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Expertise Management for Safety Leadership Positions in the U.S. Railroad Industry

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14. ABSTRACT

The U.S. railroad industry is facing critical knowledge loss of invaluable safety leadership expertise due to employee separations and a retiring workforce. The Federal Railroad Administration (FRA) sponsored TrueSafety Evaluation, LLC, in partnership with Perigean Technologies, to conduct research on Expertise Management (EM), a knowledge-management approach centered around Cognitive Task Analysis (CTA) that uses a suite of methods to elicit, analyze, and represent expertise so that it can be reintroduced into the organization. As part of this effort, the research team developed and implemented an EM Framework to identify, capture, and transfer critical knowledge from experienced railroad employees to newer staff. This research was conducted from September 2022 to February 2024.

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1 gallon (gal) = 3.8 liters (l)	
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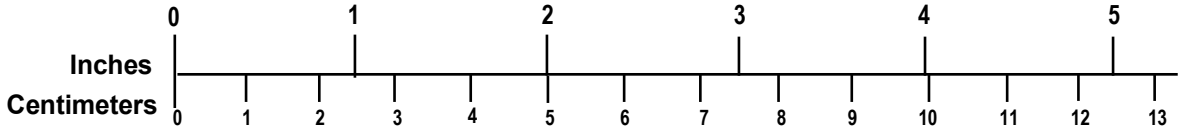

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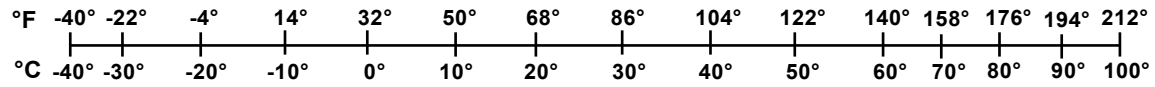

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Executive Summary

The U.S. railroad industry is facing critical knowledge loss of invaluable safety leadership expertise due to employee separations and a retiring workforce. The Federal Railroad Administration (FRA) sponsored TrueSafety Evaluation, LLC, in partnership with Perigean Technologies, to conduct research on Expertise Management (EM), a knowledge-management approach centered around Cognitive Task Analysis (CTA) that uses a suite of methods to elicit, analyze, and represent expertise so that it can be reintroduced into the organization. As part of this effort, the research team developed and implemented an EM Framework to identify, capture, and transfer critical knowledge from experienced railroad employees to newer staff. This research was conducted from September 2022 to February 2024.

The EM Framework methodology involved three stages:

1. *Knowledge Identification*: The systematic identification and prioritization of undocumented tacit knowledge from safety leaders
2. *Knowledge Capture*: The use of Cognitive Task Analysis (CTA) methods to articulate internalized mental models and critical decision paths
3. *Knowledge Transfer*: The reintroduction of captured expertise into the organizational knowledge-sharing ecosystem through various EM products

The research team produced a suite of EM products tailored for railroad organizations, including:

- *Decision Games*: Interactive training scenarios based on real-life situations
- *Job Aids*: Guides offering strategies and details for challenging tasks
- *Expert Content*: Stories and in-depth material on specific topics (e.g., Vehicle/Track Interaction)
- *Decision Requirements Tables (DRTs)*: Summaries of critical decision points

Researchers demonstrated that the EM Framework can be a valuable tool for mitigating knowledge loss in the railroad industry. Key findings include:

- Identification of crucial areas of technical expertise at risk of being single points of failure
- Recognition of the significance of non-technical leadership impact skills for safety and organizational strength
- Validation of the EM approach and products through stakeholder engagement and demonstration

Lessons from the project underscored the importance of engaging current experts for deeper knowledge capture; addressing the barriers to developing expertise, such as technology dependence and organizational structure; ensuring scalability and adaptability of EM products for diverse railroad operations; and recognizing the need for skilled facilitation in the delivery of EM products, particularly Decision Games.

The report concludes with recommendations for future roll-out strategies, emphasizing the development of 'train the trainer' programs, customization of EM products for specific railroad needs, and the creation of small “bite-sized” EM products for integration into regular training schedules.

1. Introduction

The U.S. railroad industry faces significant leadership knowledge loss due to a retiring workforce leaving the industry. To reduce the risk of key knowledge loss when these experts leave their organizations, it is critical to capture and transfer their knowledge to the remaining workforce. The Federal Railroad Administration (FRA) sponsored a research team from TrueSafety Evaluation, LLC, partnered with Perigean Technologies, to explore the use of Expertise Management (EM) to retain safety leadership knowledge when experts leave the industry. The research was conducted between September 2022 and February 2024.

1.1 Background

Stewart (2020) highlighted the urgent need to mitigate the risks of lost knowledge within railroading: "As the workforce ages and retires from the rail industry, significant experience will be lost if knowledge is not effectively transferred to and socialized among the next generation of employees." The industry's current succession programs are not adequately addressing the loss of experienced employees and their expertise due to retirement (see Figure 1, Stewart, 2020). Though inevitable, this impending loss could coincide with trends likely to shape the railroad industry for the next several decades. These trends include infrastructure upgrades made possible by federal funding, a resurgence of passenger rail, and technological advances that push the boundaries of prior experience (e.g., operating longer trains). While any of these singular trends bring a range of safety risks, collectively they show a critical need for *expertise*, making it important to ensure that critical industry knowledge remains for application.

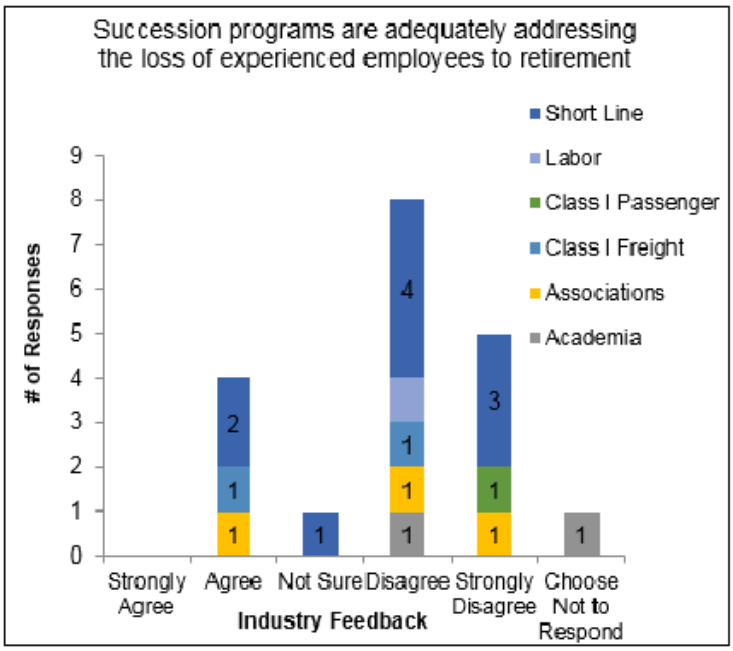

Figure 1. Succession Planning Program Success in Rail

Building on conceptual frameworks suggested by Klein (1992) and Ackerman et. al. (2003), the research team coined the term Expertise Management (EM) to emphasize the importance of focusing knowledge-management efforts on the most critical knowledge within an organization, that of expertise.

Inspired by the field of Naturalistic Decision Making, EM is a knowledge-management approach centered around Cognitive Task Analysis (CTA), a suite of methods to elicit, analyze, and represent expertise so that it can be reintroduced into the organization. More than 20 years ago, FRA initiated a series of CTAs for safety critical positions and operations in the railroad industry (e.g., dispatchers, roadway workers, locomotive engineers, teamwork communications and technology applications) (Roth, Rosenhand, & Multer, 2013, 2020; Roth & Multer, 2007; Roth, Malsch, & Multer, 2001).

The EM approach comprises processes for identifying critical, at-risk knowledge; techniques for helping experts articulate what they know; and methods for organizations to engage with their expertise to ensure the knowledge transfer of that expertise and to accelerate its development. EM is based in approaches that have previously proven successful in capturing expertise and deploying expertise management programs within railroading and other industries, including nuclear power, consumables, and electric utilities.

1.2 Objectives

The objective of this research was to mitigate the risks of lost knowledge in railroad safety leadership positions by establishing the EM Framework. Researchers demonstrated the use of the EM Framework in the rail industry to capture the core knowledge, skills, and abilities of identified safety critical experts. The team developed a suite of EM products that railroads can use to tailor organizational changes.

1.3 Overall Approach

The EM Framework offers a structure for managing the risk of lost knowledge. As conceived by Moon et al. (2015), EM comprises processes for *identifying* critical, at-risk knowledge; techniques for helping experts *articulate* what they know; and methods and products for enabling organizations to *engage* with their expertise. When fully executed, the EM Framework helps to ensure that expert knowledge is transferred to others, to accelerate the development of their expertise and mitigate the overall risk to the organization.

The first three tasks in this project mirrored the three stages of the EM Framework: Knowledge Identification, Knowledge Capture, and Knowledge Transfer.

- *Knowledge Identification* is the systematic process of identifying and prioritizing at-risk categories of tacit knowledge domains that are crucial to safety-critical planning and decision-making but largely undocumented in any written format.
- The purpose of *Knowledge Capture* is to capture and articulate, using CTA methods, the internalized mental models, critical decision paths, and core information sources used by senior leaders for safety critical decisions, and to help identify and guide potential product development that can be infused back into the organization. In this project, the Knowledge Capture process was a bottom-up approach, meaning that the experts identified the knowledge on which to focus.
- *Knowledge Transfer* refers to the process of introducing EM products back into an organization's knowledge-sharing ecosystem, including the design and delivery of learning and training activities, development of reference resources, and enabling personnel to engage with expertise. EM products are intended to share what expertise

looks like, specific knowledge of the organization and industry, and to help others understand what it means to be an expert and achieve expertise themselves.

The team established an EM Framework for safety expertise management and demonstrated the deployment of EM strategies. Specifically, the EM Framework focused on the domain of safety-critical railroad operations to help strengthen highly skilled areas of technical expertise (e.g., such as train-track interactions) and the *Leadership Impact Skills* within the railroad industry. Leadership impact skills are the foundational, non-technical skills, abilities, and competencies (e.g., emotional intelligence, team building, listening, communicating, and conflict management) that are essential for building strong organizational impacts.

The team initially executed six Project Tasks:

1. Knowledge Identification and Stakeholder Identification
2. Knowledge Capture and Synthesis
3. Knowledge Transfer
4. Formative Evaluation
5. Expertise Management Framework Development
6. Final Reporting

During the project period, FRA funded an additional four Optional Tasks:

1. Stakeholder Review Panel
2. Conference presentation(s)
3. Additional Knowledge Capture
4. EM workshop

1.4 Scope

The team focused on passenger, short line, and regional railroads as key stakeholders for the demonstration project. Although none of the interviews were from Class I carriers, many of the findings and EM products are applicable to Class I railroads.

1.5 Organization of the Report

The report is organized into the following sections:

Section 2 discusses the formative project evaluation.

Section 3 presents the project methods.

Section 4 offers findings and outcomes from the project.

Section 5 presents lessons learned from the project.

