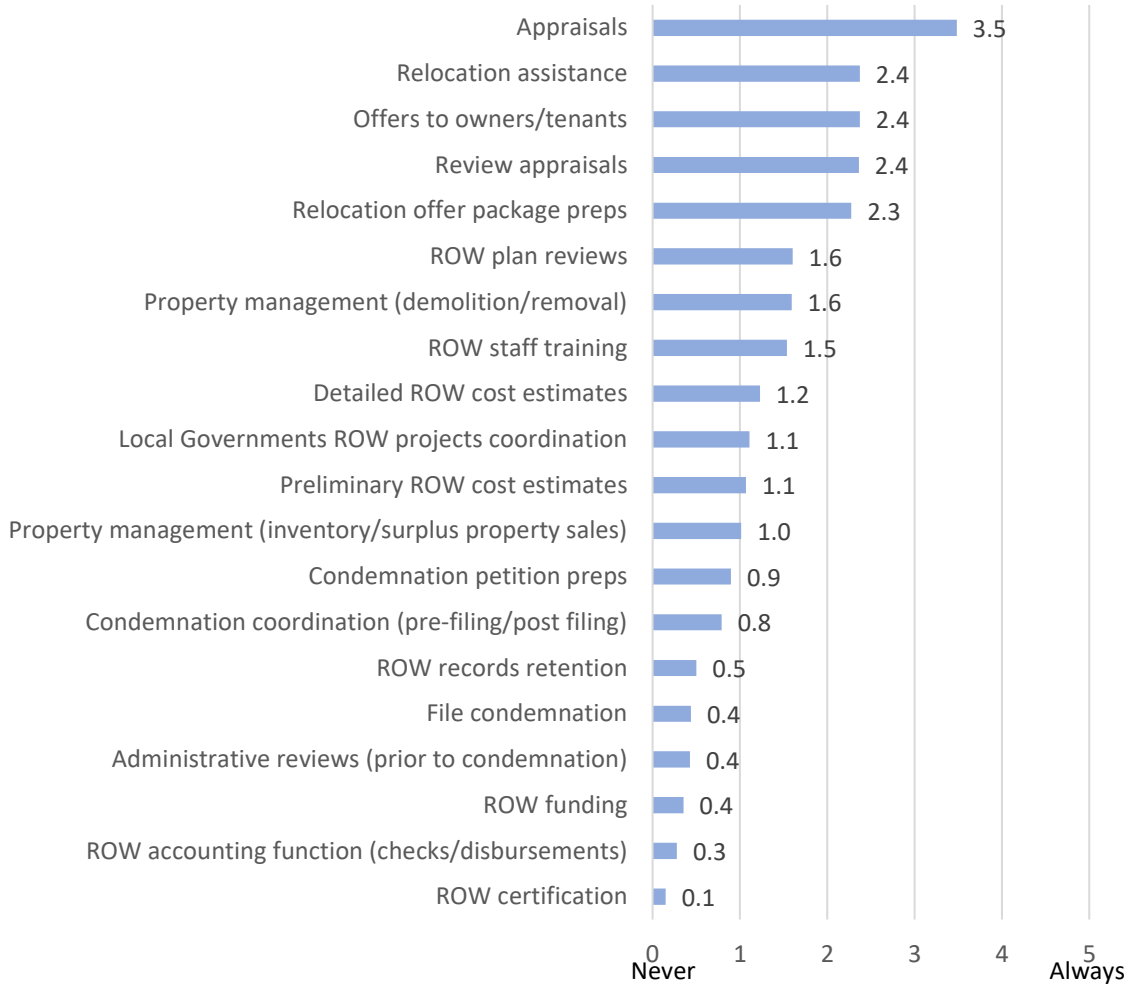


Figure 8. How often consultants are hired for a specific ROW task.

Structure for Managing Consultants

To effectively use consultants when the internal workload is heavy, DOTs are required to manage a process of hiring qualified consultants and overseeing their work. A couple of survey questions were asked to determine what structures state DOTs use to manage their consultants. The respondents were asked to select which office is responsible for hiring

consultants and to select to which office the consultants report their work. The selection results are diagrammed in figure 9 and figure 10. The survey results showed that the ROW unit in the central office has more involvement than the ROW unit in the district offices when hiring qualified consultants and outsourcing the work. However, the ROW units in both the central and district offices almost equally oversee the consultants' work.

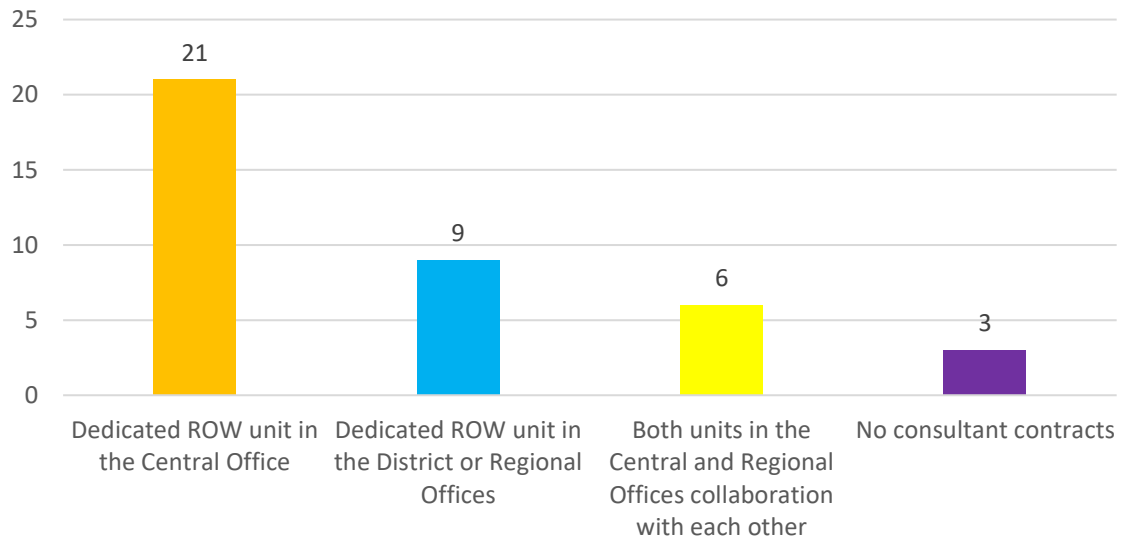


Figure 9. Which office hires consulting firms.

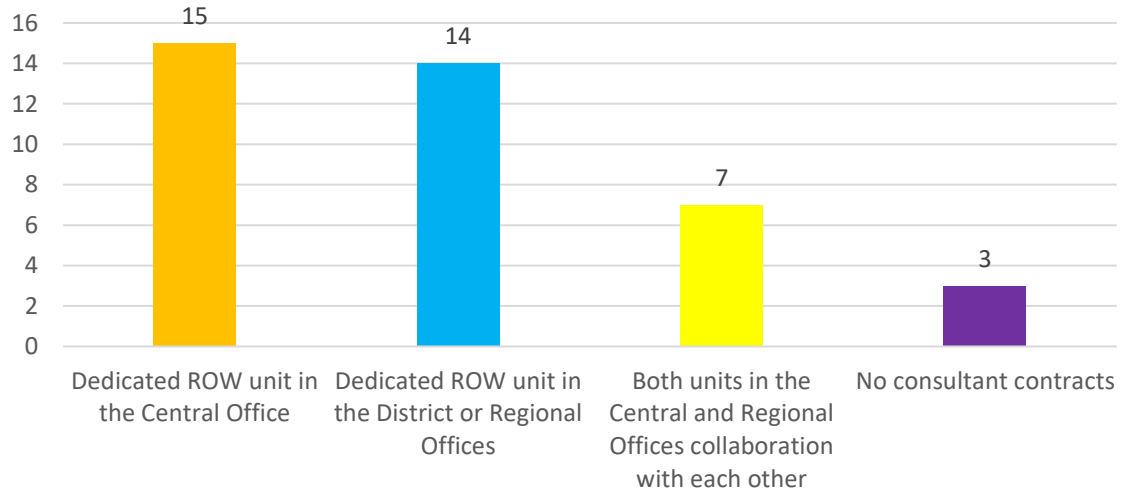


Figure 10. Consulting firms report their work to which office.

Involvement of Consultants in Acquiring Parcels

Furthermore, the research team investigated the average number of parcels acquired by ROW staff and consultants each year. Figure 11 shows the summary of responses in stacked bar charts; in general, the ratio of consultants acquiring parcels increases as the total number of parcels acquired each year increases. In addition, figure 12 shows the ratio of parcels acquired by ROW staff and by consultants in each state.

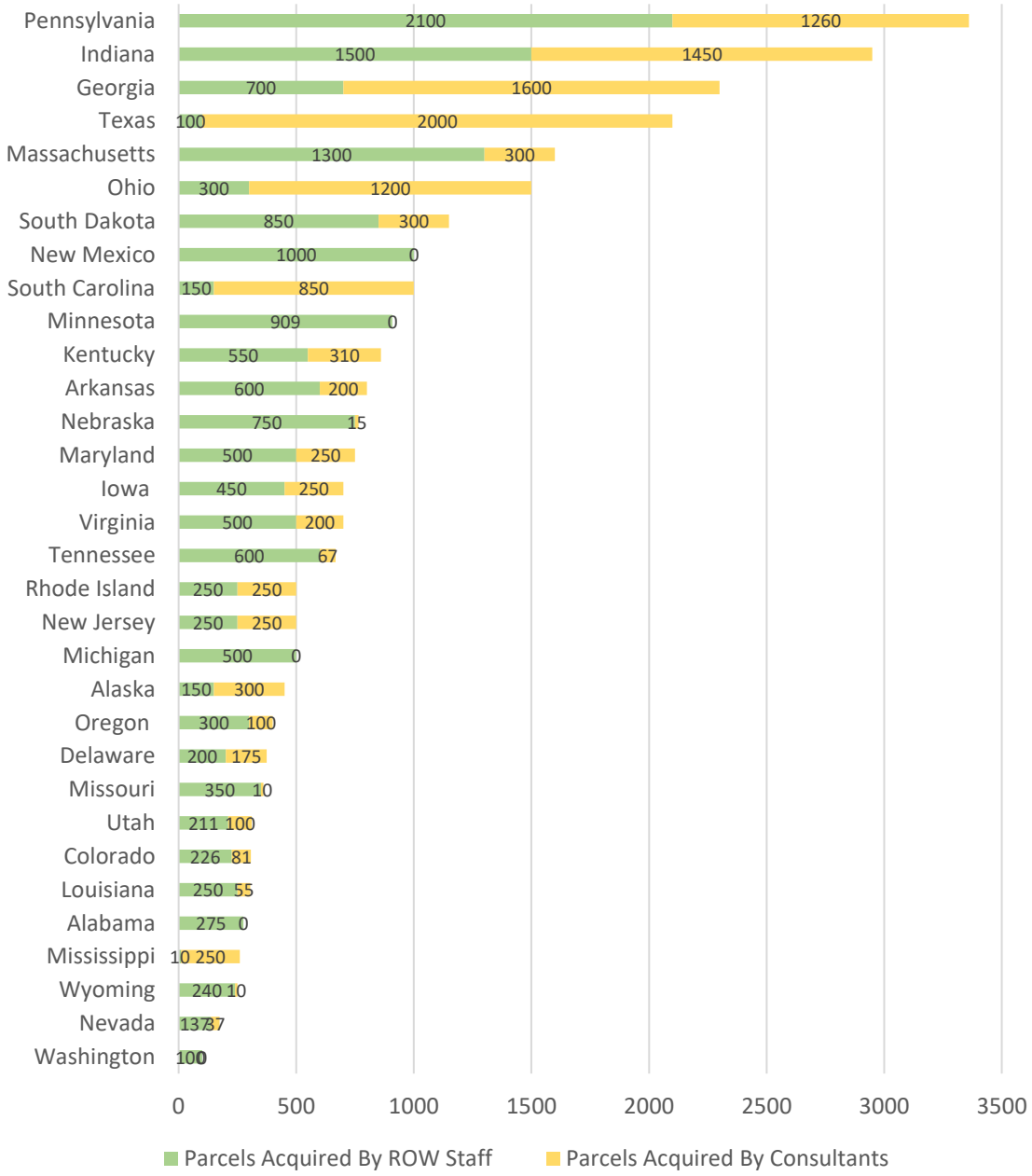


Figure 11. Absolute number of parcels acquired by ROW staff and by consultants.

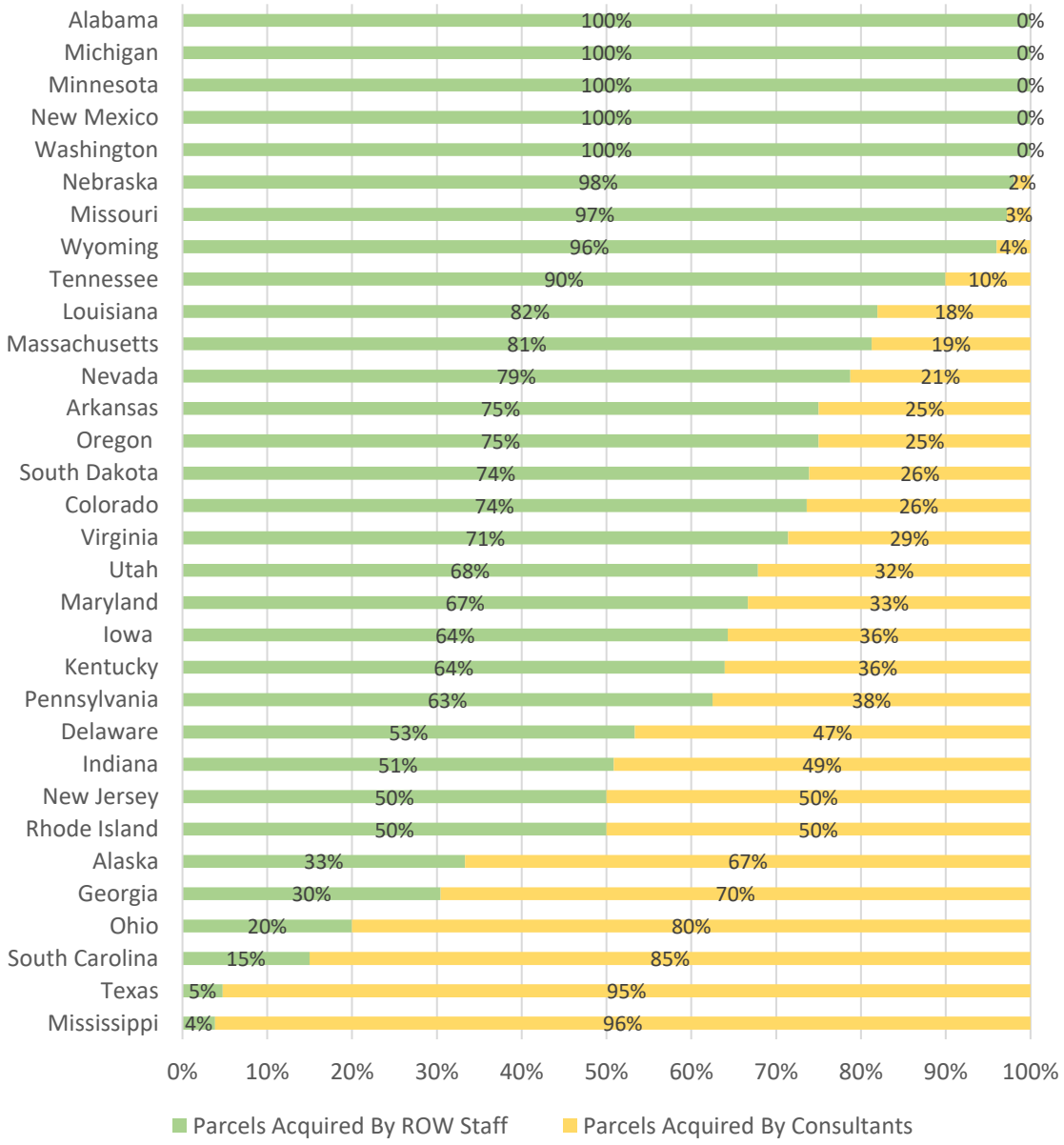


Figure 12. Percent of parcels acquired by ROW staff and by consultants.

USE OF PERFORMANCE MEASUREMENTS

The third part of the survey was to find what types of performance measurements are implemented and which levels of identity are responsible to track the measurements in the state DOTs. The main purpose of using performance measurements is to track the

progress of the ROW acquisition process by setting a specific duration for each task as a performance indicator (McMinmee et al. 2009). The survey questions first asked if the respondent's DOT uses performance measurements. For those who selected that they use performance measurements, two additional questions were asked to identify which office tracks the performance and how the performance is measured. The research team asked three specific questions to examine how state DOTs use the performance measurements:

- Has your Department established performance metrics to measure the performance of ROW acquisition process?
- At what levels does your Department track performance of the ROW acquisition process?
- Does your Department use any of the following metrics to measure the performance of the ROW acquisition services? For other measures, please describe under "Others."

Thirty respondents answered that they keep track of one or more performance measurements. The two additional questions regarding performance measurements were then asked to those 30 respondents.

Figure 13 summarizes the responses to the question regarding which office tracks the performance. Overall, the performances are generally tracked at a high level, such as the ROW unit in the central office or district and regional office, and the ROW acquisition team leader.

Figure 14 shows which types of performance measurements are measured. The respondents were asked to select multiple answers if applicable and provide any

performance measurement that was not in the options. The most popular performance measurement is the "percent of ROW acquisition projects completed on schedule," followed by the "Of the plans submitted for ROW authorization that are completed and on time, the percent of projects with ROW acquisition completed on schedule." The states are particularly interested in measuring if the acquisition tasks and projects are completed on time. Additional verbatim responses from the respondents were as follows:

- Rate of property owner satisfaction.
- Statewide percent of parcels acquired through negotiation.
- Condemnation rates, with success measured by less than 10 percent of acquisitions requiring the use of eminent domain to secure occupancy.
- Cost comparison between ROW programmed, appraised value, and actual cost.
- Number of excess properties conveyed, and gross revenue generated from excess properties conveyed.
- Utility relocations completed on time.

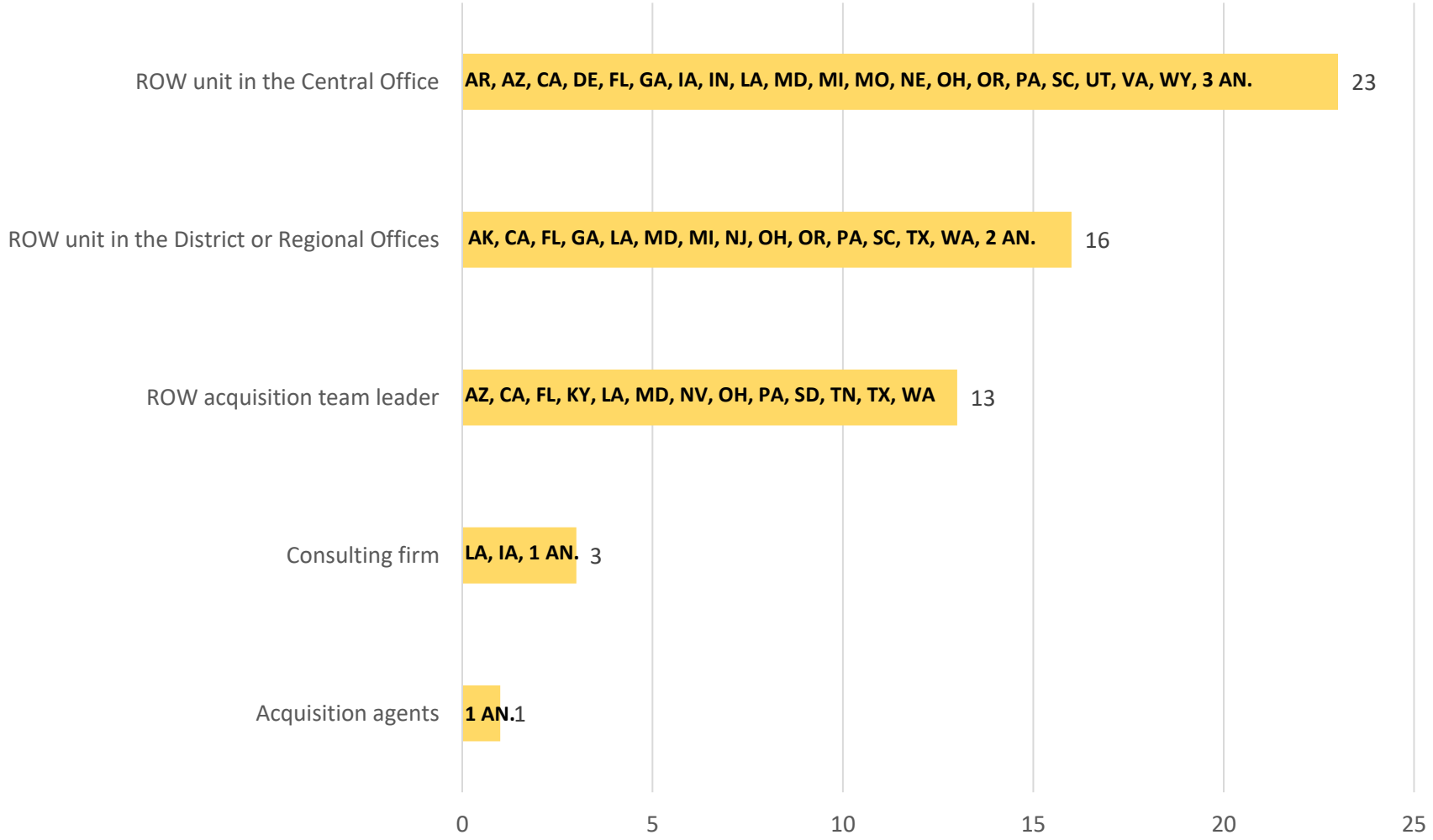


Figure 13. Who tracks performance measurements. (AN. represents anonymous respondent.)