Section 6 presents conclusions and recommendations for additional work.

Appendix A includes the complete review of the EM Products.

Appendix B contains the Facilitator's Guide for Creating and Executing Decision Games.

Appendix C provides the full, detailed EM Framework.

2. Formative Evaluation

2.1 Utilization-Focused

The research team followed the premise of *Intended Use for Intended Users*, which holds that innovations, such as introducing the EM approach to the railroad industry, should be judged by their utility for actual use, i.e., how real people in the real-world apply and experience the EM products and experience.

2.2 Purpose

Formative evaluations were conducted during the project to guide planning and implementation and help ensure success. These evaluations are especially useful to systematically identify and address emerging needs and issues as they arise. Formative evaluations primarily seek to improve research through documenting, monitoring, and providing rapid, real-time feedback about emerging ideas and shape them into a potential EM framework that is a more fully conceptualized and potentially scalable innovation.

Therefore, all project activities were evaluation opportunities to gather feedback and solicit input for project improvement and goal attainment.

2.3 Guiding Questions

The team used the following areas of interest and evaluation questions to guide the formative evaluation:

I. Assess the level of interest/need for the EM Framework and customize the products to align with those needs.
   - *To what extent are industry stakeholders interested in the EM Framework?*
   - *In what ways can the EM products be improved?*

II. Understand the potential utility of the different types of EM products at specific railroads.
   - *What are the potential uses of EM products by the participating key stakeholders?*

III. Identify strategies for rolling out the EM Framework to the railroad industry at-large.
   - *What are the immediate and future roll-out strategies for the EM Framework/products?*
   - *What are the lessons learned from the EM demonstration project to inform further development and roll-out of the EM Framework?*

2.4 Stakeholder Engagement

The team used stakeholder engagement to gather insights for the evaluation effort. Stakeholder engagement is the systematic involvement of key stakeholders throughout the lifecycle of a project to ensure that a) relevant stakeholder needs are identified, b) project goals and objectives are aligned with those needs, and c) products and processes are designed with intended users and intended uses in mind. During this project, the team engaged key stakeholders for review of not only the project processes, but also the EM Framework for broader industry buy-in, engagement, and roll-out strategies.

2.4.1 Key Stakeholders

The research team conducted project activities in concert with railroad industry stakeholders, Amtrak and the American Short Line and Regional Railroad Association (ASLRRA), who provided valuable feedback from project kick-off to final briefing. Table 1 outlines the identified key stakeholders, including titles and roles, that were engaged throughout the EM project.

Table 1. Expertise Management Project Key Stakeholders

Organization	Title	Project Role
FRA	Program Manager	Federal Sponsor
Amtrak	Executive Vice President (VP) and Chief Safety Officer	Company Lead
	Assistant VP System Safety & Technical (Tech) Training	Tech Training Oversight
	Senior Director (Sr. Dir.) Safety & Tech Training	Tech Training Lead
	Sr. Dir. Talent Development, Acting AVP	L&D Team Oversight
	Dir. Learning & Development (L&D)	L&D Team Lead
	Manager Central Reporting	Point of Contact (POC)
ASLRRA	Sr. VP Safety & Regulatory Policy Sr. VP Education & Business Services VP Safety & Compliance	Industry Lead, POC Industry Coordinator Industry Liaison
Short Line Safety Institute	Executive Director	Culture Coordinator
Anacostia Rail Holdings	Chief Safety & Compliance Officer	Company Coordinator

2.4.2 Roll Out Strategies

The project team informed EM roll out strategies by engaging key stakeholders in reviewing the EM approach/products and providing feedback about the potential utility in their segment of the railroad industry.

The team solicited, captured, and incorporated stakeholder input at various points in the EM project lifecycle, including:

- Kick-off meetings
- Identification of key stakeholders from Amtrak and ASLRRA
- Identification of priority position(s), jobs, and tasks for knowledge capture and need areas
- Ongoing progress briefings with FRA and key stakeholders
- Key stakeholder interviews conducted to better understand:
    - The overarching needs and the criticality of EM in stakeholder organizations and the U.S. railroad industry more broadly
    - The current state of knowledge management practices in the participating railroads
    - How best to adapt EM to address the gap between the current state and the desired state of knowledge management, including expertise management

- Introductions to and demonstrations of the developed EM products
- Identification of opportunities for expertise knowledge transfer at participating railroads, coordinated buy-in for the EM project, and support for additional pilot activities and partnerships.

Key stakeholder feedback is further discussed in Section 4.

3. Project Method

This section discusses the project activities, original tasks and optional tasks, and related findings and outcomes.

3.1 Knowledge Identification

The team held kick-off meetings with FRA, Amtrak, and ASLRRA to provide an overview of the EM project, identify top EM needs in those organizations, and identify high priority positions and potential interviewees. During the kick-off meetings, the team addressed project goals, methodology, deliverables, confidentiality issues, and candidate criteria for the CTA interviews.

3.1.1 Scoping Process

In initial discussions, the key stakeholders asked the team to focus efforts not only on areas of technical expertise, but also on what are often described as the "soft skills" leaders need to do their jobs effectively. These soft skills are referred to as *Leadership Impact Skills*.

Subsequently, key stakeholders from Amtrak and the ASLRRA were asked to identify candidates they considered to possess the requisite technical and leadership impact skills of interest, which are not otherwise well-documented. In addition, participants agreed that including both management and front-line craft employees would be useful for scoping the project. In September 2022, the team presented the scoping framework described in Table 2.

Table 2. Scoping Framework

	Technical Skills		Leadership Impact Skills	
	Hours	# Interviewees	Hours	# Interviewees
Management	24 (or 8, 8, 8)	1-3	24 (or 8, 8, 8)	1-3
Craft	24 (or 8, 8, 8)	1-3	24 (or 8, 8, 8)	1-3

The key stakeholders worked with the team to define the criteria for the selection of experts to invite to participate in the demonstration project (see Table 3).

Table 3. Expert Selection Criteria

Technical Skills	Leadership Impact Skills
• Seasoned expert in multiple domain areas – "franchise expert"[1] • Effectively executes complex tasks as the "go-to" performer for specific problem sets. • Deep knowledge of Safety Management Systems (SMS), technologies, and processes. • Strong situational awareness of SMS operations, its interactions, and dependencies. • Intuitive understanding of underlying safety or operational issues. • Proactively addresses safety or operational issues to reduce inherent risks. • Organizational performance suffers in their absence.	• Extensive professional network comprising internal and, more importantly, external connections. • Notices and senses interpersonal work environment and effects of emotions at work. • Skillfully manages interpersonal conflicts with compassion and understanding. • Maintains open-minded and positive attitude in communications. A good listener. • Acts with awareness of circumstances/influences. Seeks additional info if appropriate. • Exhibits emotional control in trying circumstances. • Non-judgmental when making decisions. • Highly respected by peers.

[1] See https://perigeantechnologies.com/publications/FranchiseExperts.pdf

Stakeholders were given a document to fill out with the individuals' name/contact information, position/title/location, and key roles/responsibilities. The team also asked stakeholders to identify example scenarios for prioritizing high-risk need areas.

3.1.2 Expert Selection Process

After internal discussions, Amtrak suggested four candidates and ASLRRA suggested six candidates for EM interviews, totaling 10 candidates (n=10).

The team contacted the potential interviewees via email, explaining that they were identified as an ideal candidate for participating in the project. The email included the project goal of capturing aspects of expert knowledge and building knowledge transfer activities that can help others learn from their extensive railroad knowledge and experience. The email also asked to schedule preliminary calls to discuss the project, answer any questions the candidates had, and understand their willingness to participate.

All 10 candidates agreed to a preliminary call. Over several weeks, the team conducted virtual 30-minute introductory meetings with each expert to understand their availability, location, and the areas of expert knowledge that they thought would be most valuable to capture and transfer.

After the introductory meetings, the team identified 10 experts for the Knowledge Capture process in which at least one 2-hour interview session would be conducted with each interviewee depending on availability.

In addition to this initial set of 10 experts, FRA later funded the team to support a set of additional interviews. Working with ASLRRA member Anacostia Rail Holdings (Anacostia), the team identified five safety leaders from one of their railroads with expertise in leadership impact skills.

3.2 Knowledge Capture

The next phase of this demonstration project was to help the experts articulate their expertise using CTA. CTA comprises a set of techniques for eliciting, analyzing, and representing the cognitive work inherent in domain tasks (Hoffman & Millitello, 2008; Crandall et al., 2006). CTA methods have been developed, applied, and refined over the past four decades across numerous domains.

The Critical Decision Method (CDM) is of particular value for EM (Hoffman et al., 1998). CDM is an interview technique widely used in the field of Knowledge Capture. CDM provides an interview structure with probing questions that enable a Knowledge Capture professional to help experts articulate their cognitive experience, usually in the context of an incident in which their cognitive performance influenced the outcome of the incident and, perhaps, the organization.

CDM is used to gather detailed information about how individuals make decisions in complex and dynamic situations. It is particularly useful for understanding the reasoning processes behind expert decision-making. In CDM interviews, participants are asked to recall and describe specific critical incidents or decisions they have encountered in their professional domain. These incidents are typically where the decision-maker faced uncertainty, time pressure, or other challenging circumstances. The interviewer then guides the participant through a structured set of questions designed to elicit detailed information about the decision-making process.

The research team completed the first round of Knowledge Capture interviews between September and December 2022. The team conducted 29 CDM interviews over more than 62 hours with the 10 selected experts. Most of the interviews were conducted virtually using Zoom, while interviews with several Amtrak interviews were conducted in-person in Washington, DC, and Philadelphia, PA. The team recorded all interviews.

The second round of interviews was conducted September 19–21, 2023, in person with five experts on site at a freight railroad owned by Anacostia. Anacostia's leadership team indicated interest in implementing the EM approach in their organization after participating in a series of demonstrations of the draft EM products (see Section 3.4.2.1). Because several of their experienced leaders are planning to retire over the next five years, they expressed an urgent need for EM, and selected five experts for the Knowledge Capture interviews. These interviews occurred later in the project, after the first round of interviews had progressed into the Knowledge Transfer phase, when FRA provided additional funding to conduct additional knowledge capture (Optional Task C). Nine additional interviews were conducted and recorded over 17 hours.

The interviewee breakdown, their positions, and total interview time, is shown in Table 4.

Table 4. Summary of Expert Interviews

Organization	Position	Interviewees	Number of Interviews	Duration
Amtrak	• Mechanical Technician • Locomotive Technician • AVP, Operations • Deputy Chief Engineer Track	4	10	24.0 hours
ASLRRA	• Superintendent, Operations & Mechanical • Director of Safety & Continuous Improvement • Director of Environmental Health & Safety • Roadmaster • Rail Training & Consulting • Safety & Compliance Officer	6	19	38.5 hours
Anacostia	• President • Vice President • Chief Mechanical Officer • Roadmaster • Trainmaster	5	9	17.0 hours
TOTAL		**15**	**38**	**79.5**

The team focused on capturing expertise related to leadership impact skills, using a social and emotional intelligence framework with probing questions to capture how social, emotional, and cognitive skills are used in the context of safety leadership. Leadership impact skills, often called "soft skills" or "people skills," are some of the most critical skills an organization can cultivate because research shows these impact skills lead to strong organizational outcomes. Emotional intelligence skills, for example, are widely considered some of the core competencies that define and distinguish cultures of excellence and are among the most sought-after skills for new leaders

(The Economist, 2023). Indeed, the desire of key stakeholders to focus part of the team's efforts on "soft skills" areas attests to their significance and importance in safety leadership.