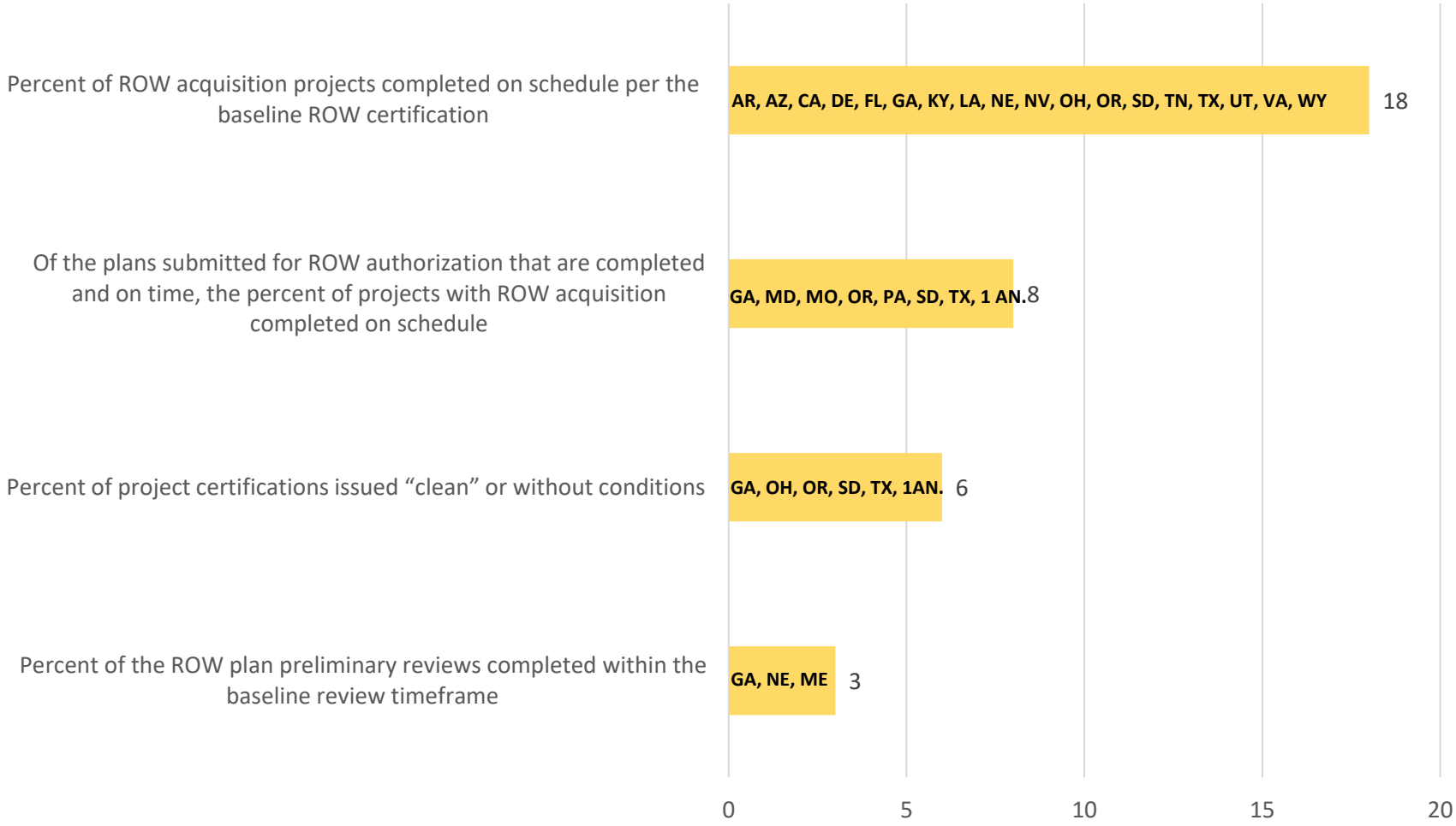


Figure 14. Types of performance measurements used. (AN. represents anonymous respondent.)

IMPORTAN CE OF FACTORS IN SETTING ROW ACQUISITION TIMELINE

There are numerous unique project features and conditions surrounding the project environment that affect the ROW acquisition timeline. Knowing the factors that affect the ROW acquisition duration is essential for better estimation of the timeline for the new projects (Aleithawe et al. 2012). The respondents were asked to select the level of importance for specific project factors in setting the ROW acquisition timeline:

- What is the relative importance of the following factors in setting the timeline to complete ROW acquisition tasks for a project?

The research team asked the respondents to gauge how important they consider each listed factor when setting a ROW acquisition timeline by using a four-point Likert scale: Absolutely Essential, Very Important, Of Average Importance, and Not Important At All. To determine the overall importance of each factor, the research team gave a quantitative score for each response and took the average score for each task. Figure 15 shows the list of project factors and corresponding average scores within the scale of 0 to 5, 5 meaning *absolutely essential* and 0 meaning *not important* in setting the acquisition timeline. The respondents indicated that the number of parcels to acquire and the need for relocation assistance are the most important factors when setting the acquisition timeline. Moreover, the project size in dollar value, project type, and needs for outsource agents are also found to be significant factors to consider when setting the timeline for ROW acquisition.

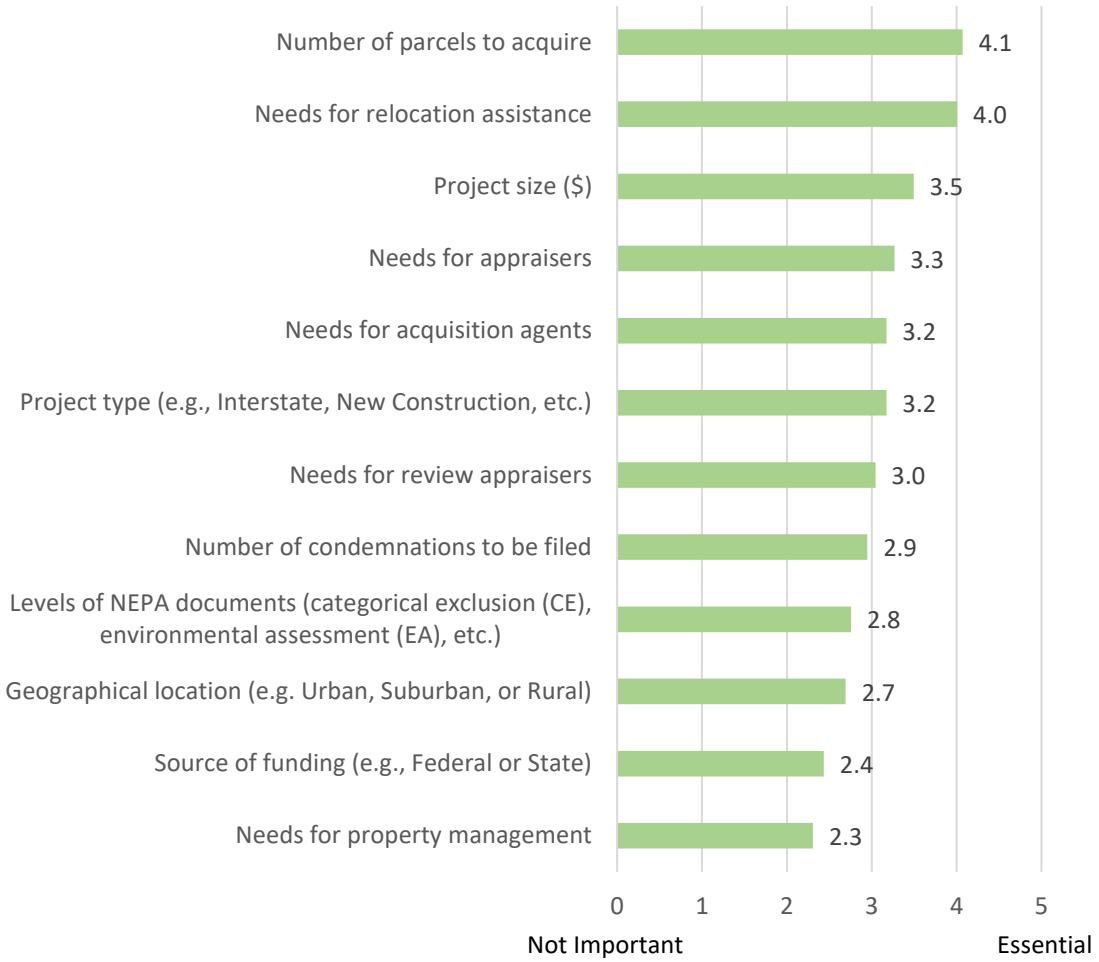


Figure 15. Importance of project factors in setting the ROW acquisition timeline.

CHAPTER 4. IDENTIFIED BEST PRACTICES TO EXPEDITE ROW ACQUISITION PROCESS IN STATE DOTS

The research team reached out to the survey respondents to conduct follow-up interviews via emails and phone calls. The main purpose of conducting interviews was to gather more information about topics that were asked in the survey if needed and identify practices used in other states to expedite the ROW acquisition process. The research team conducted interviews with the representatives who provided answers of good quality to the survey and/or interview questions and expressed interest in participating in the follow-up interviews. The verbal answers and documentations provided by the respondents are evaluated and summarized in this chapter. The research team categorized the identified best practices into seven groups based on the related procedure and phase: (1) Practices in the Early Stage of Project, (2) Develop ROW Plans, (3) Prepare Appraisals, (4) Property Acquisition and Relocation Assistance, (5) Manage Improvement Demolition, (6) Training and Peer Reviews, and (7) Process for Bringing ROW Consultants on Board. The identified best practices in each category are summarized next.

PRACTICES IN THE EARLY STAGE OF PROJECT

Due to the complex and numerous tasks involved in ROW acquisition process, some state offices of ROW developed practices to get involved at an early stage. NASEM (2014) emphasized that involvement of the office of ROW in the early project stage is a key factor to identifying potential issues when acquiring ROW, thus helping to avoid

litigation in advance. The research team identified three practices used to plan early: (1) get involved early, (2) develop an Americans with Disabilities Act (ADA) voluntary curb ramp acquisition program, and (3) break out utility relocation.

Get Involved Early

An Alabama DOT representative reported that completing the preliminary design and the subsequent environmental approval in a timely manner have been obstacles to completing the ROW map and achieving authorization. To mitigate the problem, Alabama DOT has implemented Guidelines for a Plan Development system, which lays out the required completion timeline for the various project steps. The guideline system has been very helpful in assuring all areas of project development meet set target dates or that the schedule can be adjusted. According to the guideline, ROW process is not scheduled to start until after 30 percent of the preliminary engineering and 65 percent of the plan-in-hand reviews have been completed in hopes of addressing all design issues that affect ROW.

The Texas DOT representative reported that their Office of ROW works with the design engineers early on (as early as 30 percent plans) to visualize the ROW impacts. This allows the Office of ROW to better prepare staff and contracted appraisers. Once an appraiser is on board, a relocation specialist visits the location along with the appraiser to understand the condition of the real estate and the need for relocation assistance. The Texas DOT also considers that having a provider or agent accompany the appraiser allows for early knowledge of not only relocation but any items that may need to be removed.

Develop ADA Voluntary Curb Ramp Acquisition Program

Colorado DOT has developed a new approach to ROW acquisition for constructing ADA-compliant curb ramps that is faster, more cost efficient, and simpler for landowners. The project design uses a location map instead of ROW plans and will not require legal descriptions or a cost estimate. Figure 16 shows an example of the location map used for the program.

Figure 16. Example location map for ADA voluntary curb ramp acquisition program (Colorado DOT).

All possible ownerships needing right of way are determined using global information system (GIS) and subdivision plats to determine ROW boundary lines, and laying in the type and location of the ADA ramp to be constructed. The Colorado DOT studies the fair market value of all properties in a given area where access and easements are needed and determines an amount of money to be offered to each landowner, based on land use type.

During the pilot program signing the agreement will be voluntary and Colorado DOT will not use eminent domain power in any cases.

Break Out Utility Relocation

The Maryland DOT reported that the development of ROW plans can be challenging because of the needs for the utility relocation, which requires extensive coordination with the utility company whose facilities are impacted. Unfortunately, the utility companies are often not bounded by the ROW acquisition schedule. To reduce the risk, the Maryland DOT sometimes breaks out utility relocation from the main construction project to prevent uncompleted utility relocation from delaying the schedule of construction.

DEVELOP ROW PLAN

From the survey conducted by Aleithawe (2013), it was found that late ROW design plans and revisions were considered as major concerns in the ROW acquisition process from all 36 state survey respondents. It is desirable to develop ROW plans in a timely manner with clear presentation at first to avoid causing delays to the acquisition schedule. The research team identified two practices that can help in developing plans efficiently: (1) develop a ROW parcel overlay (ROWPO), and (2) use eSignature for ROW plan authorization.

Develop Right of Way Parcel Overlay

The Michigan DOT traditionally printed black and white drawings showing consents, proposed ROW, and other details, but many property owners did not clearly comprehend

the information on the sketches. To better communicate with the owners, the Michigan DOT is developing a *right of way parcel overlay*, which is an aerial photo of a property owner's parcel of land with the design plans laid on top, as shown in figure 17. The plan is created using the Power Geopack software, which enables overlaying the traditional ROW plan on the corresponding aerial image. The aerial image can be either present or not present depending on the usage. The plan with the aerial image is used when communicating with property owners, while the plan without the aerial image is used when reviewing the plan internally because it is easier to read the comments that have been placed on the plan sheets.

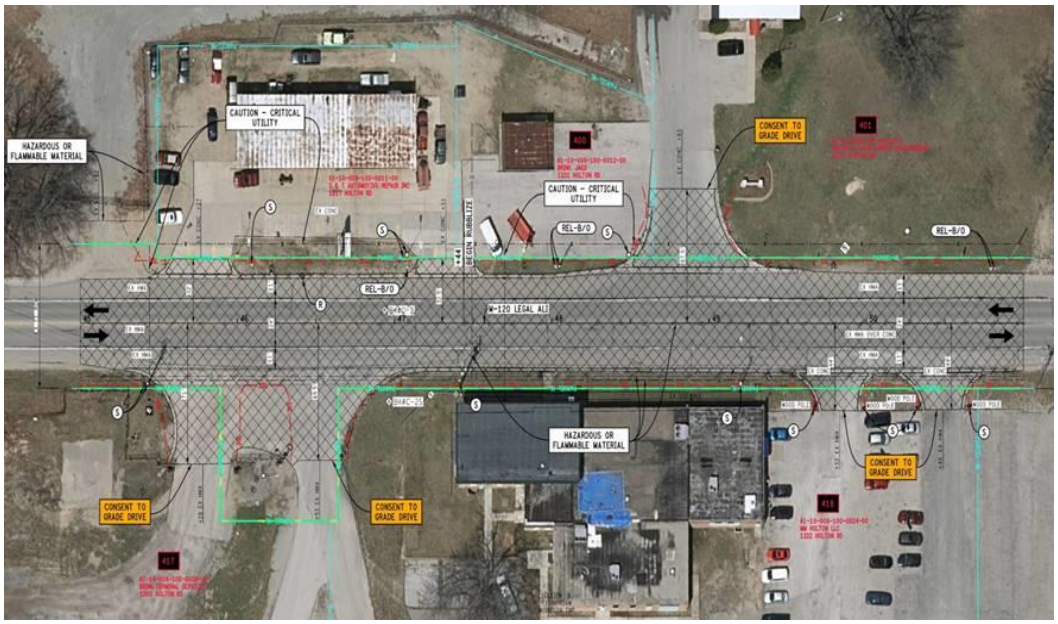


Figure 17. Example right of way parcel overlay (Michigan DOT).

Use eSignature for ROW Plan Authorization

The Colorado DOT utilizes eSignature for the chief engineer to authorize ROW plans electronically using AdobeSign, which is integrated with the Colorado DOT's existing

ProjectWise software. An eSignature is a legal way to get approval on electronic documents. It can be used to replace handwritten signatures in virtually every business process (Adobe 2020). The Colorado DOT found that using eSignature reduced the time for plans to be authorized from over a week to less than two days, which allowed the acquisition and valuation process to begin in a more timely manner.

PREPARE APPRAISALS

The appraisal is intended to make sure that a property's fair market value is offered to the property owner and to provide evidence for the expenditure of public funds (GDOT 2018). It is important to appraise the ROW at fair market value and at a reasonable cost to build trust with the property owners and to accurately measure the cost for highway and transportation projects (Aleithawe 2010). The appraisals should be created and reviewed by licensed appraisers, which can be challenging and time consuming when there is a limited number of experts available in-house. The research team found four approaches to support the creation of/review appraisal process: (1) utilize waiver valuation, (2) conduct pre-NEPA (National Environmental Policy Act) acquisition tasks with state funds, (3) perform in-house appraisals, and (4) use a fee appraiser to review appraisals.

Utilize Waiver Valuation

Waiver valuation can be used if a parcel is donated or if the parcel is uncomplicated and low valued (Caldas et al. 2006). State DOTs utilize waiver valuation to reduce time and cost to prepare the appraisals, if possible.

At the Colorado DOT, waiver valuations are generally prepared by real estate specialists, although recent legislation has allowed appraisers to prepare them, as well. Waiver valuations may be used by the Colorado DOT for properties valued below $25,000, but a release from the landowner is required for the Colorado DOT to prepare a waiver valuation above $10,000.

The Nebraska DOT also used waiver valuation for properties valued below $25,000. However, for any parcel valued over $10,000, the Nebraska DOT offered the property owner to accompany the evaluator on the field inspection. The Nebraska DOT determined that once a staff spends time to offer to accompany and performs the field review to create a short form appraisal, the cost is about the same as creating the appraisal so that the Nebraska DOT left the waiver valuation threshold at $10,000.

Waiver valuations represent about 70 percent of the appraisal works at the Ohio DOT. The requirement for review has been eliminated for the waiver valuation. The Ohio DOT representative stated that they have been saving a lot of time that would have otherwise been spent on review.

Conduct Pre-NEPA Acquisition Tasks with State Funds

The Ohio DOT sometimes elects to conduct some ROW acquisition functions, such as titles and appraisals, with state money that will not be eligible for federal reimbursement but would count toward the state participation. It allows the Ohio DOT to begin making acquisition offers when the NEPA environmental document is completed and federal authorization is granted. In this case, the acquisition offers would be eligible for federal reimbursement.

Perform In-house Appraisals

The Maryland DOT experienced challenges from using fee appraisals to procure appraisals on time. Although the Maryland DOT expanded the pool of appraisers, the appraisals they received for review lacked the desired quality due to the decline in the number of qualified and experienced appraisers who were capable of performing appraisals for eminent domain purposes. Hence, the Maryland DOT created an Appraisal Division whose mission is to perform in-house appraisals and complement the use of fee appraisers. Substantial time is required to develop staff to an adequate standard since an appraisal is a highly technical field, but the Maryland DOT found it to be a worthwhile investment.

Use Fee Appraisers to Review Appraisals

At the Colorado DOT, appraisals can be reviewed by fee appraisers. It is not the standard review process, but it can help with flexibility if there is not enough staff to conduct an in-house review, which can be a particular problem for local agencies. The review appraisers must be qualified, and there are nine fee appraisers who are qualified to perform the review process for the Colorado DOT.

PROPERTY ACQUISITION AND RELOCATION ASSISTANCE

The property acquisition and relocation assistance processes can be lengthy and challenging because the processes involve negotiations with property owners. During the negotiation process, it is important to make every reasonable effort to amicably negotiate a settlement (GDOT 2018). Transportation agencies are responsible for ensuring that parcel

owners receive fair market value of the property and relocation assistance, if needed. Despite the effort of transportation agencies to provide fair treatments, the property owner may not be satisfied (Hakimi and Kockelman 2005). The duration of property acquisition and relocation assistance is difficult to estimate because it depends on the time it takes for property owners to make a decision. Therefore, it is useful to complement the process with practices that can help to facilitate the property owners' decision making and to start the process early. The research team found three practices to make property acquisition and relocation assistance processes more efficient: (1) use an incentive program, (2) use only state funds to acquire properties early, and (3) condemn properties early.

Use an Incentive Program

State DOTs have been implementing incentive programs after the review of innovative practices used in European countries (NASEM 2014). Overall, the state DOTs experienced a reduction in time to acquire and clear parcels, while no reduction in property owner benefits (NASEM 2014). Even though the state DOTs share the same goal of using an incentive program, the details about the programs varied among the states.

South Carolina DOT's Incentive Program

The South Carolina DOT is in the process of developing incentive programs. Although the specific incentive payment plans are not set up yet, the research team found valuable information that needs to be considered when developing an incentive program. The

criteria that South Carolina DOT will consider for use of the incentive payment program include, but are not limited to:

- Areas where known market trends will increase right of way costs.
- Safety concerns that necessitate the acceleration of a project schedule (i.e. highway is washed out due to flooding, bridge collapses, highway safety improvement projects, etc.).
- When a reasonable analysis indicates that the project could be advanced under the incentive program.
- When unanticipated funding becomes available (e.g., federal stimulus money) that results in the South Carolina DOT moving a letting date up for a project. (This should be evaluated in conjunction with the first three criteria.)

Moreover, the factors considered by the South Carolina when setting payments include, but are not limited to: constrained/compressed/aggressive project schedule, location, number of relocations, delivery method, overall project budget, high public profile/political sensitivity, emergency repair/replacement projects, safety concerns, availability of unanticipated funding, potential litigation exposure, current trends of the real estate market which may increase right of way costs, and cost/benefit analysis.

North Carolina Turnpike Authority's Incentive Program

The draft of the North Carolina Turnpike Authority (NCTA) incentive program indicated that there are three types of incentive plans: (1) Right of Entry Incentive Plan, (2) Acquisition Incentive Plan, and (3) Relocation Incentive Plan. The descriptions of each incentive program are as follows:

- The Right of Entry Incentive Plan is intended to motivate owners to accept conditions as outlined in the Right of Entry agreement within 30 calendar days of receiving the request. It does not affect a property owner's final acquisition settlement or any relocation benefits, if applicable. The incentive is offered on a per-parcel basis as identified by an NCTA parcel number and not for each individual ownership interest in the parcel. The minimum payment shall be $500, and the maximum payment shall be $10,000.
- The Acquisition Incentive Plan is intended to motivate property owners to negotiate a settlement within 30 calendar days of receiving the offer to purchase. Any revision or amendments to the appraisal and/or statement of just compensation amounts shall be reflected in the calculation of the Acquisition Incentive Payment. The Acquisition Incentive Payment for fee simple and permanent easement acquisitions shall be an amount equal to 10 percent of the offer to purchase. The minimum payment shall be $500, and the maximum payment shall be $50,000.
- The Relocation Incentive Plan is designed to motivate displacees to vacate and remove personal property items from the property prior to expiration of the 90-day letter of assurance. It applies to residential and non-residential displacees and personal property only moves. Landlords, without personal property to be relocated, are not considered displacees for the purposes of the Relocation Incentive Plan and will not be eligible for a relocation incentive payment. After the 30 days acceptance period, the incentive payments get reduced in accordance with the schedules listed in table 1.

Table 1. Relocation incentive plan (North Carolina Turnpike Authority).

Residential and Non-residential Displacee Payment Schedule		
Term	*Factor*	*Max. Payment*
< 30 days	100%	$5,000.00
31–60 days	60%	$2,000.00
61–80 days	20%	$1,000.00
> 81 days	0%	$0.00 (zero)

Personal Property Only Payment Schedule		
Term	*Factor*	*Max. Payment*
< 30 days	100%	$5,000.00
31–60 days	60%	$2,000.00
61–80 days	20%	$1,000.00
> 81 days	0%	$0.00 (zero)

Mississippi DOT's Incentive Program

The Mississippi DOT has experience with using incentive payments on large-scale projects. The following are the relocation incentive payments that they utilized on a project in 2011.

- Additional $10,000 if displacee moved within 30 days of receipt of acquisition funds.
- Additional $6,000 if displacee moved within 60 days of receipt of acquisition funds.
- Additional $3,000 if displacee moved within 90 days of receipt of acquisition funds.
- $1,000 incentives were provided to business owners/landlords.

The total budget for the project was $15 million, whereas the total incentives were $318,000 (i.e., 2 percent of the total budget). The Mississippi DOT representative stated that the incentive payments accelerated project delivery, eliminated administrative adjustments for acquisitions, and resulted in no condemnations due to money issues.

Colorado DOT's Incentive Program

The Colorado DOT representative stated that they use incentive payments much more frequently for acquisition than relocation service. Nine acquisition incentive payments were used in the last two fiscal years, but relocation incentive payments have not been used for several years. The Colorado DOT found that acquisition incentive payments are more effective for relatively low-valued properties. Furthermore, using similar values of incentive payments across a project is found to be more effective and perceived as fair. The incentive payment amounts are established by the regional ROW manager. The Colorado DOT representative reported that a fixed incentive payment of $500 paired with a 30-day decision time for the property owner has been the most common for projects containing all low-value acquisitions. When valuations are higher or mixed across a project, a percentage approach has been adopted, or a mix of fixed payment and percentage. For those high-value or mixed-value projects, incentive payments have averaged 26 percent of the valuation of the property.

Use Only State Funds to Acquire Properties Early

On some projects, the Ohio DOT elects to use only state funds to acquire properties. This allows the Ohio DOT to start acquiring properties without waiting for NEPA clearance and the attendant federal authorization. It also allows them to move forward with utility relocation. The Ohio DOT representative noted that aside from timing of the work, the Department otherwise follows all uniform act requirements in the acquisition.

Condemn Properties Early

An ideal outcome would be to acquire properties by having mutual agreements with property owners and avoid filing condemnations. However, having negotiation with property owners can sometimes be challenging and a lengthy process. The Alabama DOT had an issue of various offices allowing negotiations to drag on without action and delay the completion of projects. To solve the issue, the Alabama DOT files condemnation in 30 days from presentation of the offer with negotiation continuing up to the date of Merit hearing. The time period of 30 days was considered as a reasonable time for a property owner to review the offer and render a decision. The Alabama DOT representative reported that this method has been a successful tool to set a defined timeline for scheduling and has been beneficial in getting property owners to respond in a reasonable time.

MANAGE IMPROVEMENT DEMOLITION

Depending on the condition of improvements located at the acquired parcel and the construction plan, the improvements need to be demolished before the construction begins. The demolition process can be time consuming and can cause delays to the construction schedule (Caldas et al. 2006). Therefore, it is necessary for transportation agencies to consider how they will manage the demolition process to optimize the project schedule and cost. The research team identified two approaches to manage the improvement demolition: (1) in a standalone contract, and (2) in a construction contract. The following describe how various state DOTs manage improvement demolitions:

- The Ohio DOT typically does not include any requirements to clear ROW in the construction contracts, but it is not uncommon that a construction contract would include demolition of structures. On occasion, the Ohio DOT may even let a specific demolition contract ahead of a construction contract.
- The Tennessee DOT often includes demolition activities in the construction contracts to meet the project schedule rather than expedite the process. Their ROW schedule assumes demolition activities will be done as part of construction.
- The Alabama DOT typically handles improvement demolition in the roadway construction contract in accordance with the Alabama DOT *Standard Specification for Highway Construction.* However, separate demolition contracts are sometimes let prior to the construction to remove structures for safety reasons or to allow utility relocation to proceed.
- The Colorado DOT may include clearing parcels and vacating/demolishing improvements either in the construction contract or in a standalone contract. The Colorado DOT representative added that it is considered more expedient to contract separately for property management activities on projects with a large number of improvements, or when there is considerable time between the ROW acquisition phase and the beginning of construction.
- The South Carolina DOT's standard procedure is to include demolition in the construction contract. However, the South Carolina DOT is trying to bring the demolition into the acquisition phase because improvements sitting until the beginning of construction may cause issues such as neighborhood blight, theft, and drug dealing. The South Carolina DOT considers demolishing the

improvements sooner to be better for them in many ways, such as public perception and good will.

TRAINING AND PEER REVIEWS

NCHRP (2000) emphasized that staff training is a strongly effective practice to accelerate ROW delivery. FHWA (2004) recommended to provide training for both new employees and experienced staff. The research team found two practices for training and educating ROW employees: (1) train new employees in-house, and (2) develop a peer review system.

Train New Employees In-house

The Maryland DOT reported that because it is difficult to expect new hire employees to have skillsets and requisite knowledge, they embarked on extensive training in-house and through other professional organizations, such as the International Right of Way Association, Federal Administration Resource Center, etc. The Maryland DOT focuses on teaching the required technical know-how of being able to explain the valuation of the ROW and the laws and processes governing acquisition practices that may require the use of eminent domain.

Develop a Peer Review System

As much as it is important to educate newly hired employees, it is essential to continuously train experienced staff (FHWA 2004). The Colorado DOT reported that they have a peer review system called Intra-Regional Quality Assurance Reviews. In this system design, regional ROW units conduct peer reviews of their fellow regional ROW

units' acquisition and relocation files. The region acquisition/relocation supervisor and staff travel to the other region office to review project records and discuss findings with their counterparts. Then, the final report is sent to the ROW Program headquarters and each region office. Furthermore, every two or three years, the sample of files which have been submitted to headquarters are reviewed by the Headquarters ROW Acquisition/Relocation Unit. During the review process, the best practices are determined and reviewed for adoption in other regions, and areas that need improvements are identified and suggestions of how to improve them are made. A final statewide report is provided to region ROW managers and acquisition/relocation supervisors.

PROCESS FOR BRINGING ROW CONSULTANTS ON BOARD

State DOTs experienced problems while working with consultants, such as lack of expertise, poor quality of deliverables, amount of management oversight, and higher condemnation rates (Jeong et al. 2016, NASEM 2014). Therefore, it is important to hire consultants in a systematic way to lessen the problems described above and generate qualified results. The research team found that state DOTs established different ways to bring consultants on board. This section summarizes the approaches that the Ohio, Tennessee, and Colorado DOTs use to hire consultants.

Ohio DOT's Process for Bringing ROW Consultants On Board

At the Ohio DOT, the district office selects a consultant for any specific project. It is not required for the district office to select the consultant with the lowest bid. The district office may select the consultant that the district office considers will deliver the best results for the project based on the proposal. The factors considered while selecting

consultants include costs, approaches to perform work, team members, or other reasons that the district office determines to be compelling. The consultants are rated and receive feedback by the district office in the Consultant Evaluation System (CES) every time they complete a project. The scores are available to other district offices and are reviewed when selecting for future procurement. The Ohio DOT representative reported that consultants also appreciate hearing feedback and the transparency of the Ohio DOT's selection process. The only concern that consultants voice to the Ohio DOT is when the outsourced work is performed by a subconsultant. In that scenario, the prime consultant is concerned about receiving a rating when there are issues in subconsultants' work because the rating is tied to the prime consultant as the contract holder.

Colorado DOT's Process for Bringing ROW Consultants On Board

The Colorado DOT established statewide price agreements for appraisal consultants, which were solicited through a request for proposals (RFP) in 2018 and 2019. A prerequisite for the RFP was that the appraisers must have been on the Colorado DOT's list of qualified appraisers. For appraisers to get onto the list, they need to submit an application with prior work samples that are reviewed by a panel of appraisers. The region ROW units may select any appraiser from the list and enter a purchase order at the established pricing when they need appraisal services. The Colorado DOT is also developing an invitation for bids (IFB) for acquisition and relocation consultants, but price agreements have not yet been established. Once price agreements are established, the region ROW units will be able to select acquisition and relocation consultants similar to how they select the appraisers.

Prior to the issuance of the current system, the region ROW units solicited services on a project-by-project basis. The individual project solicitations required the region ROW units to select the lowest bid. However, under the new price agreements, region ROW units may enter a purchase order with any consultant who has a price agreement, regardless of price. The performance of a consultant is graded on each purchase order, and the performance grade is reviewed by the region ROW units when selecting a consultant. Moreover, the acquisition and relocation IFB also requires that credentials and experience be submitted, and each consultant is classified as a junior agent, senior agent, or project manager. A distinct price will be established for each of the consultant classifications. The region ROW units will be provided with a list of consultants at each classification prior to selecting a consultant.

Tennessee DOT's Process for Bringing ROW Consultants On Board

The Tennessee DOT has a two-stage process for procuring consultants: prequalification and on-call contracting. Consultants must be prequalified to be eligible to perform right of way acquisition, relocation assistance, or related functions on a project receiving funding from or through the Tennessee DOT. The prequalification of consultants is evaluated by the ROW Division's Consultant Evaluation Panel. The Tennessee DOT maintains continuous on-call contracts to provide acquisition, relocation assistance, and related services. The contracts run for 5 years with work orders permitted in the first 2 years only. The Tennessee DOT selects from the on-call consultants when a consultant is needed.

SUMMARY OF IDENTIFIED BEST PRACTICES TO EXPEDITE ROW ACQUSITION PROCESS

The research team conducted follow-up interviews with the survey respondents via emails and phone calls. The research team was able to identify numerous best practices used in other states to expedite the ROW acquisition process. Table 2 shows a summary of all the identified best practices.

Table 2. Identified best practices to expedite ROW acquisition process.

Categories	Identified Best Practices
Practices in the Early Stage of Project	• Get involved early • Develop ADA voluntary curb ramp acquisition program • Break out utility relocation
Develop ROW Plans	• Develop ROW parcel overlay • Use eSignature for ROW plan authorization
Prepare Appraisals	• Utilize waiver valuation • Conduct pre-NEPA acquisition tasks with state funds • Perform in-house appraisals • Use fee appraiser to review appraisals
Property Acquisition and Relocation Assistance	• Use incentive program • Use only state funds to acquire properties early • Condemn properties early
Manage Improvement Demolition	• Manage improvement demolition in a standalone contract • Manage improvement demolition in a construction contract
Training and Performance Reviews	• Train new employees in-house • Develop a peer review system
Process for Bringing ROW Consultants on Board	• Descriptions of how Ohio, Tennessee, and Colorado DOTs bring consultants on board

CHAPTER 5. OVERVIEW OF DATA MINING PROCESS TO ESTIMATE ROW ACQUISITION DURATION

An important element in delivering highway projects on time is to set a proper timeline for ROW acquisitions. However, the complex internal and external characteristics in delivering highway projects are often problematic in estimating the ROW acquisition timeline. The research team aimed to develop a data-driven approach to evaluate opportunities to estimate the ROW acquisition timeline, considering unique project features and important external factors surrounding the project environment. The following steps were performed to achieve the objective.

- Collect the required data to analyze the ROW acquisition duration.
- Sort out the data that are appropriate for performing the data analysis.
- Conduct data mining to evaluate opportunities to estimate the ROW acquisition timeline.

DISCUSSION OF STEPS OF DEVELOPING DATA-DRIVEN MODEL TO ESTIMATE ROW ACQUISITION TIMELINE

Step 1: Collect the Required Data to Analyze the ROW Acquisition Duration

The research team collected historical data related to the ROW acquisition process that should be utilized to analyze the ROW timeline. Efforts were made to review as many accessible databases as possible to comprehend the projects characteristics. The research team was able to access the databases through help from the GDOT Office of ROW and Office of Program Control, and by searching through the GeoPi website. This study

focused on evaluating projects that had ROW authorization from the year 2010 in order to study the characteristics and challenges that exist currently. The following databases were reviewed to find historical data to be used in the data analysis:

- *Preconstruction Status Report (PSR)*: Used to extract the majority of the project features.
- *T-Pro*: Used to extract Detailed ROW Cost Estimate and to find missing project features.
- *ROW Status Meeting Data*: Used to sort out projects with significant delays due to scope change and going on the shelf.

Step 2: Sort Out the Data That Are Appropriate for Performing the Data Analysis

The research team received PSR and T-Pro data of 1,298 previous projects from the GDOT Office of ROW, which they organized into a single Excel sheet. The research team could not conduct analysis with all 1,298 projects because some projects did not have proper records and others were not applicable for the evaluation. To conduct the data analysis, it was necessary to calculate the ROW acquisition duration, using the difference between the ROW Authorization Date and ROW Certified Date indicated in the PSR. However, records of 707 projects did not have either one of those dates, making it impossible to calculate the ROW acquisition durations. Furthermore, additional projects with the following conditions were sorted out before conducting the evaluation:

- Projects without records needed in evaluation (e.g., dates, number of parcels, cost, etc.).
- Projects held before the year 2010.

- Innovative delivery projects (e.g., design–build and design–build–finance projects) and projects in the Major Mobility Investment Program (MMIP).
- Projects that had significant delays due to scope change and the project going on the shelf.

After organizing the data, the research team could conduct the analysis with historical data from 495 projects.

Step 3: Conduct Data Mining to Evaluate Opportunities to Estimate ROW Acquisition Timeline

The research team performed data mining to build a model that estimates the timeline required to complete ROW acquisition tasks, considering specific project characteristics and unique project conditions. The variables used in the analysis were selected based on literature reviews, discussions with subject matter experts, and survey results. Thirteen independent variables were selected to develop the model that estimates ROW acquisition duration (the source of the data item is provided in square brackets):

- *Number of Parcels [PSR]*: Describes the number of parcels to acquire. As shown in figure 15, from the survey conducted by the research team, the number of parcels was found to be the most important factor to consider in setting the ROW acquisition timeline. It was also determined to be significant and used in predicting the acquisition timeline in previous research (Sohn et al. 2014, Aleithawe et al. 2012).
- *Number of Relocations [PSR]*: Describes the number of parcels that need relocation assistance. The needs for relocation assistance was the second-most

important factor to consider when setting the ROW acquisition timeline, as identified from the survey in this study (see figure 15). Sohn et al. (2014) also highlighted that need for relocation assistance is one of the key factors in predicting the ROW timeline.

- *Number of Condemnation [PSR]*: Describes the number of condemnations filed to acquire. The number of condemnations was found to be one of the important factors to consider when setting the ROW acquisition timeline, as identified from the survey (see figure 15). Aleithawe et al. (2012) also found that the factor is significant and applied it in their regression model to predict the ROW acquisition timeline.
- *Length of Project [PSR]*: Describes the physical length of the project. The project length is affected by the size of the area that the project covers. Variations in the surrounding environments and in types of parcels would tend to be higher when a project is larger. Higher variation would increase the complexity of the acquisition process and cause longer acquisition duration.
- *Average Cost Estimate Per Parcel [T-Pro & PSR]*: Provides the average cost estimate per parcel, which is calculated by dividing Detailed ROW Cost Estimate Amount [T-Pro] by Number of Parcels [PSR]. The project size in monetary value was determined to be the third-most important factor in setting the ROW acquisition timeline from the survey (see figure 15). Additionally, the budgetary characteristics were found to be important factors to consider in a previous study (Sohn et al. 2014).

- *Acquired By [PSR]*: Describes if the parcels are acquired by the central office or the local/district office. From the meetings with GDOT officers, the research team learned that the acquisition performance can differ depending on which office performs the acquisition.
- *Let with Other Project [PSR]*: Describes if the project is planned to be let with other projects. If two or more projects are planned to be let together, the individual project's schedule can be influenced by the other's schedule.
- *Environment Document [PSR]*: Provides the level of environmental document needed to be completed. The level of NEPA document was found to be an important factor to consider in setting the ROW acquisition timeline from the survey (see figure 15). Moreover, Gibson et al. (2006) found that environmental sensitivity contributed to acquisition delays.
- *Design [PSR]*: Provides which office completed the design process. Aleithawe et al. (2012) and Gibson et al. (2006) found that revisions in design was one of the significant variables that contributed to acquisition delays. Therefore, the quality of design would affect the acquisition timeline. The research team made a reasonable assumption that the quality of design is dependent on the office that prepares the design.
- *Metropolitan Planning Organizations [PSR]*: Provides information regarding if the project is held in an urban or not urban area. The geographic location (e.g., urban, suburban, or rural) was determined to be an important factor to consider when setting the ROW acquisition timeline from the survey (see figure 15). The acquisition process would vary depending on the location. For example, using an

appraisal waiver was found to be more useful in rural areas because using an appraisal waiver in urban areas was often not easy due to the area's complex nature (Jeong et al. 2016).