Throughout all the interviews, the Critical Decision Method and Knowledge Audit techniques elicited reflective thought processes and cognitive skills used during routine safety operations and critical decision-making. The team used a Mindfulness Task Analysis[SM] approach for the leadership impact skills, which is a nuanced modification of traditional CTA that integrates CDM and Knowledge Audit (KA) to capture, categorize, and represent the lived experience of "mindfulness" actions, behaviors, and decisions from experts (Coplen & Moon, 2023).

3.2.1 Interview Topics

During the introductory meetings, each expert identified their areas of expertise and any high-risk areas on which they suggested we focus the demonstration effort. The resulting interviews covered a range of Leadership Impact and Technical Skill topic areas (see Table 5), some of which overlapped across experts.

Table 5. Interview Topics

Category	Topics
Impact	• Training • Program Implementation • Incident Response • Building and Managing Teams • Engaging Other Organizations • Interface between Short Lines and Class Is
Technical	• Onboard Mechanics • Mechanical Locomotive Repair • Electrical Locomotive Repair • Vehicle Track Interaction • Derailments • Track Construction and Reconfiguration

3.2.2 Synthesize Interview Results

Interviews were synthesized within and across both impact and technical skills to identify subtopic areas of interest, common areas of intersection between the two, and the underlying tacit knowledge leaders rely upon when making key safety decisions. Summation and analysis of information received in the interviews enabled creation of a Knowledge Topics Map, described in the next section. Mapping provides a good illustration of the scope of information needed in expertise management.

3.2.3 Knowledge Topic Map

To provide a top-down view of the topics covered during the interviews, the team created a comprehensive knowledge map (Figure 2). A knowledge map is a visual representation of the categorized expertise or knowledge relevant to the specific decision-making processes being studied. The interview topics were organized by either Technical or Impact Skills topic areas, based on which expert focused on which topics. The knowledge map also helped the team track topics and see overlap across experts.

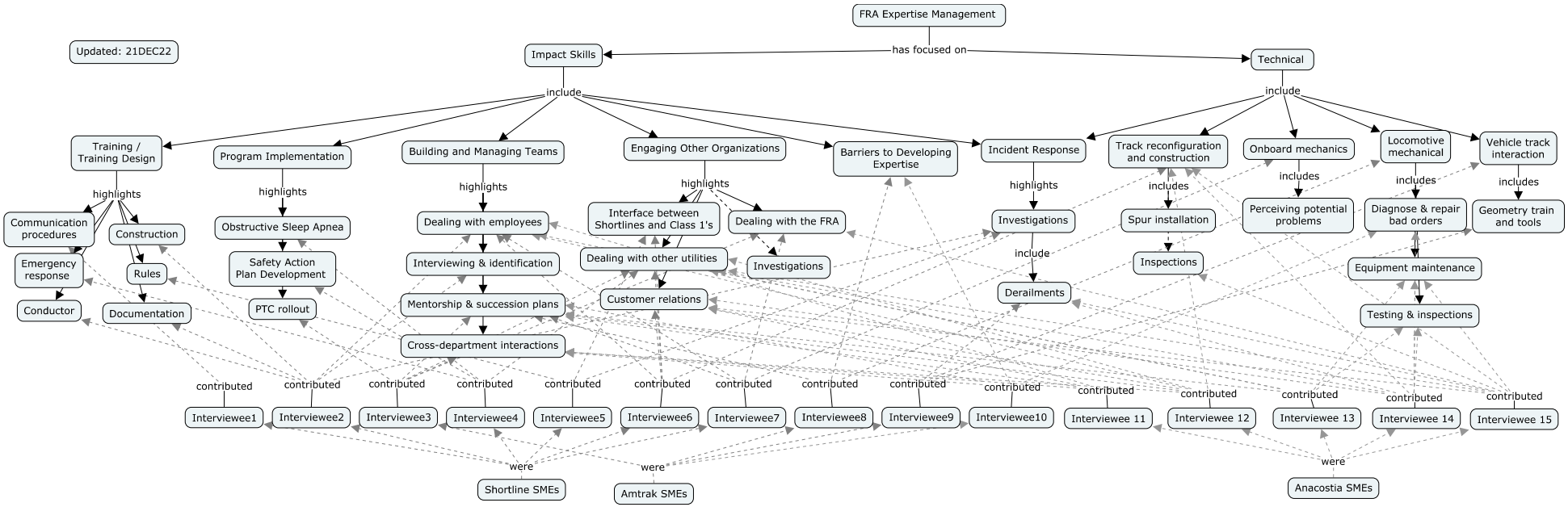

Figure 2. Knowledge Topics Map

3.2.4 Stories, Expert Content & Decision Requirements Tables

Team members collated the audio recordings, transcripts, and notes from each interview and created a single document for each expert. The individual documents were then organized based on the content and stories captured during each interview. Finally, every story was extracted and compiled in a single document based on topic areas.

From the stories documents, the team pulled out the experts' decision points to create Decision Requirements Tables (DRTs) summarizing critical decisions made during the stories captured with all experts interviewed. The DRTs are a standard tool used to make explicit the critical decisions, judgments, contexts, and other attendant cognitive elements that a person must perform to carry out a task. (See Appendix A for the DRT categories and their descriptions.)

Because knowledge about the same topics was captured across several experts, the team organized the DRTs based on topic rather than expert. Table 6 shows the DRT table structure.

Table 6. Decision Requirements Table Structure

Critical Decision, Judgment, or Action	Why Difficult?	Common Errors	Factors	Cues	Strategies	Information Sources	Suggested Changes
Example Decision, Judgment, or Action	Reasons the decision is challenging, including barriers.	Errors inexperienced people tend to make when addressing the decision.	Information known prior to the event that are used to make the decision.	Information from the environment that are used to make the decision.	How people say they make the decision.	Where the information used to make the decision comes from.	How changes to the organization, training, and/or technology could better support the decision.

The stories, expert content, and DRTs highlight the most difficult and critical aspects of expertise in the tasks and roles discussed with the experts. After the team organized and synthesized all of the interview content with the DRTs and analyzed the decision requirements for major decisions, the next step was to develop EM products that could be introduced back into organizations.

3.3 EM Product Development

Based on the Leadership Impact and Technical Skills topic areas that emerged during the Knowledge Capture process, the team drafted products and tools that could be used by the railroad industry to encourage and enable others to develop similar expert-level skills, such as train-track interactions and elements of emotional intelligence. The EM products were intended to showcase what expertise looks like in the U.S. railroad industry, identifying the underlying tacit expert knowledge of individuals, the organization, and the industry as a whole to help others understand what it means to be an expert and help them more rapidly achieve expertise themselves.

An overview of the number and types of products developed during this project is shown in Table 7. (See Appendix A for a complete review of the EM products.)

Table 7. Expertise Management Products Overview

Product	Description	Content
Decision Games (DGs)	Based on stories captured in the interviews, DGs place the learner in a particular role and ask them to make a decision, take an action, or prepare a product as if they are the expert. The games provide learners situational experience to think like an expert in complex and uncertain circumstances. The learner receives feedback based on the expert's decisions in real life.	Developed eight original DGs: • A Day in the Life • New to Management • Derailment • Rollout • Mechanical Repair • Electrical Repair • Roadmaster • Impact Skills Sections from multiple DGs were reworked to create a customized game for Amtrak's MW1000 track foreman training course.
Job Aids	Job aids provide a cognitive guide for challenging tasks or processes with expert strategies and details to be noted. Job aids can be used by novices and advanced professionals.	Developed two job aids: • Technical Locomotive Repair • Electrical Locomotive Repair
Expert Content	Based on knowledge captured during the interviews, expert content provides a deep dive into a given topic. They contain more information than a cursory review of a topic, particularly details that are not widely known within the organization. These details include history, technical knowledge, and things novices tend to miss.	Transcribed 14 pages of expert content on train-track interaction.
Decision Requirements Tables (DRTs)	DRTs extract, organize, and analyze the key elements of expertise that were captured in the interviews. DRTs can augment existing training and sensitize learners to the cognitive elements required to perform particular tasks.	Identified 64 critical decisions across topics and tasks.
Stories	The interviews captured stories about expert's experiences that were particularly challenging. Expert stories are effective for training real-life scenarios. Students learn about complex cases directly from the expert, giving them a sense of the cognitive skills required to perform effectively in difficult situations.	The team of interviewers captured over 60 detailed stories across various topics.

3.3.1 Decision Game Facilitation Guide

The team also developed a DG Facilitation Guide (see Appendix B). This guide serves two purposes: 1) explain the DG components with step-by-step descriptions of the processes necessary for facilitating the game, and 2) guide an inexperienced facilitator through the tasks of creating and facilitating the discussion sessions during the DG. The guide has a list of possible questions to help the facilitator get the discussions started and keep the players involved and interested throughout the discussion.

The first section of the guide provides facilitators with technical instructions on how to prepare for the DG facilitation session by logging in to Google Forms, advancing the game, etc. The second section provides guidance on how to assist the discussion by providing an introduction, questions to facilitate the discussions among the participants, and possible segues to the next requirement. The third section includes guidance for creating DGs based on stories captured from experts.

The next phase of the project was to identify how the products might fit into the industry and/or specific organizations before the products were fully developed. Understanding what topics certain organizations train and how they do so, the team could develop products to augment existing training programs (see Section 3.4).

3.4 Knowledge Transfer

In the Knowledge Transfer phase, the EM products are introduced back into an organizations' knowledge-sharing ecosystem, including the design and delivery of learning and training activities, development of reference resources, and enabling other personnel to engage with the expertise.

After completing an initial set of draft EM products that included six DGs and two job aids, the team set up a series of meetings with key stakeholders to introduce the expert knowledge and demonstrate the EM products. The goal of these meetings was to understand, given what was collected and created, if there were places within organizations' training spaces where these materials may be useful.

The team offered several approaches to integrating EM products into organizations, including but not limited to the following:

- Incorporate EM products into existing formats/delivery methods
- Display job aids on bulletin boards, in handbooks, and throughout work spaces
- Facilitate DGs with an expert facilitator, with options to:
    - Deliver the content as is
    - Work with training personnel to customize games to their training needs
- Provide self-run DGs via Google Forms
- Present DG modules as weekly/monthly activities
- Conduct 'train-the-trainer' workshops to facilitate DGs (online or in-person)
- Integrate expert content into existing training handbooks and manuals

3.4.1 Stakeholder Participation

Between September 2022 and February 2024, the team conducted 39 stakeholder engagement and review meetings, as presented in Table 8, to introduce, demonstrate, and/or pilot the EM products with key stakeholders. These stakeholder meetings served various purposes:

- Assess the level of interest/need for the EM products and/or how to improve them to align with these needs

- Understand the potential utility of the different types of EM products at specific railroads
- Identify opportunities to demonstrate a sample of the products in ongoing training programs
- Identify strategies for rolling out the EM products to the railroad industry at-large

These meetings allowed for stakeholder engagement and feedback to inform the further development of the EM products.