- *Program Type [PSR]*: Provides information about the program type of the project (e.g., Enhancement, New Construction, Reconstruction/Rehabilitation, etc.). The project type was identified to be a significant factor in setting the ROW acquisition timeline from both the survey conducted by the research team (see figure 15) and the study by Sohn et al. (2014). This is because the types of parcels that need to be acquired are dependent on the project type.
- *Work Type [PSR]*: Provides information about the work type of the project (e.g., Bicycle/Pedestrian Facility, Bridges, Interchange, etc.). Similar to the program type, the types of parcels that need to be acquired are dependent on the work type.
- *DOT District [PSR]*: Describes which DOT district the project was held in. Sohn et al. (2014) determined that the characteristics of the district, such as district ROW staff size and district annual ROW budget are important factors to consider when predicting the ROW acquisition timeline.

After trying various data analysis, based on its robust performance, the research team selected the decision tree data mining method to build the model that estimates the ROW acquisition duration. More detailed explanation of the methodology and results are given in the next chapter.

CHAPTER 6. DATA MINING MODEL TO PREDICT ROW ACQUISITION TIMELINE

METHODOLOGY

An approach based on a decision regression tree and Adaptive Boosting (AdaBoost) algorithm is developed in this research for creating a forecasting model for the ROW acquisition duration. The decision regression tree building technique is built by the classification and regression tree (CART) analysis method (Breiman et al. 1984). CART is able to uncover complex interactions between predictors that may be difficult or impossible to explain by the traditional statistical method of ordinary least squares (OLS) linear regression (Krämer and Donninger 1987). Another advantage of CART is that it can handle highly skewed or multimodal numerical data, as well as categorical independent variables without ordinal structure. To build a decision tree for forecasting the duration of the ROW acquisition process, the tree model takes a set of input features and splits input data recursively based on those features. In the learning process, each split at a node is chosen to maximize information gain with the least squares deviation (LSD) impurity measures and then, the splits are created recursively and this process is repeated until some stop condition is met. That is, a typical decision regression tree considers several factors, turns them into rule questions, and, given each factor, either makes a decision or continues considering another factor to split.

However, the result of a single decision tree can be biased and weak if there are many input attributes that require multiple decision rules for consideration. This is where AdaBoost works (Wang 2020, Liu 2020). AdaBoost is an ensemble learning method that was built to use an iterative approach to learn from the mistakes of weak estimators and turn them into strong ones. Instead of being biased on one decision tree to predict the value, AdaBoost can assist CART to develop several different trees and integrate them into a strong and bias-balanced predictor.

DATA DESCRIPTION

A database of 495 projects that finished the ROW acquisition process between the years 2010 and 2019 in the state of Georgia is used as the basis to create the forecasting model. Thirteen features related to these projects have been considered to develop this model, as shown in table 3.

Table 3. Database description.

Independent Variables	Units/Categories	Description
Number of Parcels	Count	Numerical, ranging from 1 to 281, with mean 25 and standard deviation 38.
Number of Relocations	Count	Numerical, ranging from 0 to 44, with mean 1 and standard deviation 4.
Number of Condemnations	Count	Numerical, ranging from 0 to 61, with mean 4 and standard deviation 7.
Length of Projects	Miles	Numerical, ranging from 0 to 13.40, with mean 1.26 and standard deviation 1.64.
Avg. Cost Estimate Per Parcel	Detailed ROW Cost Estimate ($) / Number of Parcels	Numerical, ranging from $541 to $1,924,000 with mean $90,995 and standard deviation $163,552.
Acquired By Local?	Categorical: {Acquired By Local, Acquired By GDOT}	Acquired By Local: 162 counts
		Acquired By GDOT: 333 counts
Let with Other Project?	Categorical: {Let with Other Project, Let without Other Project}	Let with Other Project: 45 counts
		Let without Other Project: 450 counts
Environment Document	Categorical: {NEPA, GEPA}	NEPA: 435 counts
		GEPA: 60 counts
Design	Categorical: {Consultant Design, Local Design, GDOT Design}	Consultant Design: 162 counts
		Local Design: 144 counts
		GDOT Design: 189 counts
MPO	Categorical: {Urban, Not Urban}	Urban: 290 counts
		Not Urban: 205 counts
Type of Work	Categorical: {Bicycle/Pedestrian Facility, Bridges, Interchange, Intersection Improvement, Operational Improvement, Roadway Project, Roundabout, Signal, Widening, Others}	Bicycle/Pedestrian Facility: 35 counts
		Bridges: 150 counts
		Interchange: 25 counts
		Intersection Improvement: 44 counts
		Operational Improvement: 23 counts
		Roadway Project: 21 counts
		Roundabout: 29 counts
		Signal: 36 counts
		Widening: 68 counts
		Others: 64 counts
Program Type	Categorical: {Enhancement, New Construction, Reconstruction, Replacement, Maintenance, Safety}	Enhancement: 51 counts
		New Construction: 29 counts
		Reconstruction: 206 counts
		Replacement: 148 counts
		Maintenance: 2 counts
		Safety: 59 counts
District	Categorical: {District 1, District 2, District 3, District 4, District 5, District 6, District 7}	District 1: 89 counts
		District 2: 50 counts
		District 3: 68 counts
		District 4: 63 counts
		District 5: 57 counts
		District 6: 43 counts
		District 7: 125 counts

MODEL DEVELOPMENT

Step 1: Finding an Appropriate Encoding Method for Categorical Features in Decision Tree

The datasets include mixed categorical and numerical attributes. A better representation of underlying information content of datasets provides better recognition performance. Three main methods can be implemented in categorical attributes transformation, including numerical encoding, one-hot encoding, and binary encoding. Considering the accuracy with number of cardinalities, the one-hot encoding scaling issue, and computational speed (figure 18) (Laurae 2017), the research team chose the numerical encoding method in this research, as shown in table 4.

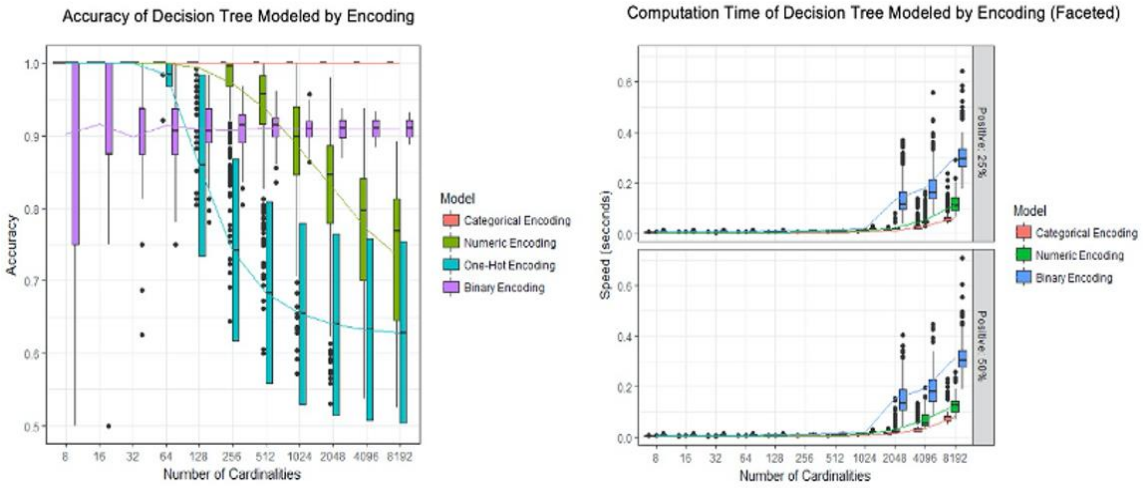


Figure 18. Comparison of three main categorical encoding methods. (Source: https://medium.com/data-design/visiting-categorical-features-and-encoding-in-decision-trees-53400fa65931)

Table 4. Numerical encoding for categorical features.

Independent Variables	Units/Categories	Encoding
Number of Parcels	Count	–
Number of Relocations	Count	–
Number of Condemnations	Count	–
Length of Projects	Miles	–
Avg. Cost Estimate Per Parcel	Detailed ROW Cost Estimate ($) / Number of Parcels	–
Acquired By Local?	Yes	1
	No	0
Let with Other Project?	Yes	1
	No	0
Environment Document	NEPA	1
	GEPA	0
Design	Consultant Design	1
	Local Design	2
	GDOT Design	3
MPO	Urban	1
	Not Urban	0
Type of Work	Bicycle/Pedestrian Facility	1
	Bridges	2
	Interchange	3
	Intersection Improvement	4
	Operational Improvement	5
	Roadway Project	6
	Roundabout	7
	Signal	8
	Widening	9
	Other (a set of small number of projects)	10
Program Type	Enhancement	1
	New Construction	2
	Reconstruction	3
	Replacement	4
	Maintenance	5
	Safety	6
District	District 1	1
	District 2	2
	District 3	3
	District 4	4
	District 5	5
	District 6	6
	District 7	7

Step 2: Building the Tree Estimator Based on CART Analysis

The tree growing process contains two basic steps (Lewis 2000):

1. *Find each predictor's best split*

   For each continuous and ordinal feature of the training dataset from the 495 projects, sort each attribute value from smallest to largest. For the sorted predictor, go through each value of the 13 attributes to determine the best split point, which is the one that maximizes the splitting criterion the most according to equation 1.

$$\Delta i(s,t) = i(t) - p_L i(t_L) - p_R i(t_R) \qquad \text{Eq 1}$$

   Where

   $i(t)$: Least squares deviation impurity measurements at node *t*,

   p_L: Probabilities of sending projects to the left child node t_L,

   p_R: Probabilities of sending projects the right child node t_R.

2. *Repeat the previous step, finding each child node's best split until the stopping rules are satisfied.*

   In this research, the stopping rules are the following:

   - All projects in a node have identical duration value.
   - The current tree level reaches the identified maximum tree depth value.

- The size of a node is less than the identified node size value.
- The improvement of the splitting criterion is less than the identified minimum improvement.

Step 3: Implementing AdaBoost to develop a stronger predictor

The logical process of AdaBoost is shown in figure 19. Firstly, a base regression tree (a weak estimator) $T_1(x)$ is generated following *Step 2*, which is based on the initial average weights set of learning projects, where $x \in R^{13\times1}$ is an attribute vector of the project. The weights of each project indicate how important it is to be considered for the current weak estimator depending on the previous performance of the forecasted duration value. Then, the maximum error of the learning samples is evaluated, and the relative errors of the predicted duration from each training project is calculated. Next, the weights for the second weak estimator is updated and more weight is assigned to the relatively poor prediction performance projects for the second weak estimator $T_2(x)$. Finally, the weak estimator generation process is reiterated until the strong predictor $T(x)$ is made to forecast the ROW acquisition duration.

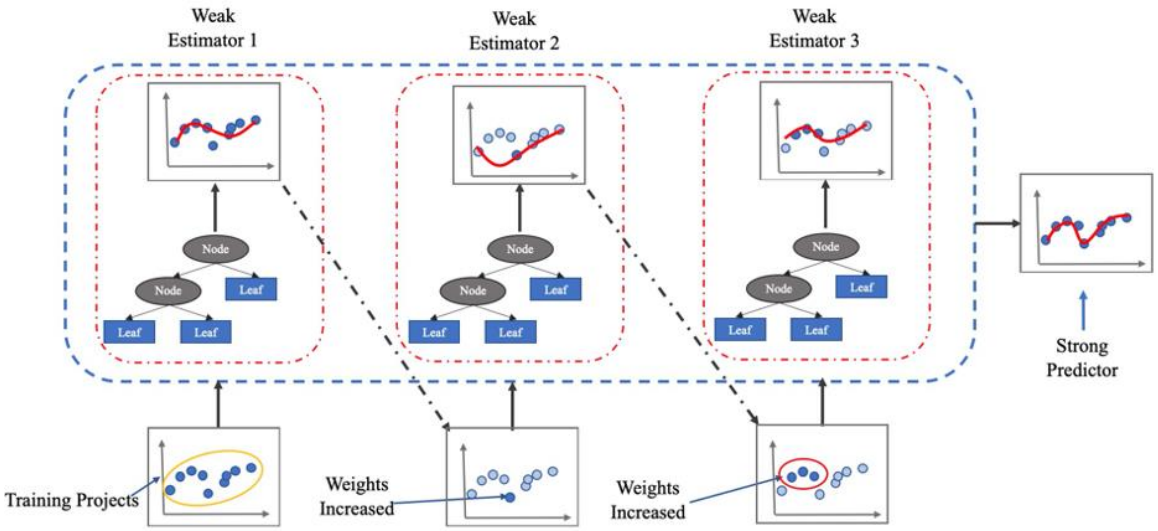


Figure 19. Logical process of AdaBoost with regression tree.

Step 4: Validating and determining the parameters of the model

CART suffers overfitting issues since the tree growth is usually too large and yields the prediction results overly optimistic. Thus, a K-fold cross-validation method (Pedregosa 2011, Fushiki 2011) is used to finalize the parameters and strengthen the performance of the model. Combined with the grid search, this method can determine the best bagging frame (i.e., number of estimators, criterion) and hyper parameters (i.e., maximum depth of the tree, minimum split numbers of the node, etc.) of the model.

RESULTS

The metrics of mean absolute error (MAE) (equation 2), R squared score (equation 3) and mean percentage absolute error (MPAE) (equation 4) were used to evaluate the performance of this model.

$$MAE = \frac{\sum_{n=1}^{N} |Y_{Predicted} - Y_{Actual}|}{N} \quad \text{Eq 2}$$

$$R^2 = \frac{\sum (Y_{Actual} - Y_{Predicted})^2}{\sum (Y_{Actual} - \bar{Y}_{Actual})^2} \quad \text{Eq 3}$$

$$MAPE = \frac{\sum_{n=1}^{N} (|Y_{Predicted} - Y_{Actual}| / Y_{Actual})}{N} \quad \text{Eq 4}$$

Where $Y_{Predicted}$ is the forecasted ROW acquisition duration; Y_{Actual} is the actual ROW acquisition duration; $\bar{Y}_{Actual}$ is the average actual ROW acquisition duration; N is 495, which is the total number of projects. The results are as shown below:

$MAE_{\text{Tree Model}} = 3.60$ months

$R^2_{\text{Tree Model}} = 0.84$

$MPAE_{\text{Tree Model}} = 38.75\%$

Figure 20 and figure 21 show the percentage error (PE) distribution of the 495 projects, which is calculated by the equation $PE = \frac{(Y_{Predicted} - Y_{Actual})}{Y_{Actual}}$.

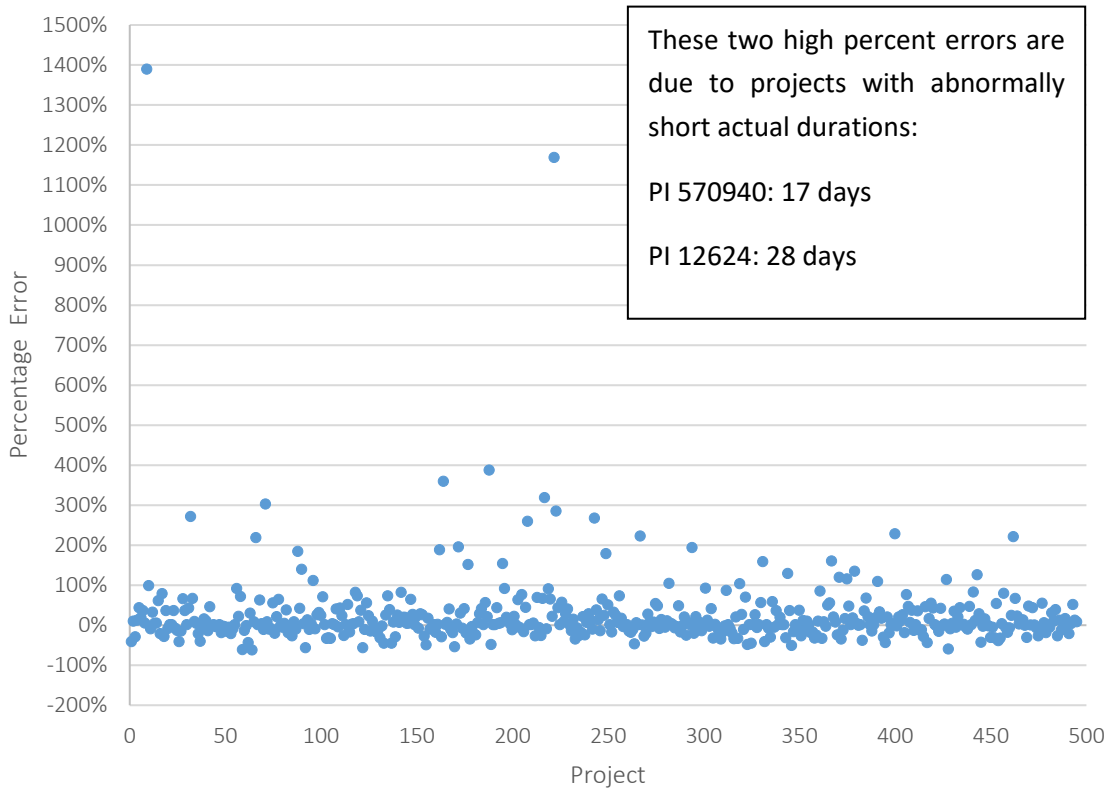


Figure 20. Percentage error distribution of 495 projects.

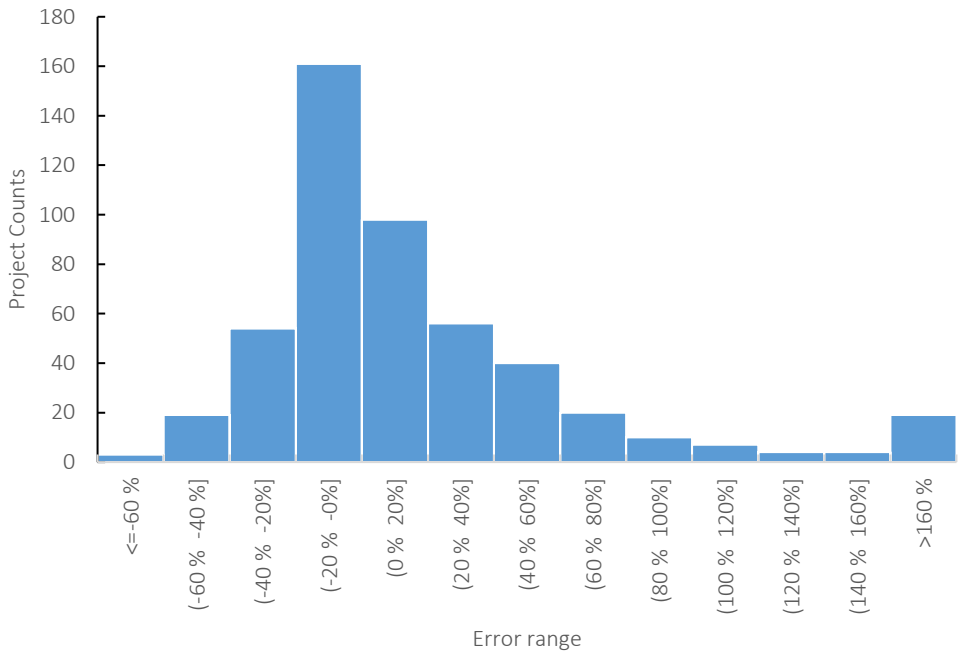


Figure 21. Percentage error distribution in range.

In order to evaluate the error margin (Wikipedia Contributors 2020a) of this model, the research team used the relative error (RE) (equation 5) to get the confidence intervals that describe the proportion of possible confidence range of ROW acquisition forecasting duration.

$$RE = \frac{(Y_{Actual} - Y_{Predicted})}{Y_{Predicted}} \quad \text{Eq 5}$$

The RE distribution of ROW forecasting duration from 495 projects is shown in figure 22.

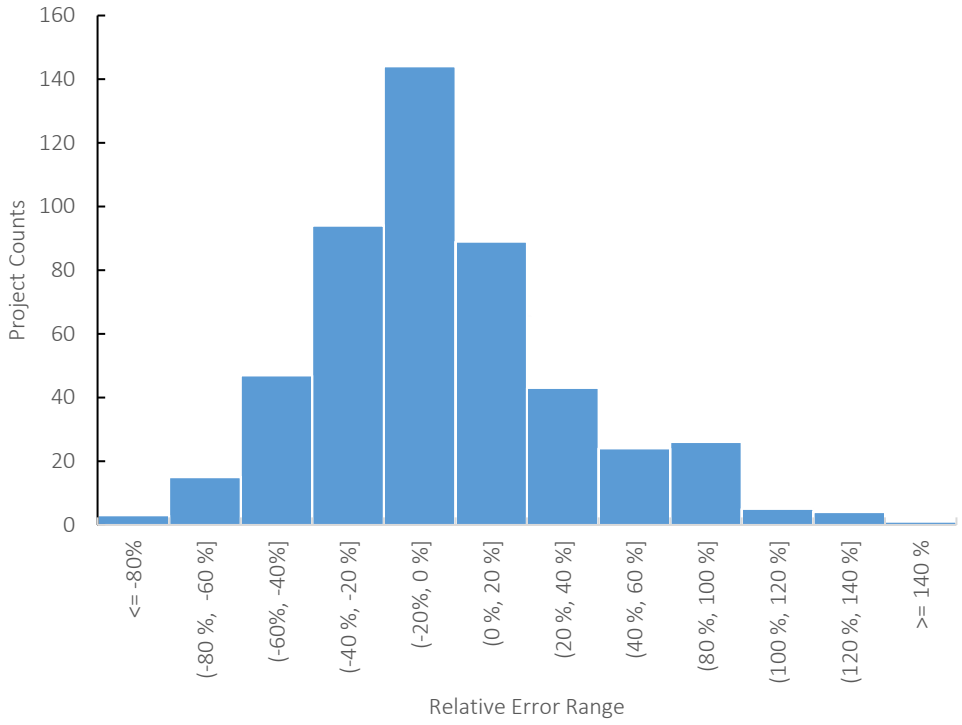


Figure 22. Relative error distribution of tree model.

The tree model prediction results are as follows:

Minimum: −90.83%

Maximum: 147.17%

Average: 10.6%

Absolute Average: 27.60%

Relative Error Deviation: 0.38

Confidence Interval (CI with 95%) (Wikipedia Contributors 2020b) – [−4.41 %, 2.29 %]

From the CI results, the low bound is −4.41% and the high bound is 2.29%. That is, the predicted ROW duration value in the tree model is in the range of $Y_{predicted} \times [95.59\%, 102.29\ \%]$ with 95% CI containing the actual ROW duration.

The MAE, R squared, MPAE, and RE results show that the tree model performance is robust for forecasting the ROW acquisition. Figure 23 is the comparison of prediction duration and actual duration for the 495 projects.

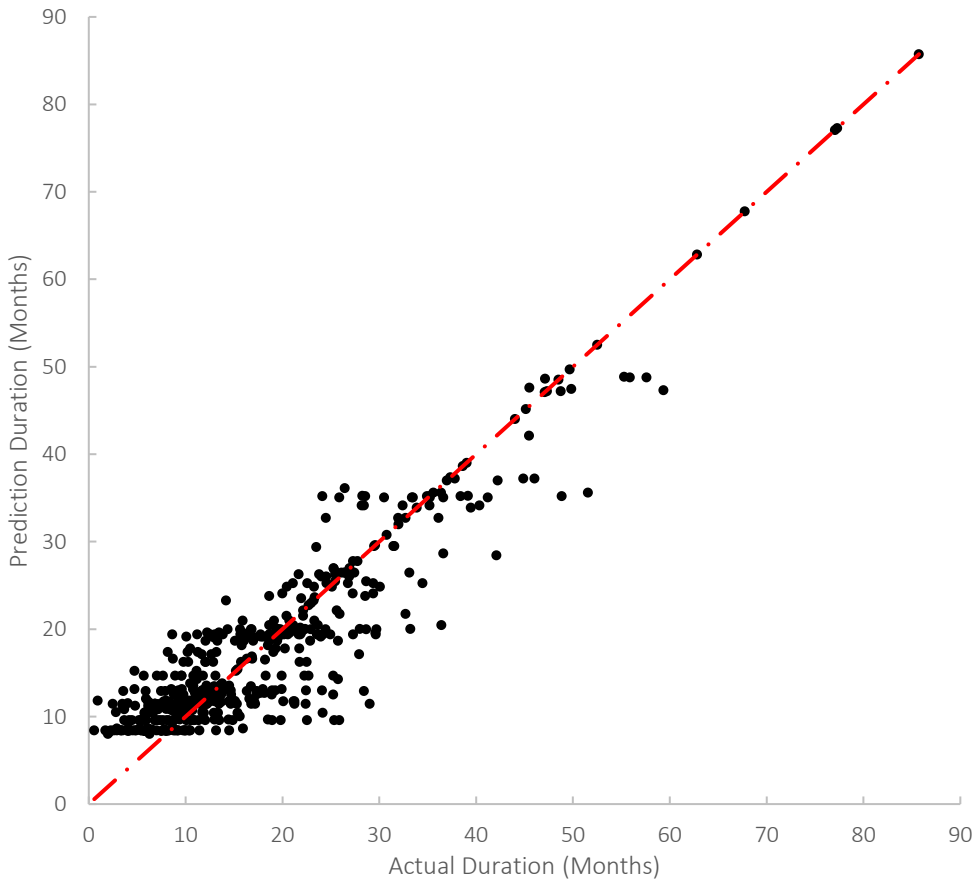


Figure 23. Comparison of prediction duration and actual duration.

This AdaBoost tree model has 10 estimators in total. Each estimator is shown as below (figure 24 through figure 43). Following the numerical encoding transformation to encode the decision tree in table 4, an example with a basic explanation of the decision tree is shown in table 5.

Table 5. An example for explanation of the decision tree.

Split Node Description	The Situation to the Next Left Node	The Situation to the Next Right Node
Total Parcels: <=28.0	Number of Parcels is in the range of [1, 28].	Number of Parcels is larger than 28.
LENGTH(MI):<=1.0	Length of Projects is in the range of [0, 1] miles.	Length of Projects is larger than 1 mile.
costEstPerpar:<=1,313,884.0	Avg. Cost Estimate Per Parcel is in the range of [$0, $1,313,884.0]	Avg. Cost Estimate Per Parcel is larger than $1,313,884.0.
Design <=2	Design belongs to Consultant Design or Local Design.	Design belongs to GDOT Design.
Program Type: <=2.0	Program Type belongs to Enhancement or New Construction with encoding number 1 and 2, respectively.	Program Type belongs to other items with encoding number larger than 2.
Relocations <=4.5	Number of Relocations is in the range of [0, 4].	Number of Relocations is larger than 4.
Type of work: <=3.0	Type of work belongs to Bicycle/Pedestrian Facility, Bridges, or Interchange with encoding number 1, 2 and 3, respectively.	Type of work belongs to other items with encoding number larger than 3.
LetWithOtherProjects: <=0	Let without other projects	Let with other projects
District: <=3	District belongs to District 1, District 2, District 3.	District belongs to other Districts with the encoding number larger than 3.
CondTotal: <=16	Number of Condemnations is in the range of [0, 16].	Number of Condemnations is larger than 16.
urbanMPO <= 0	Not Urban	Urban
ENV DOC TYPE: <= 0	GEPA	NEPA
acqByLocal: <=0	Acquired by GDOT	Acquired by Local

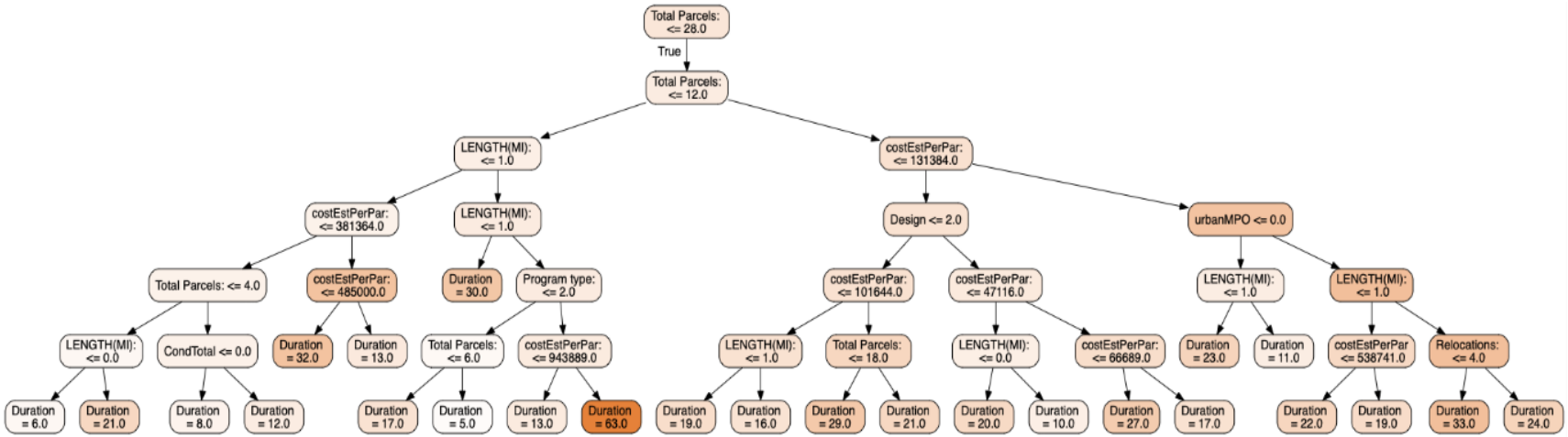


Figure 24. Estimator 1 – Left branch.

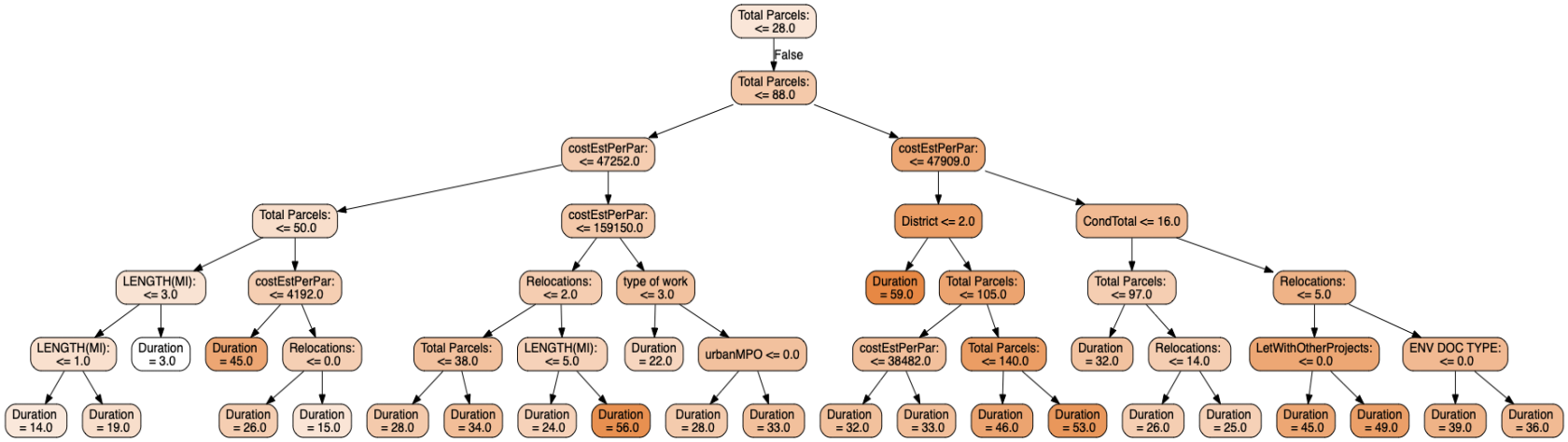


Figure 25. Estimator 1 – Right branch.

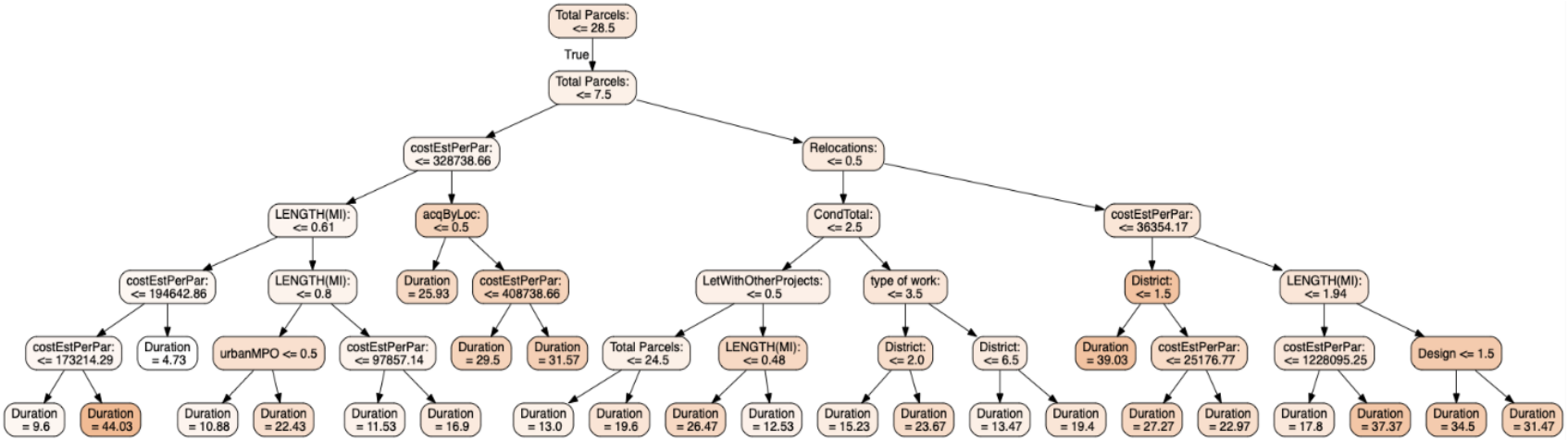


Figure 26. Estimator 2 – Left branch.

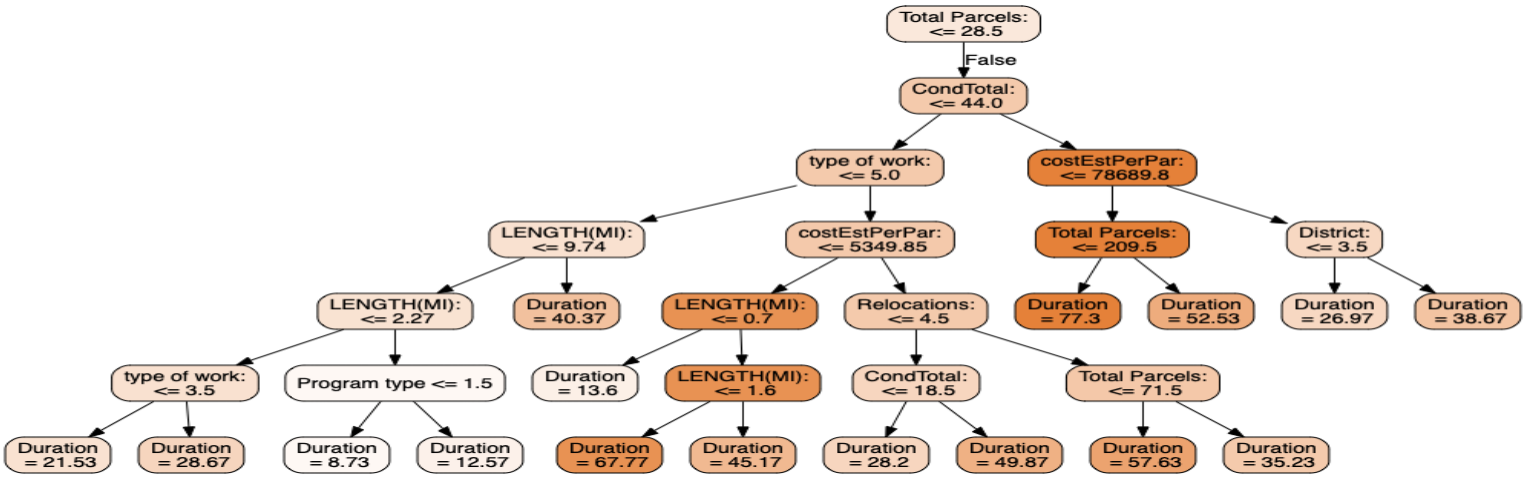


Figure 27. Estimator 2 – Right branch.

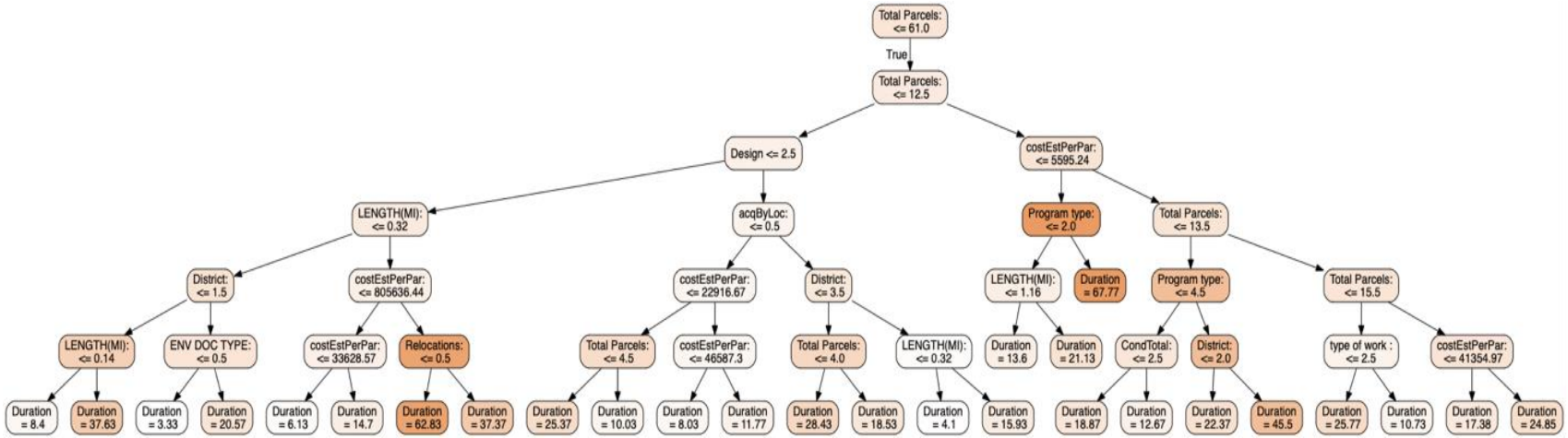


Figure 28. Estimator 3 – Left branch.

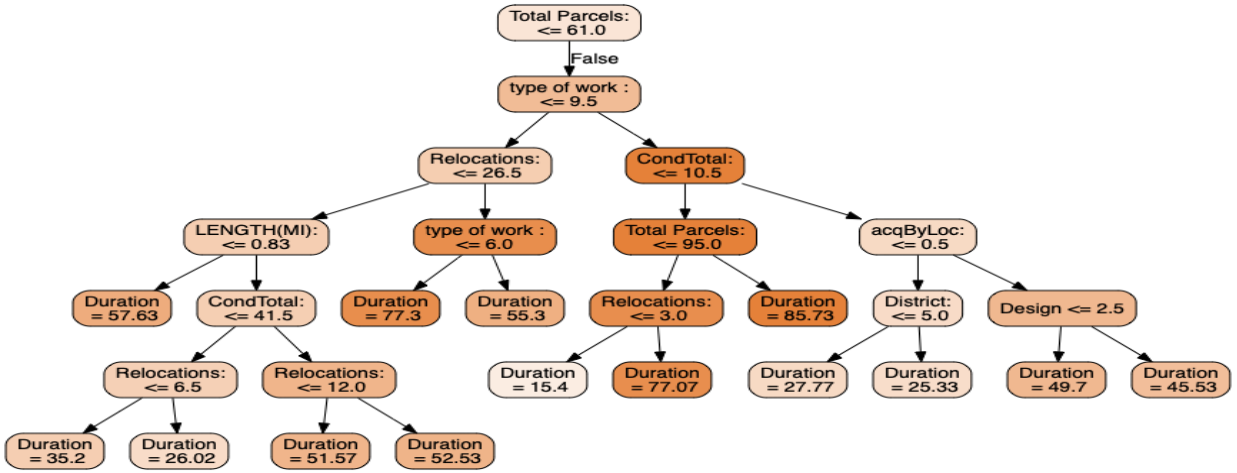


Figure 29. Estimator 3– Right branch.