Table 8. Stakeholder Engagement Activities

Meeting Focus	# of Meetings	# of Participants
Introductory	25	~61
Demonstration	14	120
Totals	**39**	**181**

EM products included stories, expert content, job aids, DRTs, and access to all DGs. The team asked key stakeholders to review the products on their own to see which aligned with their training needs. During the stakeholder meetings, the team probed about possible existing opportunities to pilot the products and stakeholders shared feedback for aligning the products, if applicable.

These stakeholder review meetings were generally either Informational/Introductory or Product Demonstration. The informational meetings provided background on the EM project and the EM Framework, and introduced the products. The team delivered demonstrations and pilots of the DGs with Aberdeen Carolina & Western Railroad, Anacostia Rail Holdings, and Amtrak. All stakeholder meetings provided valuable insights for formative evaluation and further project activities.

3.4.2 Introductory Meetings

In addition to introducing the EM project, its approach, and the EM products, the informational meetings with stakeholders had the following objectives:

- Assess the level of interest/need for the products and improve as needed to align with these needs
- Identify opportunities to demonstrate a sample of the products in ongoing training programs

Highlights from some of these informational meetings are presented in the following subsections.

3.4.2.1 Anacostia Rail Holdings

Anacostia showed particular interest in the EM efforts. The team conducted three separate EM product review meetings with Anacostia's Operations Safety, Maintenance of Way, and Mechanical groups on August 10, 15, and 25, 2023, respectively. In each meeting, team members introduced the EM project and goals and gave an overview of the EM products. The team briefly demonstrated samples of the New to Management and Derailment Decision Games, which were topics of interest to the meeting attendees. Notably, these meetings led to the

additional knowledge capture interviews conducted with safety leaders from Anacostia. The additional interviews resulted in EM products targeted at Impact Skills (see Section 3.2).

3.4.2.2 ASLRRA Webinar

On October 4, 2023, the team delivered a webinar for ASLRRA: *Expertise Management: An Innovative Approach for Succession Planning in the U.S. Railroad Industry*. The team introduced the EM project, explained EM history and CTA methods, and gave an overview of the EM products. Team members also gave a brief demonstration of the New to Management Decision Game. The webinar helped the team to reach a large audience of short line railroads, with 39 people registered from across the country.

3.4.2.3 Transportation Review Board Annual Meeting

Team members traveled to Washington, D.C., to attend the 103rd Transportation Review Board Annual Meeting and presented the project on January 9, 2024. The team prepared and delivered a 20-minute presentation, *Expertise Management: An Innovative Approach for Knowledge Management and Succession Planning in the Railroad Industry*. This presentation introduced the EM project, discussed its unique approach, and outlined the training products. Team members described CTA methods, the EM Framework, and solicited input for EM roll-out strategies.

The team also participated in an FRA panel presentation and presented two posters about Key Impact Skills and Accelerating NextGen Expertise.

3.4.3 Product Demonstrations

The primary objectives of the product demonstration meetings were to not only introduce the EM project to stakeholders, but also to:

- Assess the level of interest/need for the products and improve as needed to align with these needs
- Understand the potential utility of the different types of EM products at specific railroads
- Identify opportunities to demonstrate a sample of the products in ongoing training programs

The next sections highlight some of these important meetings, particularly the three facilitated demonstrations, in which at least half a day was dedicated for a group of railroad employees to participate in at least one of the draft DGs. The team demonstrated the EM application of Knowledge Transfer with three railroad entities: Aberdeen Carolina & Western Railroad, Anacostia, and Amtrak.

3.4.3.1 Aberdeen Carolina & Western Railroad

The first demonstration was an on-site visit at Aberdeen Carolina & Western Railroad in North Carolina on June 26, 2023. The purpose of the visit was to introduce the EM project, demonstrate the potential use of the EM products at the organization, and gather feedback on the EM products. The participants included the Director of Safety Training, the Chief Mechanical Officer, two trainmasters, and a mechanical supervisor. Each participant had between 10 and 30 years of industry experience and held training responsibilities.

The team introduced the EM project, explaining that the aging workforce creates risk for loss of expertise, and succession planning alone cannot fully mitigate that risk. Team members discussed the EM project goals of identifying critical at-risk experience, performing Knowledge Capture interviews, developing Knowledge Transfer products, and pilot-testing the EM approach/products. The team provided a brief overview of the EM products, including stories, DRTs, DGs, and job aids, and encouraged the group to think about ways the EM products meet their railroad's training needs.

The next activity was a facilitated demonstration of the *New to Management* DG, which covered various tasks and responsibilities that managers might face on the job. A skilled facilitator led the group through real-life scenarios and asked the participants to respond to different challenge questions based on each scenario. After each participant responded to the challenge questions by themselves, there was a facilitated discussion about their responses, ensuring everyone shared their answers. The DG included Expert Tips that a real expert provided for that scenario. The DG followed this sequence (scenario → challenge → expert tips) until the game's completion.

The team wrapped up the on-site visit with a feedback session to understand the group's thoughts on the usefulness of the EM products in their organization.

3.4.3.2 Anacostia Rail Holdings

The team piloted a virtual Decision Game demonstration on January 18, 2024, with four safety leaders from Anacostia. One participant was an expert who had participated in the interviews with the team.

First, team members explained EM history and its purpose to help organizations recognize where the expertise lies in their organization and where it is at risk of being lost. The team then discussed CTA and its purpose to help the experts articulate what they know.

Team members described the DG structure and the group facilitation, which included individuals developing their own responses, going around the virtual room to share their responses, and participating in the facilitated discussion among the group.

The first facilitated DG was the *New to Management* DG. After a short break, the team moved on to the second DG, *Leadership Impact Skills*. Ample time was left at the end of the demonstration for group feedback.

3.4.3.3 Amtrak MW1000 Training Class

The team worked closely with Amtrak MW1000 technical trainers to review and identify sections from each DG that would be useful in one of their upcoming training courses. The team sent participants the DGs with links from the instructor side, as well as a spreadsheet with each section from all the DGs, so they could indicate which sections were relevant to their training goals. In the spreadsheet, Amtrak's team wrote "1" next to a section if they wanted to include it and "2" next to a section if it was relevant but required small modifications to better suit their MW1000 class (a class for training track foremen). The purpose of this process was to focus the content and remove anything that was extraneous to their immediate training needs.

After discussing which of the existing DG sections pertained to their MW1000 class, the team reworked the DG to create a new, modified game that combined their chosen sections. The updated DG was sent to the Amtrak trainers for their review, and they returned their comments

with edits. To accommodate their course specifications, the team again modified the DG, then met to make final edits and ensure the DG was ready for pilot implementation in their upcoming MW1000 training class.

On February 6, 2024, the team traveled to Trenton, New Jersey, to facilitate the customized DG with 13 Amtrak employees (11 students, 2 instructors) in the MW1000 training class.

3.4.3.4 EM Workshop

On February 27, 2024, the research team delivered a day-long workshop, *Expertise Management Workshop for Safety Leadership Positions in the U.S. Railroad Industry.* Open to the industry-at-large, the workshop was coordinated with FRA to tailor the materials and develop an initial list of invitees for a snowball outreach approach. In the workshop, the team welcomed 27 safety leaders, trainers, and researchers who joined for part of or the workshop. The workshop was recorded.

During the workshop, team members introduced the EM approach, the tools and products that support it, and demonstrated the usefulness of the products developed. Concluding the workshop, a panel of transportation safety leaders, researchers, and practitioners explored the role of emotional intelligence in safety leadership expertise, as these critical impact skills are at risk of loss.

4. Findings, Outcomes, and Stakeholder Feedback

This section presents the findings and outcomes derived from the qualitative analysis of information and data gathered during the interviews and stakeholder engagement process. These findings and outcomes help shed light on various aspects of succession planning from a knowledge management and knowledge transfer perspective. Additionally, they highlight important implications and the potential impact of the project on industry practices.

4.1 Summary of Formative Evaluation Findings and Key Stakeholder Feedback

The five questions that guided the formative evaluation and stakeholder feedback on each are discussed in this section.

1. To what extent are industry stakeholders interested in the EM Framework?

Most participants expressed interest in the EM Framework, recognizing that the nature of many railroad jobs, positions, and tasks are highly complex in nature with critical technical skills sometimes held by only one or a few individuals. These critical skills often involve knowledge that exists only in the minds of workers and not otherwise articulated or documented.

In addition, a lot of routine tasks conducted by many foreman and safety leaders, such as Roadmaster and Trainmaster, involve a complex understanding of railroad system dynamics (i.e., the interactions between the people, equipment, infrastructure, environment, and the broader community and railroad industry). Knowing who to go to for the right information, how to engage with them when needed, and being able to regulate one's emotional reactivity to constantly changing pressures and stressors of the job requires a broad range of social and emotional skills to perform these jobs well. The social and emotional skills needed for building authentic, trusting, and respectful relationships are increasingly recognized as not only foundational but critical for safety, efficiency, and productivity.

2. In what ways can the EM products be improved?

Because this was a pilot demonstration project, there was limited opportunity to demonstrate the full range of the products developed, with most of the demonstrations focused almost entirely on the DGs. Improvements for each products type are discussed below.

Decision Games. DGs are among the most valuable products that come out of applying the EM Framework and were recognized by participants as having considerable training value. Suggested improvements to the decision games focused mostly on creating bite-sized chunks, or scenarios, that can be more easily applied in different settings on a regular basis, such as weekly or monthly meetings, that don't require additional training time. Looking at how, when, and where to infuse DGs into existing organizational practices would provide high practical value.

Job Aids. Two job aids were developed as part of this study, Technical Locomotive Repair and Electrical Locomotive Repair. The job aids are straightforward to use, but creating digital/editable versions will make them more useful and applicable in different contexts.

Expert Content. The main improvements suggested by stakeholders to expert content were to expand the content that has already been captured in the interviews and to make it more easily updateable (i.e., like a wiki).

Decision Requirements Tables. Although the DRTs developed for this project were not demonstrated, there may be considerable potential value to trainers who are interested in applying the EM Framework in their organization, especially if the organization has well-qualified trainers. DGs that are updated over time can be used to evaluate on-going training programs.

Stories. Stories captured through the interviews were also considered rich with detail, especially for those positions considered as single points of potential failure. Improvements suggested to this product category were to capture more of them. Each of the stories were reviewed by the interviewee for accuracy and suggested improvements were incorporated into the finalized version. Some interviewees were more thorough in their review of the stories than others. One interviewee commented that his story needed considerable work but he did not have the time to make the needed changes. Others accepted their stories will little to no feedback.