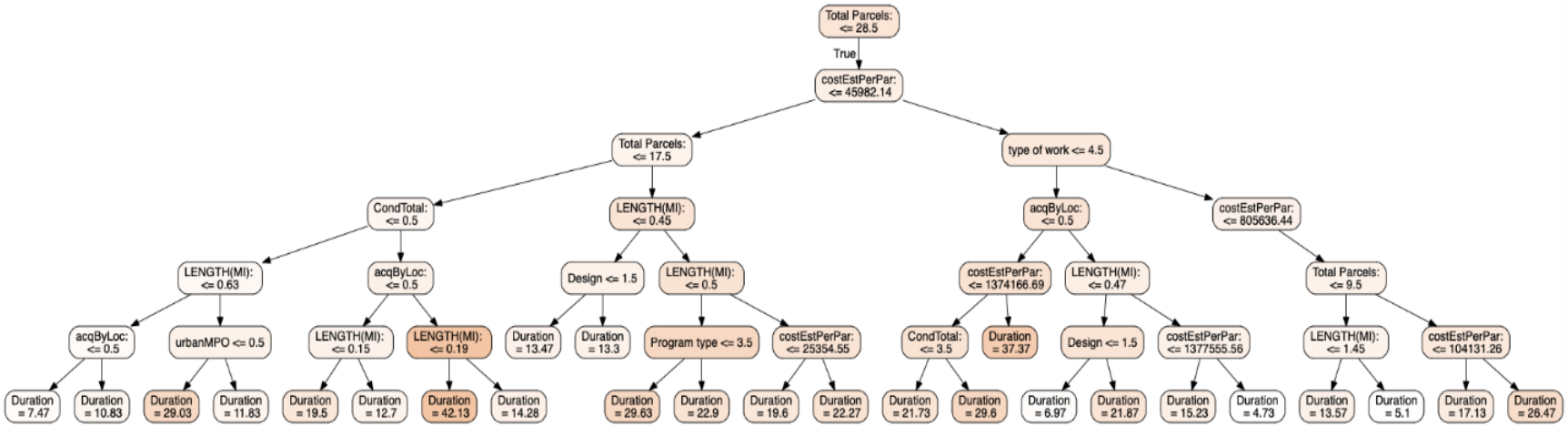


Figure 30.. Estimator 4 – Left branch.

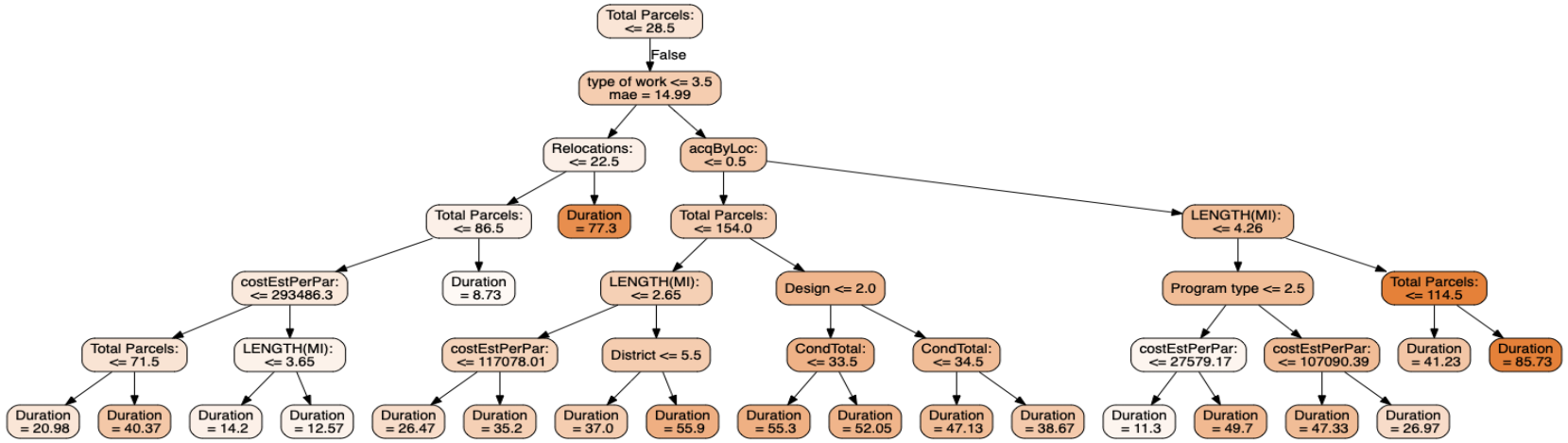


Figure 31. Estimator 4 – Right branch.

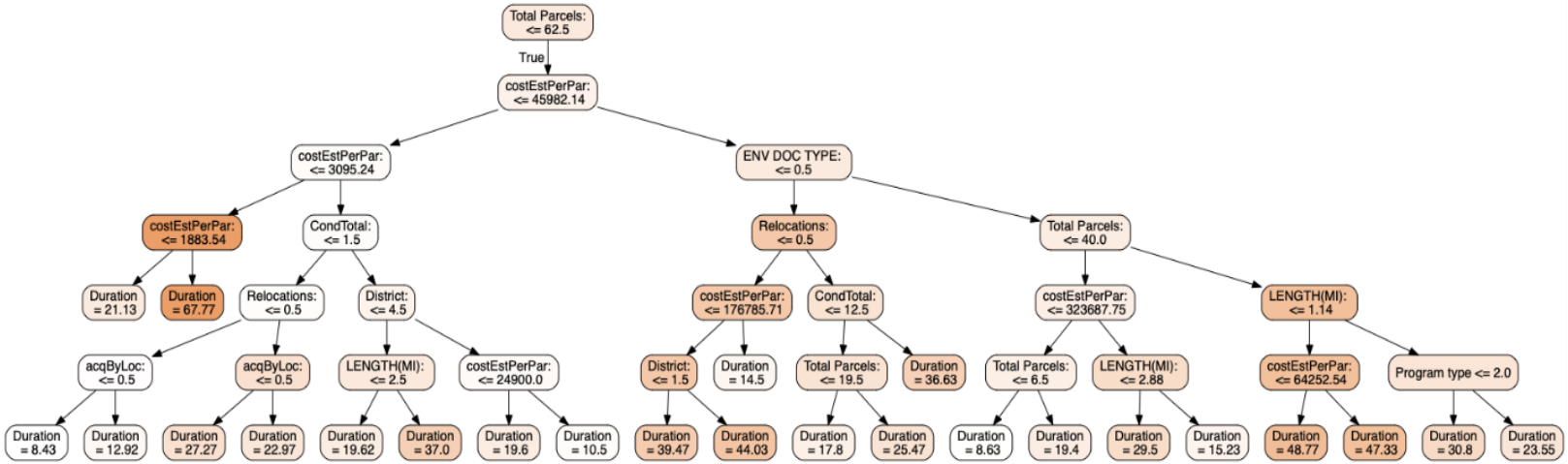


Figure 32. Estimator 5 – Left branch.

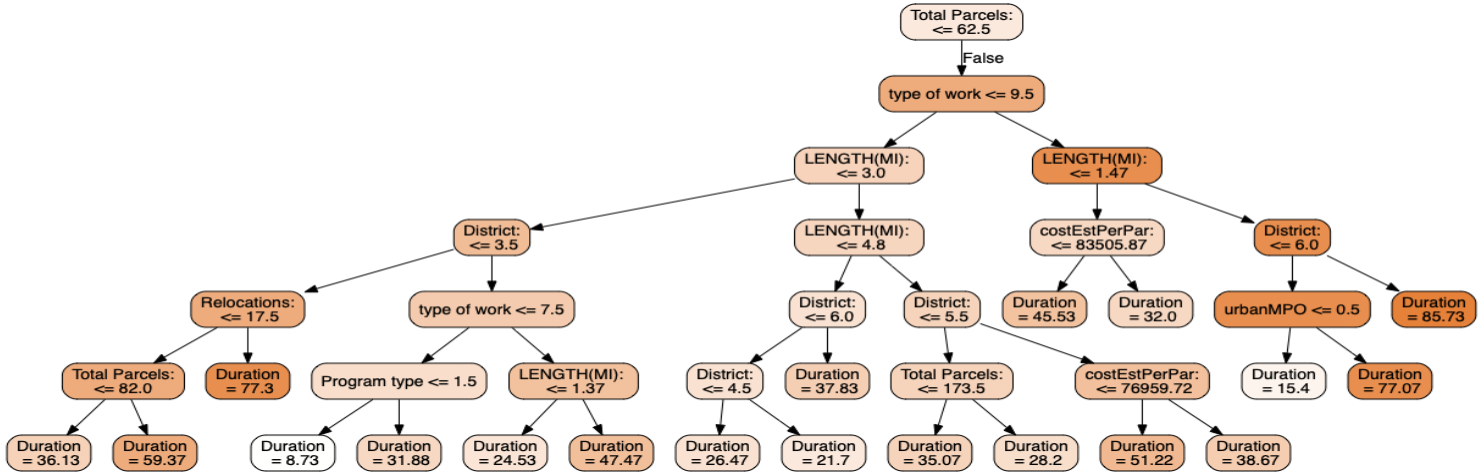


Figure 33. Estimator 5 – Right branch.

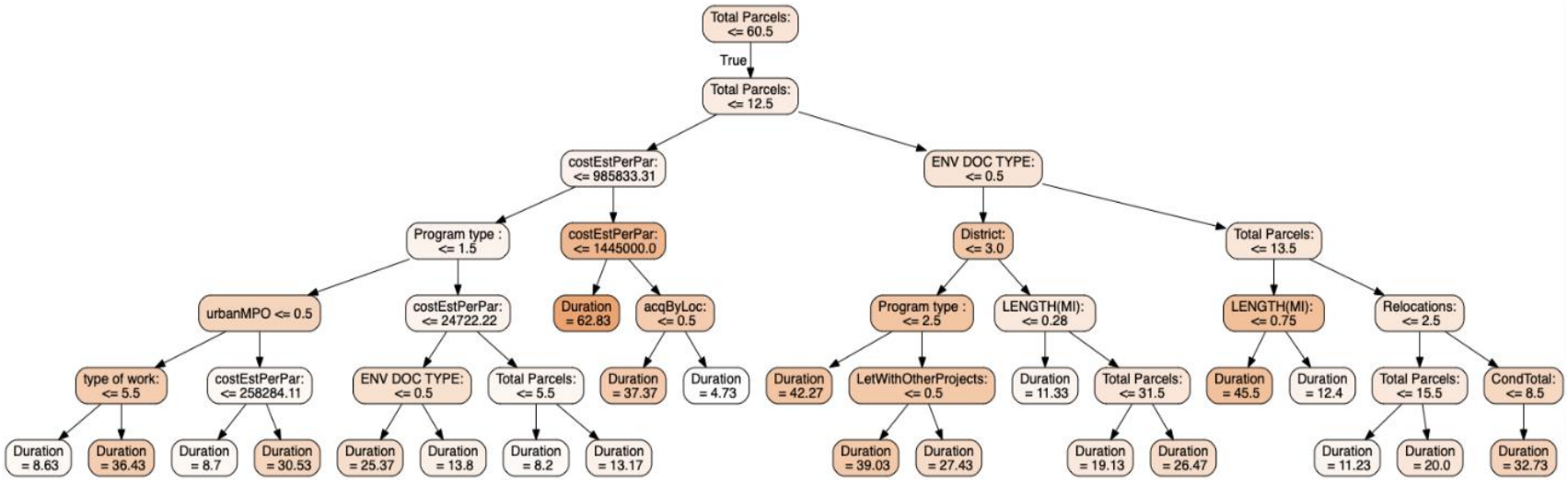


Figure 34. Estimator 6 – Left branch.

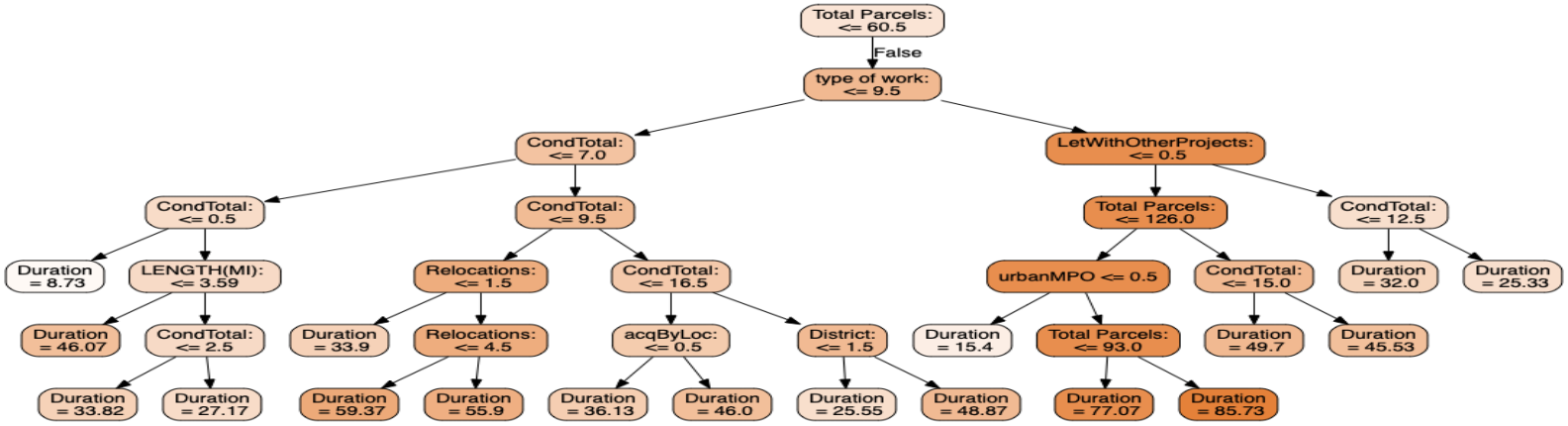


Figure 35. Estimator 6 – Right branch.

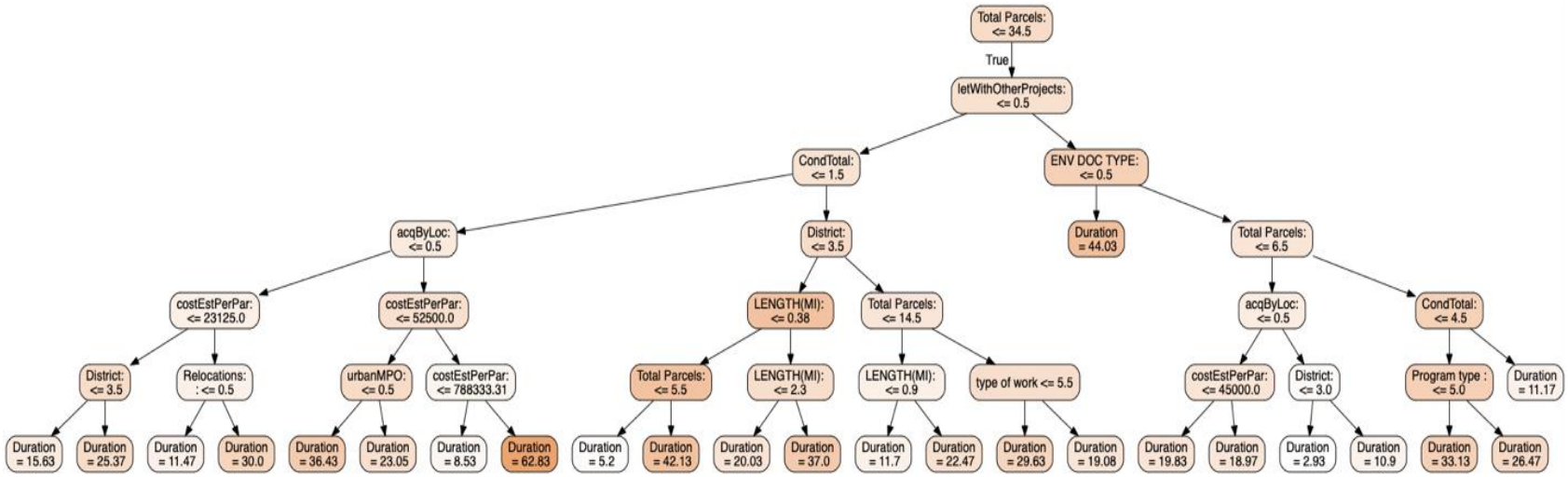


Figure 36. Estimator 7 – Left branch.

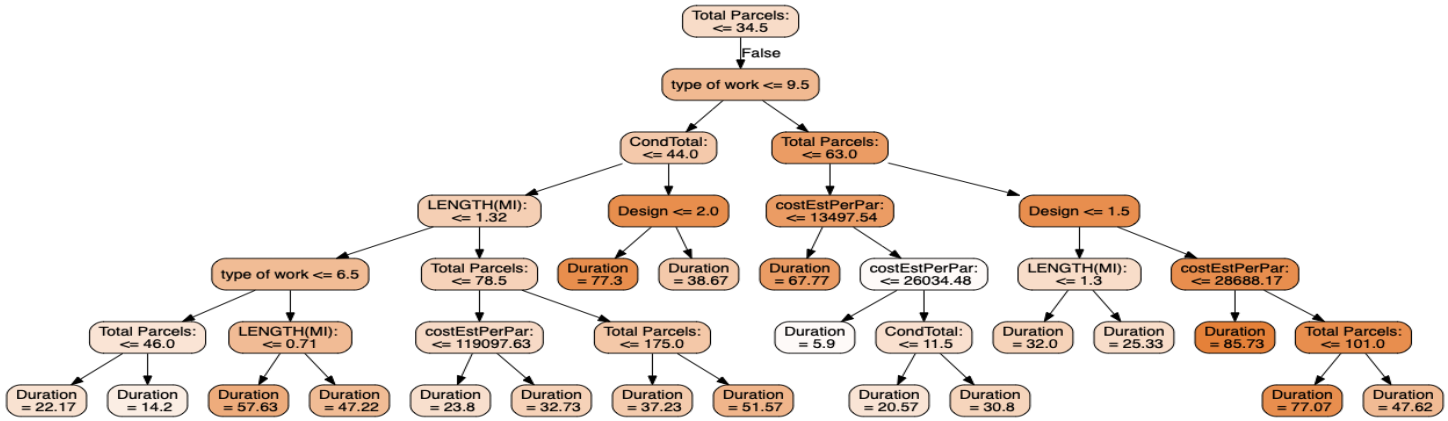


Figure 37. Estimator 7 – Right branch.

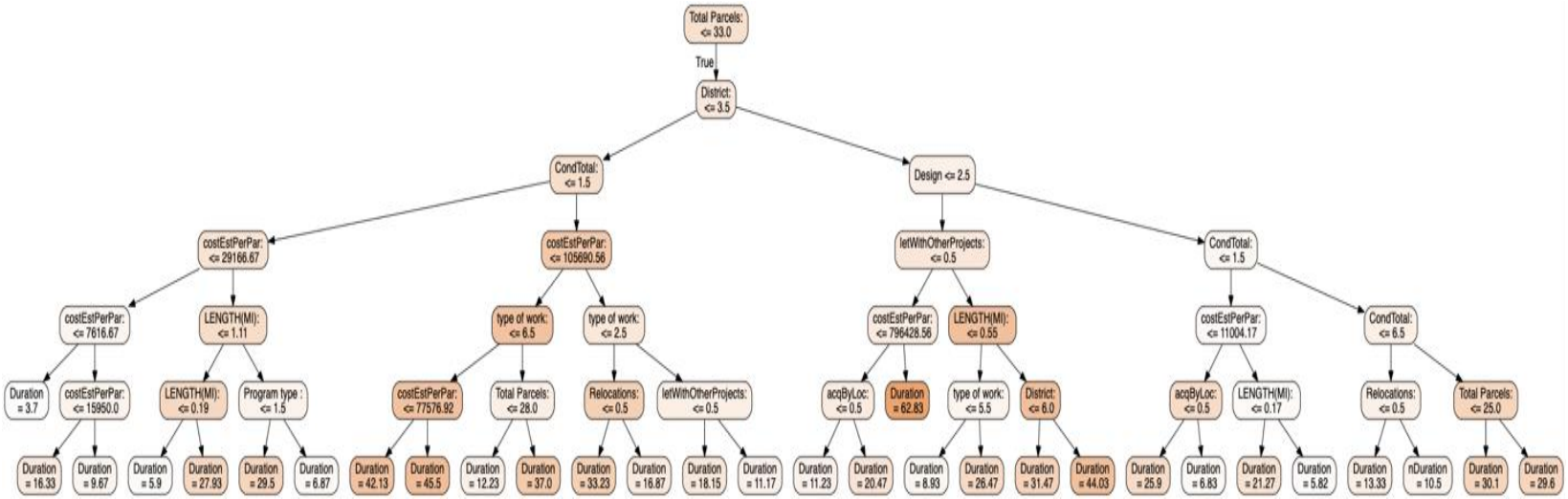


Figure 38. Estimator 8 – Left branch.