In general, each of the products described above can be customized for specific jobs, positions, tasks, or activities in railroad operations depending on the high priority needs of the organization for targeted users (the two job aids are good examples). Also, many opportunities exist for how expert content and stories collected from individual interviews can be customized. For example, some suggested using the recordings of the expert's voice in classroom settings, because the expert was so clear in his presentation of complex information so that even a novice could understand it. Likewise, The DRTs offer numerous opportunities for customization by training experts who can incorporate that content into existing training programs as needed.

3. What are the potential uses of EM products by the participating key stakeholders?

Stakeholders discussed the potential uses of each EM product type developed for this project.

Decision Games. DGs can be delivered in-person by a facilitator and/or an expert during training sessions or introduced as a self-serve activity to supplement training, incorporating the full DG scenarios into existing classes and training programs. Shorter versions of the decision games can also be created for discussion purposes during regularly scheduled meetings and events.

Job Aids. Job aids can be implemented into the organization in whatever format is most beneficial to them. For example, they can be put on an employee's clipboards, laminated, and posted throughout physical workspaces, and/or introduced into training during onboarding.

Expert Content. Organizations can deliver the expert content as stand-alone content or carve out pieces of the material to augment existing training.

Decision Requirements Tables. DRTs can augment existing training and sensitize learners to the cognitive elements required to perform specific tasks.

Stories. The expert stories are the basis for the DGs; however, they can also augment existing training. Students are more likely to remember information when it is presented as a story and multiple opportunities are created for distribution of the stories throughout training sessions.

4. What are some roll-out strategies, immediate and future, for the EM Framework/products?

See Section 2.4.2 for detailed roll out strategies.

5. *What are the lessons learned from the EM demonstration project to inform further development and roll-out of the EM Framework?*

During review meetings, stakeholders asked clarifying questions, provided input, and discussed their feedback. After larger events, such as the webinar and the Anacostia demonstrations, the EM project team posed a few specific questions to the stakeholders, focusing on the potential use of the EM products at their railroads. The following themes emerged as highlights from the stakeholders:

- Many [78% (n=18)] considered being a "trainer" as part of their railroad job and found the EM products to be relevant to their work.
- Most [88% (n=21)] affirmed that succession, or loss of expertise, is an issue of concern at their railroads.
- Many [70% (n=17)] indicated they would recommend the EM approach or its products to other railroads, based on their demonstration experience.
- Multiple comments discussed the importance of non-technical skills, specifically emotional intelligence, on the job/at work.
- Suggestions for further development of the EM Products included the incorporation of visual aspects, such as visual job aids and video-based scenarios.

In addition, stakeholders expressed encouragement and support for the EM approach after their demonstration experience, particularly in the context of expertise loss. Some comments include:

"We've had five compliance program managers in four years. Turnover is real and our subject matter experts are aging out. How do we capture the lessons learned in 20 years of wrestling in the mud without tossing new managers in the pit without any preparation? This is beyond the scope and abilities of one railroad ... this is industry-wide." *– Senior Leader, 19-years railroad experience*

*"*The knowledge of the leaders getting ready to retire needs to be passed down." *– Manager, 11-years railroad experience*

"Anything that provokes thought in new managers and staff is helpful. The more real-life scenarios that promote this thought process, analysis, and feedback is a positive development tool." *– Senior Leader, 32-years railroad experience*

"Being able to get students to engage and think about deeper, underlying causes of actions." *– Trainer, 17-years railroad experience*

5. Lessons Learned

This section presents practical challenges as the primary form of "lessons learned" emerging from the project experience. These lessons learned can be very large or small in scope and can cover a wide range of topics. Most importantly, they capture a shift in understanding about an activity or process and provide new learning for ongoing or future programming.

5.1 Practical Challenges for Knowledge Identification

5.1.1 Understanding Expertise

Amtrak and ASLRRA identified their own interview candidates. Knowledge identification can often be this straightforward because managers and colleagues typically know the experts in their organization. The suggested candidates were suitable for demonstrating EM. That said, in executing a full EM approach, knowing the characteristics of experts can help identify targets for EM activities. These characteristics are detailed in the EM Framework, along with an approach for calculating the risks of lost expertise (see Appendix C).

5.1.2 Recall

Some of the identified experts were trainers or consultants who had not performed operational tasks for over 10 years. Although these interviewees had significant experience, it is preferred to identify interviewees still practicing their roles. It can be more difficult for interviewees to recall and recount instances when they are farther removed from them, and it may not be clear moving forward that deeply historical experience will be useful for the organization moving forward.

5.2 Challenges to Achieving Expertise in the Rail Industry

The CTA interviews, as well as content captured during the interviews, revealed some barriers to achieving expertise in the railroad industry. These barriers include the following:

- Challenges in working with technology
    - Computers not only get in the way of developing deep understanding because people don't put their hands on things or see things up close and personal, but also because they can hide or mask data, especially dynamic data that show fluctuations (e.g., only show start/stops or averages).
    - Junior staff haven't 'grown up' with the technology, so they don't understand what they might be missing or other ways things might work.
    - Experience with older systems is never handed off because of the implicit assumption that new systems are coming online, even though the older systems remain in operation and in some cases serve critical functions.
- Challenges to gaining experience
    - Junior staff may not get opportunities to work on the more difficult or interesting problems and/or may get segmented into completing only tasks supporting production.

    - Junior staff may not significantly overlap in schedule with experts and thus miss the opportunities to shadow them.

- Challenges introduced by organizational structure
    - Motivation to become an expert may not exist and the organization may do nothing to encourage it.
    - People from different departments may not have enough cross-departmental knowledge to understand how certain things affect others.

5.3 Practical Challenges for Knowledge Capture

5.3.1 Time Constraints

The initial goal of this research was to interview four experts for 24 hours each. The team has found that this level of interviewing provides both a broad and deep view of one's expertise. Given the operational needs of rail partners and the demonstrative status of this project, the team spent less time with each expert but also interviewed more experts in the actual research. Although not as much time was spent with each expert as originally planned, the breadth of the topics provided an advantage for demonstrating the broad applicability of the overall approach.

CTA interviews typically last from two- to four-hours for a single task or incident. However, because experts' time is valuable and limited, one of the biggest challenges for the Knowledge Capture stage is pulling experts out of work to spend time in interviews. Interviews can also be interrupted because the expert is needed on the job. Committing to CTA interviews is a huge time commitment for the expert and the organization. In this project, the most amount of time spent with a single expert was 7.5 hours across five interview sessions.

5.3.2 Location

In most EM projects, face-to-face knowledge elicitation is preferred because it is easier to build rapport and beneficial to see the expert in their element. However, in-person interviews and observations are not always feasible, mainly because of costs. In addition to the onsite interviews noted above, the team also traveled to Aberdeen Carolina & Western Railway in Candor, North Carolina, for a demonstration and an equipment tour. These onsite visits were valuable for gathering additional insights and context about the organizations, insights that internal EM teams would likely have as an advantage over this demonstration effort.

5.3.3 Expert Review

Ideally, all Knowledge Transfer products should be reviewed by the experts who provided their expertise. All products should be marked as "Draft" until the experts are able to review the content, and their comments should be incorporated as appropriate. It is also important to expect that experts will vary in the degree to which they provide feedback. In this project, some experts did not spend an extended amount of time reviewing the content, while other experts wanted to edit some of the content for one reason or another. Iterations added more time to the product development process, but getting products "right by the experts" is a key to success. Managing this process was limited in this demonstration effort.

5.3.4 Scope

When engaged in an EM effort, there is always another incident that could be captured, always another aspect of the expert's experience that could be explored. Often, EM engagements end for practical reasons, especially because the expert must get back to work (Moon et. al, 2015). It is impossible to capture everything an expert knows in a few interviews. This demonstration project was not intended to be comprehensive, although the practical but premature closure of topics with some experts likely left significant expertise unaddressed.

5.3.5 Identifying At-Risk Expertise

Typically, the EM process is top-down regarding at-risk expertise. An organization identifies a high-need area, and the interviews target expertise pertaining to that specific area. For this effort, the key stakeholder railroad organizations selected the experts, and the team used a bottom-up approach, starting with the experts and moving to topics they suggested. This project did not perform a formal process for identifying their organizational at-risk expertise. Tools and processes that can support such an approach can be found in the EM Framework.

5.3.6 CTA Limitations

Conducting high quality CTA interviews requires a skilled interviewer. While the methods provide guidance in the structure and appropriate questions to ask the expert, it takes time and practice to become skilled at knowledge elicitation, which is a limitation of the EM approach.

CTA comprises a set of retrospective interviewing techniques which carry well-known limitations of memory. It can sometimes be difficult for experts to recall and recount instances when they are many years removed from them. That said, it is also well known that expert performers tend to carry strong memories of their biggest successes and failures. In fact, experts often recall the failures so well because they have spent significant cognitive effort in figuring out how to avoid them in the future.

5.3.7 Liability, Confidentiality, and Other Sensitivities

It is helpful to audibly record interviews; however, the interviewees and/or management may have concerns about the confidentiality of such data collection. The team addressed audio recordings early in the project so everyone agreed on moving forward. There were a few topics that the interviewees preferred not to explore. There may be additional sensitivities that should be addressed prior to the interviews, including labor matters. It is important to be aware of and track these matters throughout any EM project.

5.3.8 Artifacts

Some experts shared first-hand products with the team. For example, one expert shared their desktop with researchers to see diagrams and Google Maps of their main yard to explain a track reconfiguration project. Documents, pictures, videos, and other artifacts help enrich the Knowledge Capture process; however, these items were not always available to the team.

5.3.9 Formatting

The EM Framework does not provide formatting recommendations for products. The team created the DGs in Google Forms as a way to broadly share the product's utility; however, it is

preferable to facilitate the games in person. Google Forms offered the ability for trainers to see how individual trainees responded, if trainees use the recording feature. DRTs can be used as both an analytic and data collection technique. For this project, the DRTs were a useful analytic product, but they alone do not provide a clear pathway for their use as a training product.

5.4 Practical Challenges for Knowledge Transfer

5.4.1 Generalization

Throughout the Knowledge Transfer stage, the team reminded stakeholders that this was a *demonstration* project. The draft products were not designed to fit any organization's specific needs or be comprehensive training materials. Rather, the products were created to show the potential for implementing the EM process and EM products into an organization.

5.4.2 Time Constraints

Railroaders have busy schedules. Some railroads do not have enough staff to allow for a group to be pulled out of service for basic training, let alone a demonstration project. In addition, staff are only willing to dedicate so much time to participate in training outside of their work duties. The research team was fortunate for and appreciative of the time the partner rail organizations provided.

5.4.3 Applicability

Because railroads range in scope and responsibility, it was difficult to identify where the skills and knowledge that were captured fit into the larger industry picture. It was challenging to create products that were applicable sector-wide (e.g., specific references from organizations had to be generalized). Researchers worked within organizations but looked for industry-wide benefits, which posed the challenge of making content generic enough for the problems any railroad might face and still provide a valuable training experience.