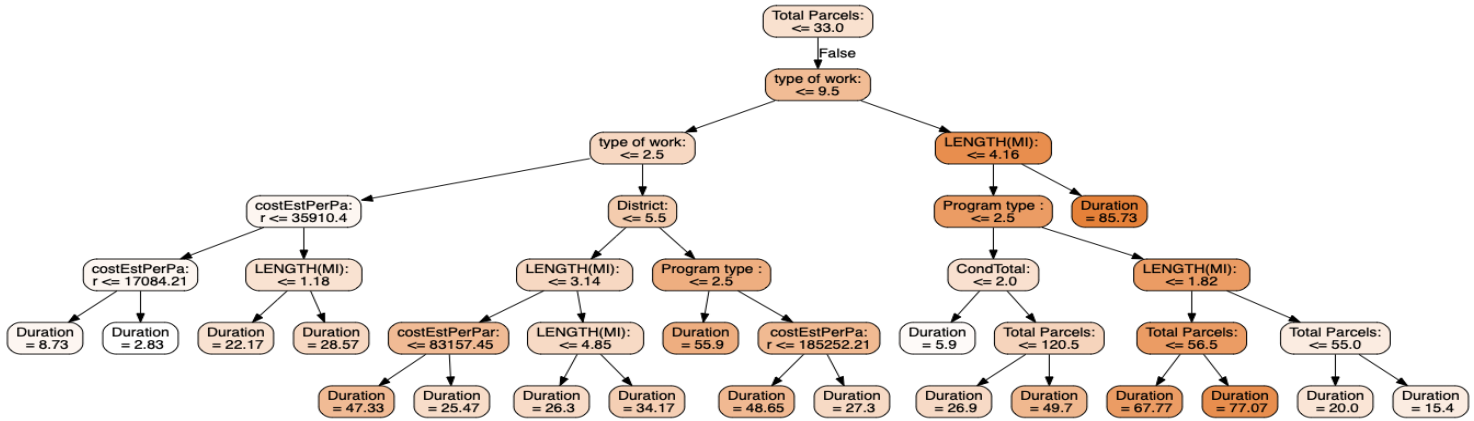


Figure 39. Estimator 8 – Right branch.

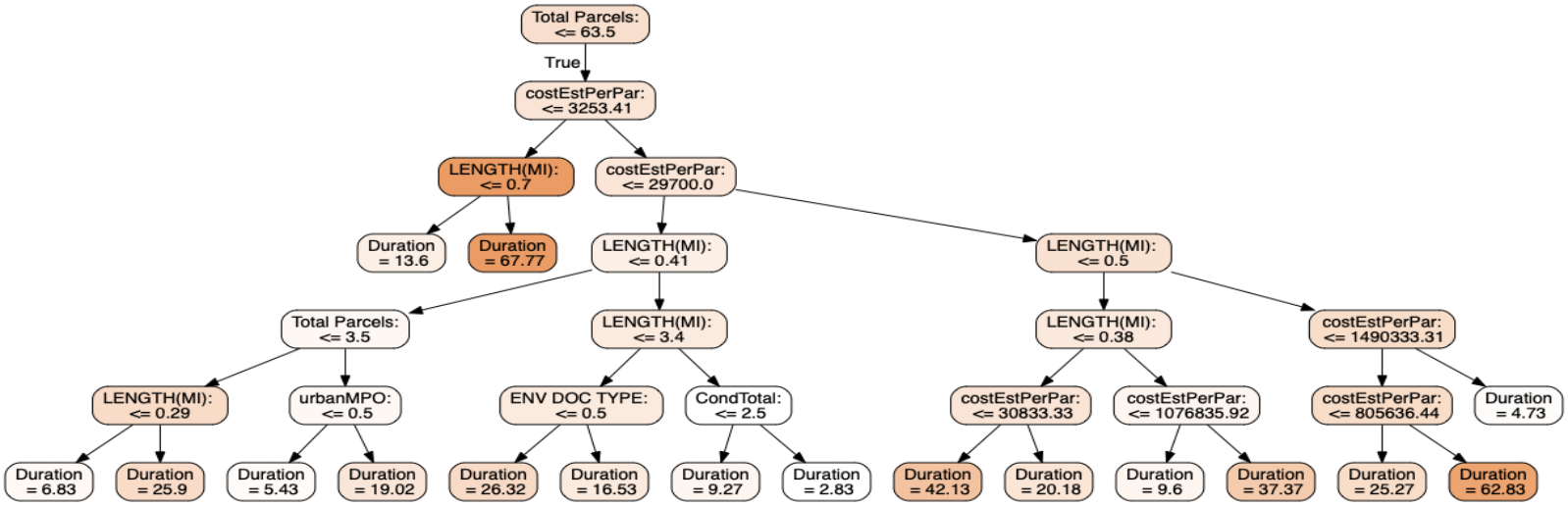


Figure 40. Estimator 9 – Left branch.

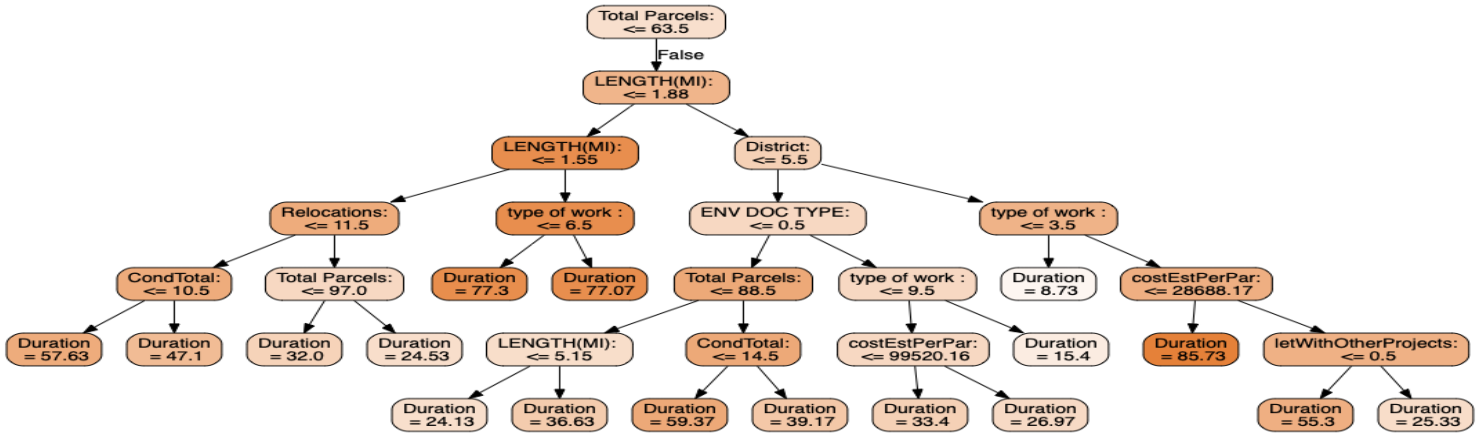


Figure 41. Estimator 9 – Right branch.

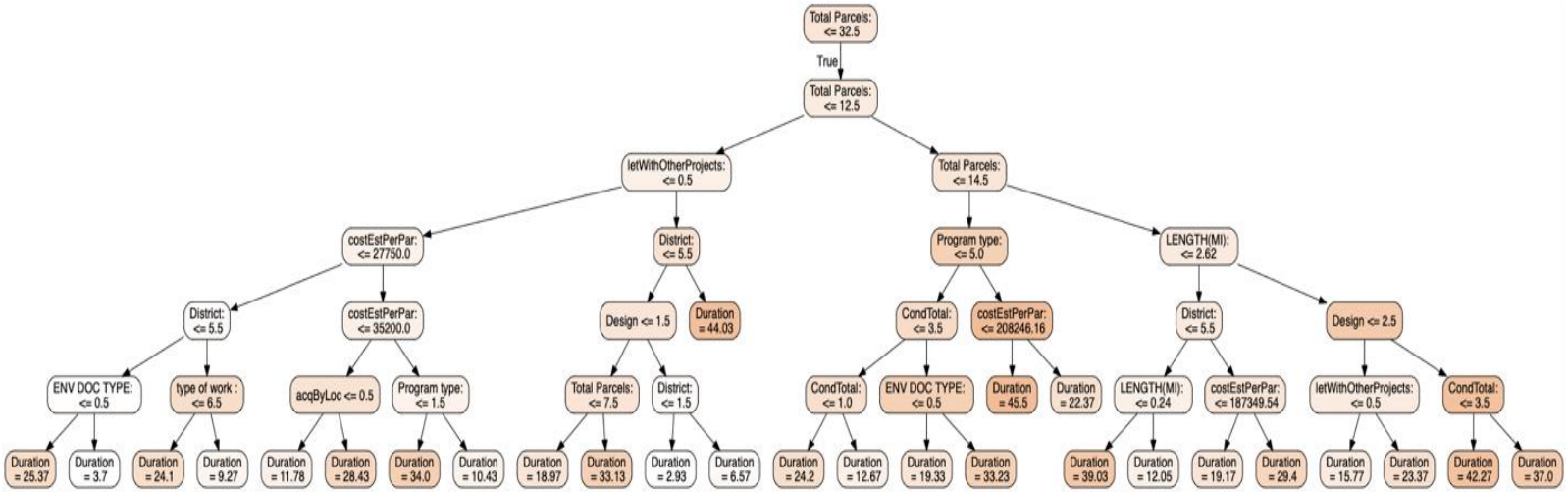


Figure 42. Estimator 10 – Left branch.

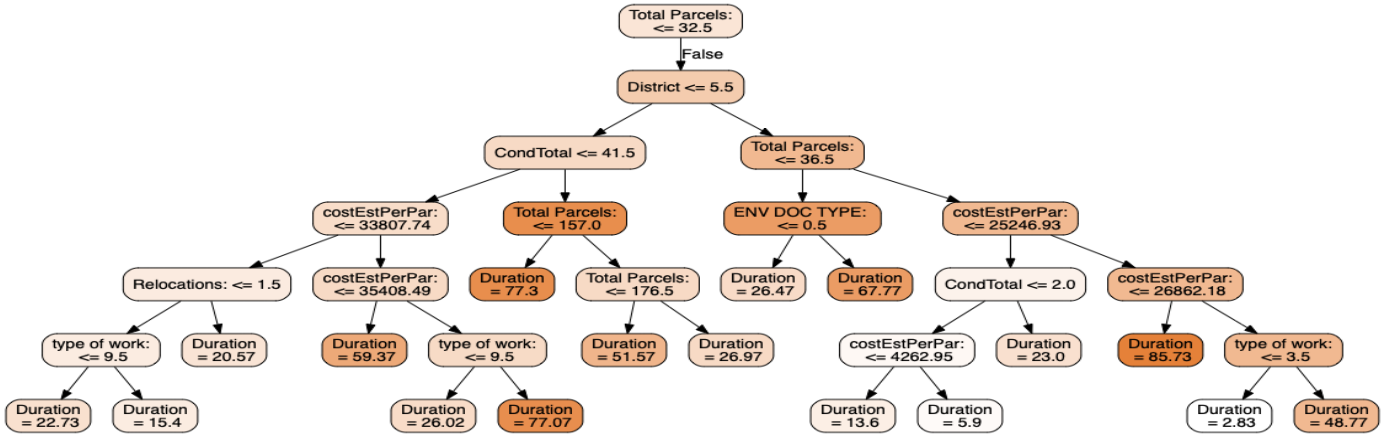


Figure 43. Estimator 10 – Right branch.

CHAPTER 7. USER MANUAL OF THE DEVELOPED EXCEL VISUAL BASIC FOR APPLICATION (VBA) TOOL

PURPOSE OF THE TOOL

The purpose of the Excel Visual Basic for Application tool is to provide a data-driven forecasting model on the ROW acquisition timeline. ROW staff can use this tool to help with decision-making in the practice of project planning and in the practice of estimating ROW acquisition management. The prediction of the acquisition timeline generated by this tool is from the ROW Authorization Date to the ROW Certified Date.

The tool is designed for regular design–bid–build (DBB) transportation projects let by the Georgia Department of Transportation. After entering the general project features and ROW acquisition attributes, the user can obtain predictions on the timeline for ROW acquisition. This VBA tool is an innovative approach for predicting project schedules. The tool is to assist ROW staff with data-driven predictions, which are complementary to the experience and expert judgement of ROW personnel.

STRUCTURE OF THE TOOL

The tool has three pages: Home, Input Data, and ROW Acquisition Timeline Prediction Results. Each page is introduced below.

Home Page

The Home page contains links to the Input Data page and Results page (see figure 44). When opening the tool, only the "*Input Data*" button is activated.

- Click the "*Input Data*" button to enter project features and ROW acquisition attributes. Successful completion of the data entry form returns the user to the home page and activates the "*Calculation*" button.
- Click the "*Calculation*" button to activate the "*Results*" button.
- Click the "*Results*" button to access the ROW Acquisition Timeline Prediction Results page.
- Click the "*Clear and Start Over*" button to erase all information for the current project and start over with another project. Note: The previous data input and results will not be saved.

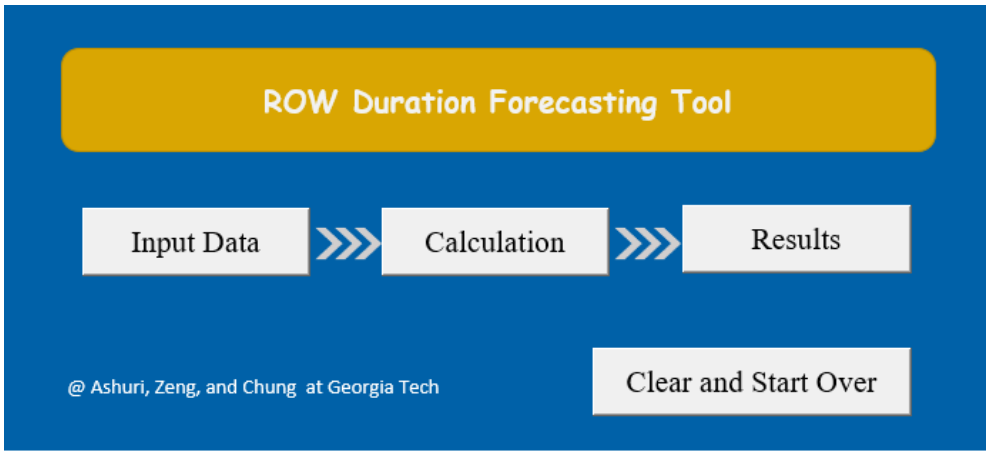


Figure 44. Home page.

Input Data Page

The Input Data page allows entry of project features and ROW acquisition attributes through entry fields and drop-down menus (see figure 45).

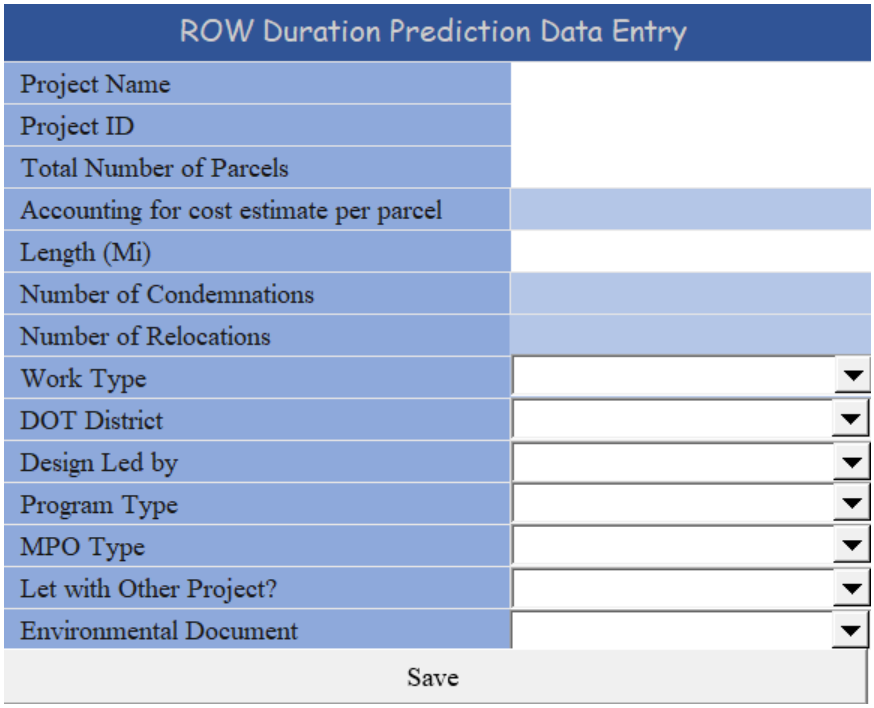


Figure 45. Screen capture. Input Data page.

Following are detailed instructions on the project features and ROW acquisition attributes to be input. All the information can be found in the GDOT databases, Preconstruction Status Report (PSR) and T-Pro. The source of the data item is provided in square brackets.

1. *Project Name [PSR]*
    - Input the project name. This is for notation only. The input value will not impact the calculation and prediction results.
2. *Project ID [PSR]*
    - Input the project identification number. This is for notation only. The input value will not impact the calculation and prediction results.
3. *Total Number of Parcels [PSR]*

- Input total number of parcels to acquire.

4. *Accounting for Cost Estimate Per Parcel [T-Pro & PSR]*
    - Input average cost estimate per parcel, which can be calculated by dividing Detailed ROW Cost Estimate Amount [T-Pro] by Total Number of Parcels [PSR].
5. *Length (Mi) [PSR]*
    - Input the physical length of the project in miles.
6. *Number of Condemnations [PSR]*
    - Input the number of condemnations to be filed to acquire properties.
7. *Number of Relocations [PSR]*
    - Input the number of parcels that need relocation assistance.
8. *Work Type [PSR]*
    - Select the work type of the project (e.g., Bicycle/Pedestrian Facility, Bridges, Interchange, etc.).
9. *DOT District [PSR]*
    - Select the DOT district where the project is held (e.g., DOT District 1 to 7).
10. *Design Led by [PSR]*
    - Select the office that prepares the design process (e.g., Consultant Design, Local Design, or GDOT Design).
11. *Program Type [PSR]*
    - Select the program type of the project (e.g., Enhancement, New Construction, Reconstruction, etc.).

12. *MPO Type [PSR]*

    - Select “Urban” if the project is associated with one of the Metropolitan Planning Organizations. Otherwise, select “Not Urban”.

13. *Let with Other Project? [PSR]*

    - Select “Yes” if the project is planned to be let with another project. Otherwise, select “No”.