5.4.4 Demonstration Opportunities

While the team produced deliverable training content, it was unclear from an outsider's perspective *where, when, and how* to introduce the products within the industry and in particular organizations. Without insight into existing organizational and industry training content, it was difficult to pinpoint where the products might be most useful. Some stakeholders noted that organizations may be reluctant to modify their training materials with outside content. Therefore, researchers had to walk a fine line to avoid overlapping with existing training programs so as not to create products or tools that organizations already had or otherwise would not use. It is presumed that implementing an EM approach from within an organization would likely not involve this challenge.

5.4.5 Customization

DGs are generated from real-life stories. To customize the content for individual training groups, the team amalgamated and modified sections from multiple DGs into a cohesive game. For example, some scenarios fit Amtrak's MW1000 training goals, but the challenges went beyond what would be expected of their employees. The research team reworked the scenarios in a way that made sense for their training purposes but did not stray too far from the original story. This

required going back and forth with the trainers to modify the game to best suit their needs, which took additional time out of their already busy training schedules.

5.4.6 Facilitation

One barrier to implementing DGs can be the lack of a skilled facilitator. Some people just do not have the skills necessary to run an effective discussion. Participants get more out of the DG when they think by themselves then discuss their responses as a collective group. The learning value is often in the interaction, so having a skilled facilitator is critical.

6. Conclusion

This report investigated the challenges posed by the imminent departure of a highly experienced workforce within the railroad industry, specifically in safety leadership roles. The EM project, a collaborative initiative funded by FRA, has demonstrated that strategic knowledge capture and transfer using the EM Framework can be useful in mitigating the risks associated with the loss of such critical expertise.

High-level takeaways

- In this demonstration project, the EM Framework uncovered the tacit knowledge of seasoned employees, which is often not captured through traditional documentation.
- CTA methods were invaluable in discovering the intricate decision-making processes and the internalized expertise of safety leaders.
- The EM products, including decision games, job aids, and expert content, were demonstrated for transferring knowledge and received positive feedback from stakeholders for their potential utility in existing training and operations.

Lessons Learned

- The criticality of "single points of failure" was highlighted, where knowledge resided with just one or a few individuals, reflecting the dependency on those individuals with unshared expertise.
- There was a clear recognition of the need to balance technical skills transfer with non-technical, leadership impact skills such as emotional intelligence and conflict management, which are vital for leadership roles.
- Effective knowledge transfer requires active engagement from both experts and learners, highlighting the importance of skilled facilitation in training scenarios.

Implications

- Institutions within the railroad industry could adopt and tailor the EM Framework to their specific needs, ensuring a continuous flow of expertise within their organizations.
- Cross-training programs that support succession planning with the EM approach could be prioritized to address concerns with single points of potential failure within critical safety roles.
- Further FRA investment in the development of EM products may be worth considering, ensuring training is relevant to the evolving challenges and technologies in the railroad industry.

Next Steps

Next phases for implementing the EM Framework more broadly in support of workforce development initiatives could include:

- A broader implementation of the EM Framework across different segments of the railroad industry to test its adaptability and scalability

- Development of a structured “train the trainer” program to expand the cadre of professionals who are adept at using EM tools and processes
- Continued collaboration and customization of EM products to integrate into the existing training curricula of various railroads
- Exploration of digital and virtual reality technologies to enhance the EM product suite, making it more interactive and accessible

In conclusion, the EM project has laid a robust foundation for the preservation and dissemination of critical safety knowledge in the railroad industry. The continued evolution of the EM Framework and its products is important to ensure the industry's preparedness to cope with the imminent generational transition and to maintain the highest standards of safety and efficiency. Further studies may want to focus on how these tools could be integrated into the broader industry, considering the unique challenges and opportunities presented by different railroad operations.

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Appendix A.
Complete Review of EM Products

Expertise Management for Safety Leadership Positions in the U.S. Railroad Industry – Appendix A

Expertise Management Products

Prepared by TrueSafety Evaluation, LLC, and Perigean Technologies

Expertise Management Products

EM Product Overview

Product	Description	Content
Decision Games	Based on stories captured in the CDM interviews, Decision Games place the learner in a particular role and ask them to make a decision, take an action, or prepare a product as if they are the expert. The games provide learners situational experience to think like an expert in complex and uncertain circumstances. The learner receives feedback based on the expert's decisions in real life. There are several ways to implement Decision Games. They can be delivered in-person by a facilitator and/or an expert during training sessions or introduced as a self-serve activity to supplement training.	We developed 8 original Decision Games: • A Day in the Life • New to Management • Impact Skills • Rollout • Roadmaster • Electrical Repair • Mechanical Repair • Derailment In addition, working with Amtrak's Technical Training group, we reworked sections from multiple Decision Games to create a customized game for a MW1000 track foreman training course.
Job Aids	Job aids provide a cognitive guide for challenging tasks or process with expert strategies and details to pay attention to. Job aids can be used by novices and advanced professionals. Job aids can be implemented into the organization in whatever format is most beneficial to them. For example, they can be put on employee's clipboards, laminated, and posted throughout physical workspaces, and/or introduced into training during onboarding.	We developed 2 job aids: • Technical Locomotive Repair • Electrical Locomotive Repair
Expert Content	Based on knowledge captured during the CTA interviews, expert content provides a deep dive into a given topic. They contain more information than a cursory review of a topic, particularly details that are not widely known within the organization. These details include history, technical knowledge, and things novices tend to miss. Organizations can deliver the expert content as stand-alone content or carve out particular pieces of the material to augment existing training.	We transcribed 14 pages of expert content on Vehicle/Track Interaction.
Decision Requirements Tables	Decision Requirements Tables (DRTs) extract, organize, and analyze the key elements of expertise that were captured in the CTA interviews. DRTs can augment existing training and sensitize learners to the cognitive elements required to perform particular tasks.	We identified 64 critical decisions across topics and tasks.

Product	Description	Content
Stories	The CTA interviews captured stories about expert's experiences that were particularly challenging. Expert stories are effective for training real-life problems. Students learn about complex cases directly from the expert, giving them a sense of the cognitive skills required to perform effectively in difficult situations. The expert stories are the basis for the Decision Games; however, they can also augment existing training. Students are more likely to remember information when it is presented as a story and distributed throughout training sessions.	Our practitioners captured over 60 detailed stories across various topics.

Decision Games

Decision Games place the learner in a particular role and ask them to make a decision, take an action, or prepare a product as if they are the expert. The games provide learners situational experience to think like an expert in complex and uncertain circumstances. The learner receives feedback based on the expert's decisions in real life.

There are several ways to implement Decision Games. They can be delivered in-person by a facilitator and/or an expert during training sessions or introduced as a self-serve activity to supplement training.

You can access the Decision Games as a learner through the link below:

https://perigeantechnologies.com/fra-dashboard#

A Day in the Life Decision Game

It's a Wednesday. The week has been relatively quiet for you and your management role.

Just as you sit down to check your email, the phone rings. It's your supervisor. So much for the relatively quiet week...

* Indicates required question

1. **Email** *

Personal Relationships

A train crew has gone past a red signal. Your supervisor sends you to the site to investigate the incident. There were three people at the head end of the train, three people at the rear end of the train, and a heavy train in between the two.

Two of your friends were at the head end of the train. You have them write statements and ask them what happened. One of your friends, the local chairman, tells you it was his fault because he didn't tell the crew that there was a red signal. He takes the blame for not stopping the train in time, and he signs the paperwork confirming he is guilty.

After collecting the statements from the head of the train, you pull the local chairman out of service. As a result, he cannot work for at least 15 days. You send him a letter confirming his charges, and you call him to sign the paperwork. However, he avoids your calls because he goes on a 12-day vacation.

When he returns, the local chairman tells you, "I can't lie to you anymore. It was not my fault that the train passed the red signal." He reveals that there were three other workers at the rear end of the train who caused the incident, but one of them had previously gotten in trouble, and the local chairman was protecting him from getting fired.

The local chairman confesses that he screamed on the radio for the rear end to stop pushing the train; however, since 10 days have already passed, you cannot investigate the incident any further. To make matters worse, your boss tells you that you are gullible for believing your friends' statements.

Challenge

What could you have done differently to avoid this situation?

Your response should include what you could have done differently and the reason why you are including it.

2. **State what you could have done differently and the key reason why you are including it.** *

Expert Tips

These are recommendations from an expert:

1. Get statements from everyone in the area, rather than believing your friends immediately.
2. Even if someone did not see anything, have them fill out a form saying so.
3. Look at every angle and ask as many questions as possible.

3. **Do you understand the expert tips?** *

Mark only one oval.

- ◯ Yes, I understand and don't need more information.
- ◯ Yes, I understand, but I'm interested in learning more.
- ◯ No, I don't understand and feel like I need help with this part.

Culture Change

After handling the first issue of the day, you get a call that multiple employees have gotten injured at a particular terminal. Your organization wants to implement new safety approaches to decrease the number of injuries at the terminal and improve the overall culture. You are asked to come in and help the team.

You go to the terminal to investigate the problem. After talking to some of the hourly employees, you realize that they have little respect for the train master or their supervisors. The employees tell you, "They are just trying to get us terminated" and "They threaten our jobs and our livelihood."

Challenge

What is your recommendation for dealing with this situation?

Your response should include your recommendation and the reason why you want to include it.

4. **State your recommendation for dealing with this situation and the key reason why.** *

Expert Tips

These are recommendations from an expert:

1. Leadership is paramount. The supervisor has so much influence as far as how people work, what they do, and how they do it.
2. It is apparent that there is not a respectful relationship between the hourly workers and the trainmaster based on the comments the hourly workers made to you.
3. Replace the trainmaster.

5. **Do you understand the expert tips?** *

Mark only one oval.

- ◯ Yes, I understand and don't need more information.
- ◯ Yes, I understand, but I'm interested in learning more.
- ◯ No, I don't understand and feel like I need help with this part.

Replacing the Trainmaster

You know that the leadership is inadequate at that particular terminal. You have a conversation with the Vice President of Operations about the situation, and you both decide that it is in everyone's best interest to replace the trainmaster.

Manufacturing Error

You feel confident about your decision to replace the trainmaster. Just as you wrap up a difficult conversation with your VPO, a foreman tells you that there is a problem with an entire locomotive fleet.

Throughout one of your locomotive fleets, the gear cases have a labyrinth seal. The seal holds in the gear case oil. Over time, it has worn through the bolts that hold the seal onto the wheel. The bolts cannot hold it, and the seal comes off the wheel, resulting in total failure of the wheel set.

The issue is brought to your attention after a 24 hour inspection in the pit.

When you go to look at the locomotives yourself, you immediately see discoloration. You jot down some notes about what you're seeing. The paint on the seal is gone, but it looks like a rainbow.

You continue to see discolorations across the fleet, and you share your notes with other mechanics. Throughout the day, people have reported total failures.

Challenge

What do you think is causing the discoloration?

Your response should include what you think is causing the discoloration and the reason why you are including it.

6. **State what you think is causing the discoloration and the key reason why you think that.** *

Challenge

What is your recommendation for next steps?

Your response should include your recommendation and the reason why you want to include it.

7. **State your recommendation for next steps and the key reason why.** *

Expert Tips

These are recommendations from an expert:

1. Heat comes from a lack of lubrication or metal touching metal, so it was an early indicator that something was wrong.
2. Send out a work order, saying the wheels have to be changed out if there is a discoloration.
3. Remove the discolored wheels from every locomotive in the fleet.

8. **Do you understand the expert tips?** *

Mark only one oval.

- ◯ Yes, I understand and don't need more information.
- ◯ Yes, I understand, but I'm interested in learning more.
- ◯ No, I don't understand and feel like I need help with this part.

Lessons Learned

You have completed A Day in the Life in your management role.

List three key lessons you learned from this case study that you can apply in future cases.

9. **State the first lesson you learned from this case study and how you will apply it in future cases.** *

10. **State the second lesson you learned from this case study and how you will apply it in future cases.** *

11. **State the third lesson you learned from this case study and how you will apply it in future cases.** *

New to Management Decision Game

You have recently been hired to manage a new operation. The owners know they've found the right hire, and they are counting on you to guide the early days.

* Indicates required question

1. Email *

Interviewing Applicants

Your first priority as the new manager is to build your team. Recruiting garnered some interest from the local community. As you receive applications for the **supervisor** and **mechanical** technician openings, it's clear that some people aren't qualified. You narrow the candidates down to six people who might be appropriate for the jobs, including three supervisors and three mechanical technicians. You schedule interviews with all of them to see if they are fit for the job.

Challenge

What are the top three questions will you ask the *supervisor* applicants to determine if they are suitable for the job?

Your responses should include the questions and the reason why you want to include them.

2. State the most important question you will ask the *supervisor* applicants and the key reason why. *

3. State the second most important question you will ask the *supervisor* applicants and the key reason why. *

4. State the third most important question you will ask the *supervisor* applicants and the key reason why. *

Challenge

What are the top three questions will you ask the *mechanical technician* applicants to determine if they are suitable for the job?

Your responses should include the questions and the reason why you want to include them.

5. State the most important question you will ask the *mechanical technician* applicants and the key reason why. *

6. State the second most important question you will ask the *mechanical technician* applicants and the key reason why. *

7. State the third most important question you will ask the *mechanical technician* applicants and the key reason why. *

Expert Tips

These are recommendations from an expert supervisor on interviewing job candidates:

1. Ask the interviewee to give you examples about specific instances from their previous experience.
2. A lot of people can say they know stuff, but when you ask them to tell you what exactly they did, it says a lot about their work.
3. Ask specific technical questions to see if the interviewee actually knows what they are talking about.
4. Make sure you consider hiring people with high-strength skills in certain areas in addition to people with all-around skills.
5. Hiring people is not only about their technical skills. Are the candidates are a good fit for the team? If they do not work well with others, reconsider hiring them.
6. You can mentor and train less experienced workers if they have ambition, morals, and personality.

8. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Initial Team Meeting

A week later, you finally have your team together. You feel confident in your hires, and you arrange to meet with the entire team for their first day on the job. As everyone comes in, you notice some people already know each other. Others are new to the industry. It's your job to introduce the team and set your expectations.

Challenge

What is your goal for the initial meeting?

You response should include your goal for the meeting, what you will say to your new team, and the reasoning why for both.

9. State your goal for the meeting and the key reason why it is your goal. *

10. State what you will say to your new team and the key reason why you want to say that. *

Expert Tips

These are recommendations from an expert supervisor on conducting an initial team meeting:

1. Ask everyone to introduce themselves and share their background so the team can understand everyone's strengths and weaknesses.
2. Set your work and culture expectations from the start.
3. Explain the operation's goals and the timeline for starting service.

11. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Dealing with a Hot-Headed Employee

Three weeks in, the operation is going smoothly. You are happy with your employees, but you are slightly concerned about one in particular.

You hired one of the mechanical technicians with some reservations. His previous manager said he was a great mechanic but warned you that he could be a hothead sometimes. You needed a solid mechanic, and you felt confident that you could handle his behavior. Within the first few weeks, you noticed his irritability, but it wasn't a major problem.

You witness his anger culminate as you walk through the shop today. While working on a locomotive with an electrical problem that is difficult to trace, he gets aggravated. He yells a cuss word and throws a wrench across the shop.

Challenge

What is your recommendation for dealing with this situation?

Your response should include your recommendation and the reason why you want to include it.

12. State your recommendation for dealing with this situation and the key reason why. *

Expert Tips

These are recommendations from an expert supervisor on dealing with an employee in this situation:

1. Ask the employee to step away and take a walk.
2. After the employee cools down, tell them it is okay to get frustrated, but it is not okay to cuss and throw things.

13. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Ignoring the Rules

As the manager of the operation, you see a lot of things from across the yard. You start to notice some inconsistency between the rules and what the workers are doing. For example, the rulebook states that employees cannot get on and off moving equipment, yet you see people getting on and off moving equipment all day long.

You ask your employees, "Why are you getting on and off the equipment when your rule says you can't?" One of your employees responds, "I've been doing it this way for years. I don't follow that rule." In your experience, you know that practices are learned through word of mouth, and the less experienced workers will think it's okay for them to ignore the rule, too.

You go to your organization's Vice President and tell him what you're seeing. He says they changed the rule to allow people to get on and off moving equipment, but they never updated it with documentation. This whole situation isn't sitting well with you because it's your job to enforce the rules and ensure a safe operation.

Challenge

What are three things you can do to sort out this situation?

Your responses should include your options and the reason why you are including them.

14. State the option you have the most confidence in and the key reason you are including it. *

15. State the option you have the second most confidence in and the key reason you are including it. *

16. State the option you have the least confidence in and the key reason you are including it. *

Expert Tips

These are recommendations from an expert supervisor on dealing with rule inconsistencies:

1. When practices are inconsistent, it is important to update the rules structure and make sure everyone is on the same page.
2. You can put out a general order to change the rule. Be specific about when people can and cannot get off moving equipment.
3. If people struggle to get on and off moving equipment, train the employees in the field and evaluate how they move. Tailor training based on who you are working with, and have more experienced people help teach the trainees.

17. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Employee Disagreements

At this point, you feel like you're getting to know all of your employees except for one inspector. He's not very communicative with you or his coworkers. It's hard to get to know him because he keeps to himself, but he's great at his job.

When he writes up defects on the truck, the crew often complains that he is wrong. The crew thinks a lot of the defects are subjective. The inspector's feelings get hurt when the crew questions his authority and expertise, and it has been an ongoing issue.

Both the inspector and the crew report their frustrations with you, so you must address the situation.

Challenge

What is your recommendation for dealing with this situation?

Your response should include your recommendation and the reason why you are including it.

18. State your recommendation for dealing with this situation and the key reason why. *

Challenge

What is your biggest concern at this point?

Your response should include your concern and the reason why you are including it.

19. State your biggest concern and the key reason why. *

Expert Tips

These are recommendations from an expert supervisor on dealing with employee disagreements:

1. Try to understand why both sides are upset. Let each side know you will talk to both sides about the issue.
2. Not everyone has to agree, but people need to be able to disagree and still have a relationships.
3. Most of the time, when people come to you to talk, they are not looking for a response. They just want to tell you how they feel.
4. Let your employees know you are there to talk, and they can always come to you.

20. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Finding Cracks

Things are going well a couple of months into the operation. You've got the right team, and you're getting praised for your work from your employees and supervisors. You're feeling confident they made the right decision to hire you as manager.

Just when you're starting to feel like everything is under control, you get some unfortunate news. When you arrive at work in the morning, your Mechanical Manager informs you that someone found a crack on a passenger train's equalizer beam between a married pair during the third shift inspection last night. You know about another organization that experienced the same defect on a similar model train two years before, so you have an idea of the potential consequences.

You grab your personal protective equipment and inspect the train yourself. It's easy to see the crack, but you can't see the backside of the equalizer. Your entire fleet consists of 15 married pairs, so you are concerned about finding cracks on all of them. After inspecting the other 8 married pairs in the shop, you find another hairline crack on one of them.

Challenge

What are your top three recommendations for next steps?

Your responses should include your recommendations and the reason why you are including them.

21. State the most important recommendation and the key reason you are including it. *

22. State the second most important recommendation and the key reason you are including it. *

23. State the third most important recommendation and the key reason you are including it. *

Expert Tips

These are recommendations from an expert supervisor on handling cracks on a locomotive at this point in the situation:

1. Immediately remove the cracked locomotives from service.
2. Get your PPE and inspect the cracks yourself.
3. Tell the General Manager as soon as possible to keep them informed on the situation.
4. Inspect the entire fleet. Continue inspections every night.
5. Call the manufacturer and ask them to come look at the cracks.

24. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Talking to the General Manager

You decide to tell your General Manager about the cracks immediately. You have a round table meeting with her that morning. You brief your GM on the situation, telling her the crew found two cracks on two separate married pairs so far. You also tell her the crew is continuing inspecting inspections as the trains come into the shop.

Your GM asks you what you are going to do. She wants to know if you can continue operations and meet service requirements. She tells you to let her know when you have all the necessary information together, and you agree to meet again later in the afternoon.

Challenge

What are your top three concerns at this point?

Your responses should include your concerns and the reason why you are including them.

25. State your biggest concern and the key reason why. *

26. State your second biggest concern and the key reason why. *

27. State your third biggest concern and the key reason why. *

Expert Tips

These are recommendations from an expert supervisor on handling cracks on a locomotive at this point in the situation:

1. Remember you are dealing with passenger trains, and the safety of the passengers comes first.
2. The FRA could ground the entire fleet and put them out of service if they know about the cracks.
3. There are potential dangers when you hide information from the FRA. Truth and honestly go a long way when dealing with the FRA.

28. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Continuing Inspections

Your team continues inspections in the shop. They find another hairline crack. Your Mechanical Manager has expertise in manufacturing, and he says that the cracks are not as bad as they seem. He suggests putting a daily inspection plan together until you devise a solid plan with the manufacturer. You call the manufacturer with whom you are under warranty, and you ask them to come look at the cracks. It is the end of the week, so they cannot send their engineers until next week.

If anyone finds something that looks like a defect, they perform non-destructive testing with dye penetrant. If there is a crack on the married pair, the penetrant concentrates on the crack and illuminates where the crack is. Since your Mechanical Manager is familiar with this process, he puts together a standard operating procedure and disseminates it to the workers. You continue inspections as trains enter the shop.

Challenge

Do you think you should notify the FRA about the cracks in the fleet?

Your response should include your decision and the reason why you chose that decision.

29. State whether or not you think you should notify the FRA about the cracks and the key reason why or why not. *

Notifying the FRA

You have another meeting with your GM that afternoon. You inform her of your plan, which includes frequent and detailed inspections, dedicating a technician to inspect the cracks every night shift, communicating with the manufacturer, and removing cars with cracks from service.

You also tell your GM you think you should notify the FRA immediately. She says, "If they find the cracks, we should tell them, but I don't think we should tell them before that." She is worried that the FRA will ground the whole fleet.

Challenge

What are three uncertainties that are occurring to you right now?

Your responses should include the uncertainties and a strategy to address them.