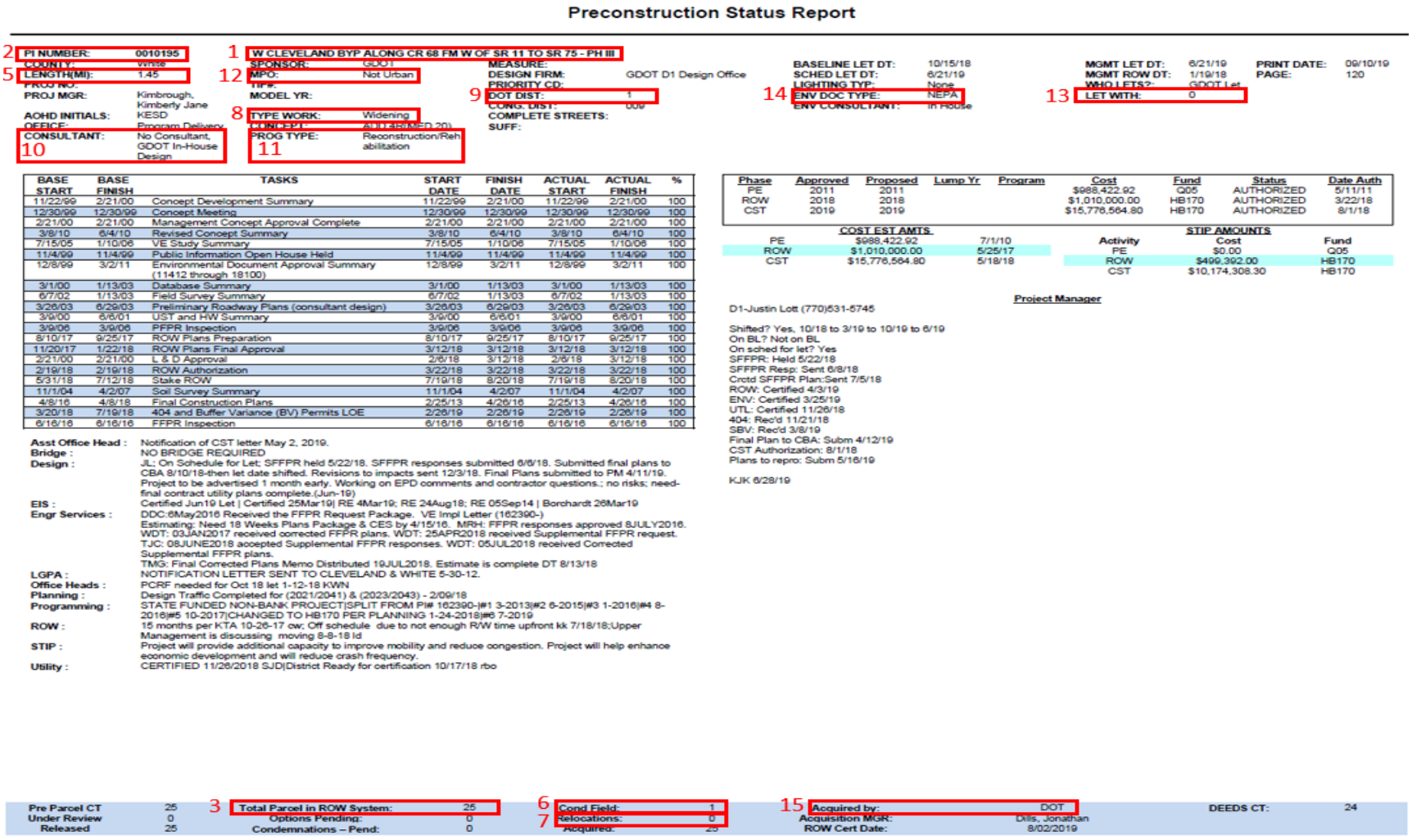
14. *Environmental Document [PSR]*

    - Select the type of environmental document needs to be completed (e.g., Georgia Environmental Policy Act [GEPA] or National Environmental Policy Act [NEPA]).

15. *Acquired By [PSR]*

    - Select the office that performs acquisition (e.g., Central Office or Local/District Office).

Figure 46 shows where the input data (corresponding to the numbers labeled above) can be found in a PSR example.



Preconstruction Status Report

2 PI NUMBER: 0010195
COUNTY: White
5 LENGTH(MI): 1.45
PROJ NO:
PROJ MGR: Kimbrough, Kimberly Jane
AOHD INITIALS: KESD
OFFICE: Program Delivery
CONSULTANT: No Consultant, GDOT In-House Design
10

1 W CLEVELAND BYP ALONG CR 68 FM W OF SR 11 TO SR 75 - PH III
SPONSOR: GDOT
12 MPO: Not Urban
TIP#:
MODEL YR:
8 TYPE WORK: Widening
CONCEPT: ADJUSTED 20)
PROG TYPE: Reconstruction/Rehabilitation
11

MEASURE:
DESIGN FIRM: GDOT D1 Design Office
PRIORITY CD:
9 DOT DIST: 1
CONG. DIST: 009
COMPLETE STREETS:
SUFF:

BASELINE LET DT: 10/15/18
SCHED LET DT: 6/21/19
LIGHTING TYP: None
14 ENV DOC TYPE: NEPA
ENV CONSULTANT: In House

MGMT LET DT: 6/21/19
MGMT ROW DT: 1/19/18
WHO LETS?: GDOT Let
13 LET WITH: 0

PRINT DATE: 09/10/19
PAGE: 120

BASE START	BASE FINISH	TASKS	START DATE	FINISH DATE	ACTUAL START	ACTUAL FINISH	%
11/22/99	2/21/00	Concept Development Summary	11/22/99	2/21/00	11/22/99	2/21/00	100
12/30/99	12/30/99	Concept Meeting	12/30/99	12/30/99	12/30/99	12/30/99	100
2/21/00	2/21/00	Management Concept Approval Complete	2/21/00	2/21/00	2/21/00	2/21/00	100
3/8/10	6/4/10	Revised Concept Summary	3/8/10	6/4/10	3/8/10	6/4/10	100
7/15/05	1/10/06	VE Study Summary	7/15/05	1/10/06	7/15/05	1/10/06	100
11/4/99	11/4/99	Public Information Open House Held	11/4/99	11/4/99	11/4/99	11/4/99	100
12/8/99	3/2/11	Environmental Document Approval Summary (11412 through 18100)	12/8/99	3/2/11	12/8/99	3/2/11	100
3/1/00	1/13/03	Database Summary	3/1/00	1/13/03	3/1/00	1/13/03	100
6/7/02	1/13/03	Field Survey Summary	6/7/02	1/13/03	6/7/02	1/13/03	100
3/26/03	6/29/03	Preliminary Roadway Plans (consultant design)	3/26/03	6/29/03	3/26/03	6/29/03	100
3/9/00	6/6/01	UST and HW Summary	3/9/00	6/6/01	3/9/00	6/6/01	100
3/9/06	3/9/06	PFPR Inspection	3/9/06	3/9/06	3/9/06	3/9/06	100
8/10/17	9/25/17	ROW Plans Preparation	8/10/17	9/25/17	8/10/17	9/25/17	100
11/20/17	1/22/18	ROW Plans Final Approval	3/12/18	3/12/18	3/12/18	3/12/18	100
2/21/00	2/21/00	L & D Approval	2/6/18	3/12/18	2/6/18	3/12/18	100
2/19/18	2/19/18	ROW Authorization	3/22/18	3/22/18	3/22/18	3/22/18	100
5/31/18	7/12/18	Stake ROW	7/19/18	8/20/18	7/19/18	8/20/18	100
11/1/04	4/2/07	Soil Survey Summary	11/1/04	4/2/07	11/1/04	4/2/07	100
4/8/16	4/8/18	Final Construction Plans	2/25/13	4/26/16	2/25/13	4/26/16	100
3/20/18	7/19/18	404 and Buffer Variance (BV) Permits LOE	2/26/19	2/26/19	2/26/19	2/26/19	100
6/16/16	6/16/16	FFPR Inspection	6/16/16	6/16/16	6/16/16	6/16/16	100

Phase	Approved	Proposed	Lump Yr	Program	Cost	Fund	Status	Date Auth
PE	2011	2011			$988,422.92	Q05	AUTHORIZED	5/11/11
ROW	2018	2018			$1,010,000.00	HB170	AUTHORIZED	3/22/18
CST	2019	2019			$15,776,564.80	HB170	AUTHORIZED	8/1/18

COST EST AMTS

PE	$988,422.92	7/1/10
ROW	$1,010,000.00	5/25/17
CST	$15,776,564.80	5/18/18

STIP AMOUNTS

Activity	Cost	Fund
PE	$0.00	Q05
ROW	$499,392.00	HB170
CST	$10,174,308.30	HB170

Project Manager

D1-Justin Lott (770)531-5745

Shifted? Yes, 10/18 to 3/19 to 10/19 to 6/19
On BL? Not on BL
On sched for let? Yes
SFFPR: Held 5/22/18
SFFPR Resp: Sent 6/8/18
Crctd SFFPR Plan:Sent 7/5/18
ROW: Certified 4/3/19
ENV: Certified 3/25/19
UTL: Certified 11/26/18
404: Rec'd 11/21/18
SBV: Rec'd 3/8/19
Final Plan to CBA: Subm 4/12/19
CST Authorization: 8/1/18
Plans to repro: Subm 5/16/19

KJK 6/28/19

Asst Office Head : Notification of CST letter May 2, 2019.
Bridge : NO BRIDGE REQUIRED
Design : JL; On Schedule for Let; SFFPR held 5/22/18. SFFPR responses submitted 6/6/18. Submitted final plans to CBA 8/10/18-then let date shifted. Revisions to impacts sent 12/3/18. Final Plans submitted to PM 4/11/19. Project to be advertised 1 month early. Working on EPD comments and contractor questions.; no risks; need-final contract utility plans complete.(Jun-19)
EIS : Certified Jun19 Let | Certified 25Mar19| RE 4Mar19; RE 24Aug18; RE 05Sep14 | Borchardt 26Mar19
Engr Services : DDC:6May2016 Received the FFPR Request Package. VE Impl Letter (162390-)
Estimating: Need 18 Weeks Plans Package & CES by 4/15/16. MRH: FFPR responses approved 8JULY2016.
WDT: 03JAN2017 received corrected FFPR plans. WDT: 25APR2018 received Supplemental FFPR request.
TJC: 08JUNE2018 accepted Supplemental FFPR responses. WDT: 05JUL2018 received Corrected Supplemental FFPR plans.
TMG: Final Corrected Plans Memo Distributed 19JUL2018. Estimate is complete DT 8/13/18
LGPA : NOTIFICATION LETTER SENT TO CLEVELAND & WHITE 5-30-12.
Office Heads : PCRF needed for Oct 18 let 1-12-18 KWN
Planning : Design Traffic Completed for (2021/2041) & (2023/2043) - 2/09/18
Programming : STATE FUNDED NON-BANK PROJECT|SPLIT FROM PI# 162390-|#1 3-2013|#2 6-2015|#3 1-2016|#4 8-2016|#5 10-2017|CHANGED TO HB170 PER PLANNING 1-24-2018|#6 7-2019
ROW : 15 months per KTA 10-26-17 cw; Off schedule due to not enough R/W time upfront kk 7/18/18;Upper Management is discussing moving 8-8-18 ld
STIP : Project will provide additional capacity to improve mobility and reduce congestion. Project will help enhance economic development and will reduce crash frequency.
Utility : CERTIFIED 11/26/2018 SJD|District Ready for certification 10/17/18 rbo

Pre Parcel CT 25
Under Review 0
Released 25

3 Total Parcel in ROW System: 25
Options Pending: 0
Condemnations – Pend: 0

6 Cond Field: 1
7 Relocations: 0
Acquired: 25

15 Acquired by: DOT
Acquisition MGR: Dills, Jonathan
ROW Cert Date: 8/02/2019

DEEDS CT: 24

Figure 46. PI 0010195 PSR (Input Data fields indicated).

ROW Acquisition Timeline Prediction Results Page

The ROW Acquisition Timeline Prediction Results page allows the user to check the predicted results (see figure 47). The top cell indicates the predicted acquisition timeline in months and the cells below show the decision tree (estimator) used to predict the timeline. The decision paths are highlighted in green.

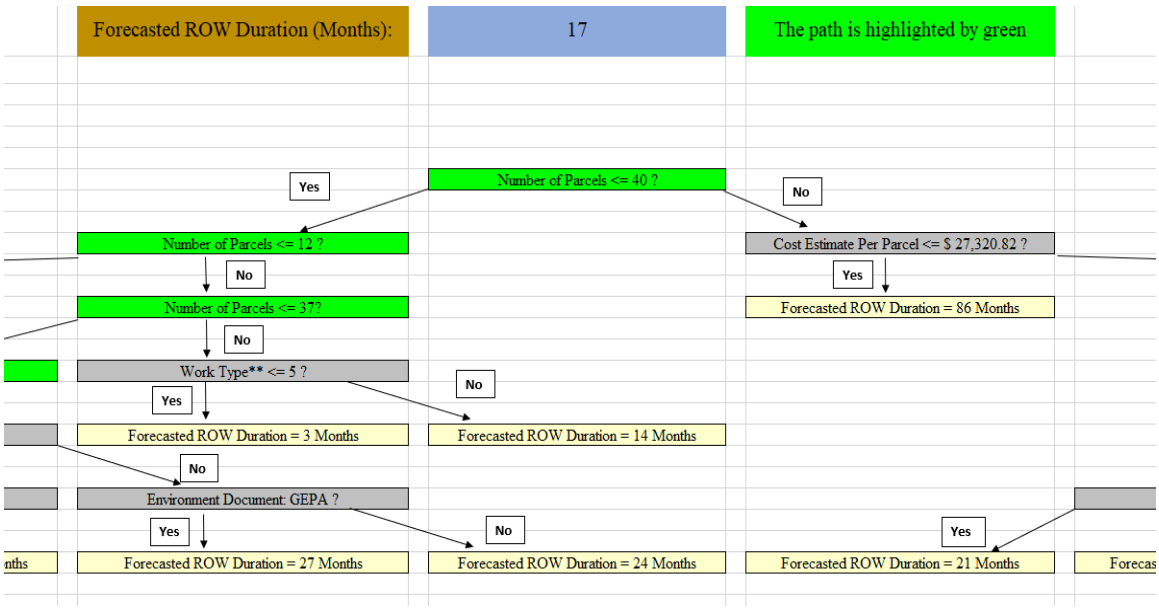


Figure 47. ROW acquisition timeline Prediction Results page (Results for PI 0010195).

To demonstrate how a result is achieved, the values of input data for the PI 0010195 are shown in table 6 and the corresponding decision tree paths result is shown in figure 48. Because the input Total Number of Parcels value is 25, the first path is “Yes” for the question “Number of Parcels <= 40?”. The second and third questions are “Number of Parcels <= 12?” and “Number of Parcels <= 37?”, respectively. Therefore, the

corresponding paths are “No” and then “Yes”. The next question is “Number of Relocation <=2?”. Since the input Number of Relocations is 0, the path for the question is “Yes”. Then again, for the question “Number of Parcels <=35?”, the path is “Yes”. Lastly, because the input Accounting for Cost Estimate Per Parcel is $40,400.00, the last path is “Yes” for the question “Cost Estimate Per Parcel <= $ 104,131.26” and gives the Forecasted ROW Duration of “17 Months”.

Table 6. PI 0010195 input data.

Project Name	**W CLEVELAND BYP ALONG CR 68 FM W OF SR 11 TO SR 75 - PH III**
Project ID	10195
Total Number of Parcels	25
Accounting for Cost Estimate Per Parcel	$40,400.00
Length (Mi)	1.45
Number of Condemnations	1
Number of Relocations	0
Work Type	Widening
DOT District	District 1
Design Led by	GDOT Design
Program Type	Reconstruction/Rehabilitation
MPO Type	Not Urban
Let with Other Project?	No
Environmental Document	NEPA

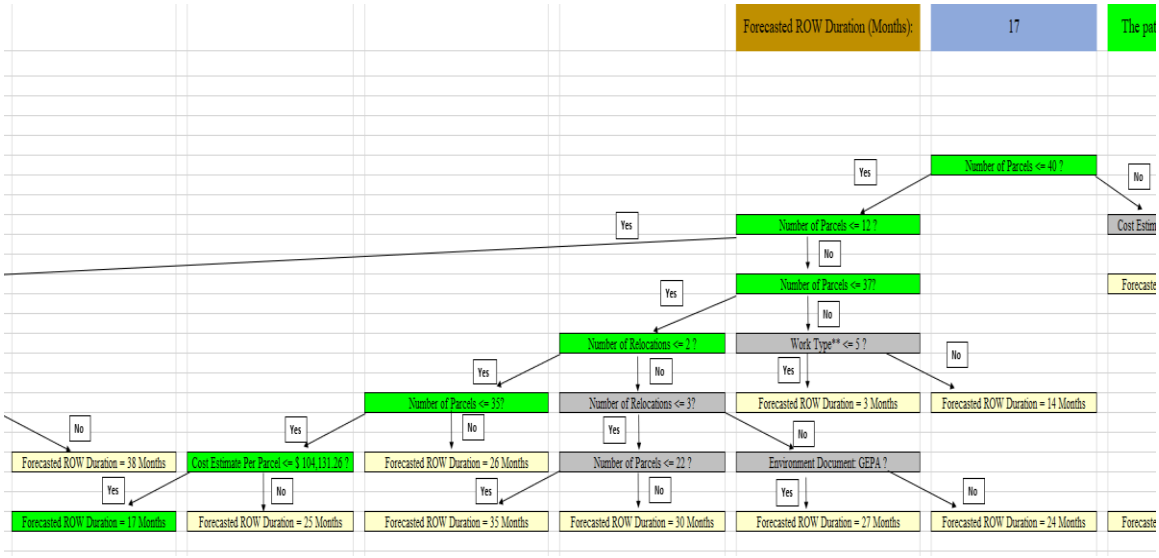


Figure 48. Decision tree paths result for PI 0010195.

For more information about the tool, contact Dr. Baabak Ashuri at the Georgia Institute of Technology:

Baabak Ashuri, Ph.D., DBIA
Professor
Georgia Tech
Phone: (404) 385-7608
Cell: (404) 509-4957
E-mail: baabak@gatech.edu

CHAPTER 8. CONCLUSIONS

The objectives of this research were to provide practical opportunities to expedite the ROW acquisition process and develop a data-driven model to estimate the ROW acquisition timeline, which can help GDOT to facilitate project delivery for major projects. The current state of the practices in ROW acquisition among state DOTs and best practices that can be used to expedite the ROW acquisition process were identified through surveys and follow-up interviews with state DOTs' ROW agents. Moreover, GDOT's projects records were analyzed to estimate the ROW acquisition timeline, considering unique project features and important external factors surrounding the project environment.

The research examined the following areas of the current state of the practice: (1) organizational structures of offices of ROW, (2) consultant management, (3) use of performance measurements, and (4) importance of factors in setting the ROW acquisition timeline. The specific topics identified with respect to these areas include, but are not limited to:

- Overall organization and reporting structure of state DOTs' office of ROW.
- Roles and responsibilities of central and district/regional offices.
- Involvement of consultants during ROW acquisition.

- Structure of managing consultants.
- Identity of who tracks performance measurement.
- Types of performance metrics measured.
- Importance of factors in setting the ROW acquisition timeline.

The research identified numerous best practices that can be used to expedite the ROW acquisition process. They were categorized into the following seven groups, based on the related procedure and phase: (1) Practices in the Early Stage of Project, (2) Develop ROW Plans, (3) Prepare Appraisals, (4) Property Acquisition and Relocation Assistance, (5) Manage Improvement Demolition, (6) Training and Performance Reviews, and (7) Process for Bringing ROW Consultants on Board. The identified best practices in each category are summarized below. Table 7 summarizes the identified best practices.

Table 7. Summary of identified best practices to expedite the ROW acquisition process.

Categories	Identified Best Practices
Practices in the Early Stage of Project	• Get involved early • Develop ADA voluntary curb ramp acquisition program • Break out utility relocation
Develop ROW Plans	• Develop ROW parcel overlay • Use eSignature for ROW plan authorization
Prepare Appraisals	• Utilize waiver valuation • Conduct pre-NEPA acquisition tasks with state funds • Perform in-house appraisals • Use fee appraiser to review appraisals
Property Acquisition and Relocation Assistance	• Use incentive program • Use only state funds to acquire properties early • Condemn properties early
Manage Improvement Demolition	• Manage improvement demolition in a standalone contract • Manage improvement demolition in a construction contract
Training and Performance Reviews	• Train new employees in-house • Develop a peer review system
Process for Bringing ROW Consultants on Board	• Descriptions of how Ohio, Tennessee, and Colorado DOTs bring consultants on board

Lastly, the research developed a ROW acquisition timeline forecasting model through a data mining analysis of GDOT's project records. The following steps were taken to build the model: (1) collect the required data to analyze the ROW acquisition duration, (2) sort out the data that are appropriate for performing the data analysis, and (3) conduct data mining to estimate the ROW acquisition timeline. The ROW acquisition timeline forecasting model takes into account 13 project attributes to predict the ROW acquisition timeline and provides results with high accuracy. The model was developed using

Microsoft Excel Visual Basic for Application so that it can be used to facilitate decision-making in the practice of estimating ROW acquisition management.

ACKNOWLEDGMENTS

The research reported herein was sponsored by the Georgia Department of Transportation through Research Project Number 18-35. The authors acknowledge and appreciate the help from Ms. Katrina Anderson, Mr. Troy Byers, and Mr. Troy Hill. Their invaluable assistance and insight were critical to the completion of this research. The authors also thank Ms. Supriya Kamatkar, Ms. Sarah Lamothe, Ms. Alece Anderson, and Mr. Floyd Williams, who have helped us throughout the progress of this research project.

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