30. State the first uncertainty occurring to you and a strategy to address it. *

31. State the second uncertainty occurring to you and a strategy to address it. *

32. State the third uncertainty occurring to you and a strategy to address it. *

Pushing Back

You push back. You are a little nervous because you disagree with your GM. You could lose your job if you tell the FRA and they ground the entire operation until it is fixed.

However, you think of the worst-case-scenario: a train could derail and injure or kill the passengers. You tell your GM about your previous experience with a different organization where you never lied to the FRA. You also have a friendly relationship with the FRA representatives in your area. In your opinion, they are level-headed and reasonable people.

Despite your boss' concerns, you call your FRA representatives and ask them if they have time to come to your property tomorrow. You tell them you want to show them something you found on your trains.

33. How confident are you in your decision to tell the FRA? *

Mark only one oval.

	1	2	3	4	5	
Not	○	○	○	○	○	Very confident

Expert Tips

These are recommendations from an expert supervisor on relationships with the FRA:

1. Be proactive and transparent with your plans (daily inspections, standard operating procedures, etc.)
2. Do not hide things from the FRA because they will likely find out one way or another.
3. When you are truthful and honest with the FRA, they are more likely to stay out of your business and trust you.

34. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

FRA Visit

The FRA comes to your site the next morning. You bring them into your office and tell them about your situation. You walk them through the timeline of events. You reference the other organization with similar train models and cracks.

You show the FRA pictures of the cracks and the standard operating procedures that you gave to your technicians to monitor the cracks. You bring the FRA to the shop floor and show them the cracks in person. You demonstrate the dye penetrant testing.

You tell them your plans to continue inspections and your ongoing communication with the manufacturer. Back in your office, you ask the FRA representatives, "Where do we go from here?"

They tell you that they are comfortable with your plan and to let them know when you get more information from the manufacturer.

Emergency Response

Just as the crisis seems to wind up, you get a call early the next morning that one of your company's tank cars containing liquid petroleum gas derailed and hit a pile of gravel. You are out of town, so you cannot get to the scene immediately.

The derailment occurred in a complex area. Passenger trains run at 79 mph along many tracks and crossovers, and it gets busy during rush hour times. In addition, liquid petroleum gas (LGP) causes a lot of concern among the locals. Years ago, there was another incident where an LPG rail car derailed, and your company signed an agreement with the fire department that you would dial 9-1-1 if there were any future accidents involving LPG cars. This particular derailment became a major public relations issue, a community issue, and a costly liability.

The emergency responders dramatically overreacted, sending over 100 individuals, multiple trucks, and several helicopters to the scene. The incident even caused an evacuation of the nearby neighborhood. You know there will be publicity surrounding the event, and your company's reputation is on the line.

Challenge

Who are the top three stakeholders you will contact to remediate the situation?

Your responses should include the stakeholders and the reason why you are including them.

35. State the most important stakeholder you will contact and the key reason why. *

36. State the second most important stakeholder you will contact and the key reason why. *

37. State the third most important stakeholder you will contact and the key reason why. *

Expert Tips

These are recommendations from an expert supervisor on stakeholder relationships in this situation:

1. Have strong relationships with the heads of the local police and fire departments.
2. Preparation prior to an incident minimizes the repercussions. Reach out to local emergency responders to train them on your operation and what to do in case of emergencies.
3. Coordinate with the Association of American Railroads to begin the hazmat plan, and call the hazmat response contractors to get the tank car back on the track and clean up.
4. Call your legal team to get in touch with the claims folks to speak with all of the businesses who were impacted.
5. Have a media team for situations like this.
6. Attend the neighborhood Town Hall meeting to answer any questions and comments from the community.

38. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Responders

The police department controlled the scene until they declared it was not a terrorist attack. However, they were not trained to assess the hazmat situation. Then, the fire chief became the authority when they got to the scene. Your company's head of mechanical, the hazmat contractor, and the FRA were responsible for assessing the damage.

It took the FRA approximately 6 hours to arrive at the scene. They operated under the assumption that this was an extremely dangerous accident. After inspecting the scene, the FRA told the emergency responders it was not a major incident. The tank cars' inner shell was not touched during the derailment, so they just had to get the train back on the track.

It took the hazmat contractor approximately 10 hours to arrive at the scene. After assessment, they agreed with the FRA folks that the incident was not a catastrophe. The contractor lifted the rail car and put it back on the track.

In most areas of the country, no one would hear about a rail car going off the track into a gravel pile. You are frustrated because the responders did not understand that this was not a severe emergency, and there are consequences for your railroad.

Challenge

What is your biggest concern at this stage?

Your response should include your biggest concern and the reason why you are including it.

39. State your biggest concern at this stage and the key reason why. *

Expert Tips: Building Relationships

Because of external pressure, you send out a public apology. You create an emergency response communication plan so the organization is better at responding to these types of situations.

You initiate a year-long process to build trust with emergency response teams, customize training, and work with stakeholders to eliminate unnecessary responses in the future. You bring in a safety train, which is a train made up of different types of tank cars and a classroom car, for training purposes. You get instructors from the Bureau of Explosives (BOE), who inspect tank cars around the United States at manufacturing facilities, to assist with training for the emergency responders. The BOE conducts a 101 Class on tank cars, including how they are constructed and designed, what happens if they are impacted, what happens if they are set on fire, mechanisms to avoid tank explosions, and damage assessment.

You reach out to the fire chief and invite his fire department to the railroad for damage assessment training. The fire chief says the fire department had not previously dealt with tank cars, and most of them do not have any training on it. They were competent hazmat responders but not in the railroad context.

As training continues, you notice that everyone involved is getting smarter and exchanging ideas. Growing relationships, finding opportunities to work together, and familiarizing everyone with emergency response benefits the fire department and your organization.

Main Yard Reconfiguration Project

You feel confident about managing the emergency response situation. Now you're gearing up a major reconfiguration project in the main yard. The current yard only has one way in and one way out. Anytime you need to land or depart a train, the whole yard shuts down. The objective of the reconfiguration project is to maintain continuous operations as trains are adjusted and moved. You are involved in the end-to-end management of the project. People rely on your expertise throughout the process.

The route from the west end comes from two Class 1 railroads where you get all your business. You have three tracks right in the middle of your classification yard where you classify cars (i.e., intermodal and oil trains) for local deliveries. Trains come into the classification yard, get switched around, put in order, and sent out to commercial customers.

The three arrival and departure tracks go right up the middle of the yard on 8,000-foot tracks. Anytime you need to depart or land a train, the whole yard shuts down. You want to be able to make multiple movements at a time.

The biggest constraint is the west end of the main yard. There is an oil water separator vault on the northeast side and storm water drains along the tracks. You cannot go further south because of wetlands.

Furthermore, the switches make the main yard a tough area to work. Your company typically lets your employees in the field determine the most efficient ways to work in the main yard; however, if management sees something concerning, they propose alternative solutions.

Challenge

What are the top three potential challenges that could occur throughout the reconfiguration process?

Your responses should include the potential challenges and a mitigation strategy to deal with each challenge.

40. State one potential challenge that could occur throughout the reconfiguration process and a mitigation strategy to deal with it. *

41. State a second potential challenge that could occur throughout the reconfiguration process and a mitigation strategy to deal with it. *

42. State a third potential challenge that could occur throughout the reconfiguration process and a mitigation strategy to deal with it. *

Expert Tips

These are recommendations from an expert supervisor on managing a major reconstruction project at this point:

1. Think of all the scenarios that could happen, including the problems and solutions for each.
2. Consider tracks, switches, types of trains, schedules, crossing blocks, degree of curvature, and derailments.
3. Ask yourself questions like, "If something happens here, how do we recover from that?" "Are we creating a bigger problem for something that may never happen?" "Will we block a major arterial?"
4. Use Google Earth and put yellow lines where the construction is being done to get a visual of the changes.

43. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Dealing with Outside Utilities

Because of your expertise, you help design the entire reconfiguration. Your higher-ups hire a consulting team to reaffirm your design ideas. You are the main person interacting with the consultants. You immerse yourself in the project, so you fully understand what the reconstruction entails and the necessary improvements.

The consulting team conducts interviews with your company. You give them your data and a model of the current operation. They walk around the main yard to map things out. The consulting team confirms that your company operates as efficiently as you say it does.

After the consulting team provides their recommendations for the design, your organization hires a design team through a different contract. The design team comes from a civil engineering firm. They receive the information from the consultants about where to put the tracks and the plans for improving operational activities. The design team surveys the main yard to ensure the engineering details are correct.

The design team is good at what they do, but they do not fully understand railroad operations. You feel responsible to get them up to speed and make sure they do not miss important details that have major effects.

The design team presents phases of the design to you, and you review them. You ask your employees who work in the field their opinions about each phase. You want to understand their challenges and make their lives easier.

Challenge

It can be difficult working with outside utilities who are not familiar with the railroad industry. What are your three biggest concerns?

Your responses should include your concerns and a strategy to address each concern.

44. State your biggest concern dealing with outside utilities and a strategy to address it. *

45. State your second biggest concern dealing with outside utilities and a strategy to address it. *

46. State your third biggest concern dealing with outside utilities and a strategy to address it. *

Expert Tips

These are recommendations from an expert supervisor on dealing with outside utilities:

1. Hold weekly meetings with your team and the outside utilities to get everyone on the same page. Get them up to speed on railroad operations.
2. Share important details that could have major effects.
3. Make yourself available for questions, and be understanding when the outside utilities might not know everything.

47. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Customer Service: Thinking Ahead

You cannot stop service during the reconstruction process. You still have to provide for your customers. However, there will be certain occasions when you have to shut down the yard for several days at a time. In order to minimize the impact of the construction shutdowns, you create a project schedule and plan multiple weeks ahead. You make it a priority to work closely with your customers and let them know how they will be impacted by the reconstruction project.

A frustrated customer gets upset that the project affects their business. He threatens that he is going to shut your company down. You call the customer to figure out his concerns.

Challenge

What are three strategies for dealing with frustrated customers?

Your responses should include your strategies and the reason why you are including them.

48. State the strategy you have the most confidence in and the key reason why.

49. State the strategy you have the second most confidence in and the key reason why.

50. State the strategy you have the least confidence in and the key reason why.

Expert Tips

These are recommendations from an expert on dealing with angry customers:

1. Listen to the customer's complaints and let them know you want to help.
2. Give the customers something in return, even if it is just your cell phone number or a listening ear.

51. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Surprise Visit

Since you took over management of the operation, there have been four derailments in a particular location with the same type of train from a railroad company. Crews have to shove the train into the yard because of the way the tracks are laid out. When the trains cross the segment of track with a sharp curve, they derail and take out a power pole. Because there have been multiple incidents, regulators have gotten involved.

The last derailment occurred two months after you became the manager. The area was out of service for three days. Two weeks later, you get a strange call from a representative from the railroad that just derailed at the location, saying, "Hey, does your inspector have time to meet me in the yard to talk through this and look at the track?" Your inspector is busy. You say, "No. Let me know what time, and I'll show up." They never call you back, so you decide to show up to the yard anyway.

When you arrive, you see operations and engineering people from the railroad company looking at your track. No one told you they would be there, and they are caught off guard when you show up.

Challenge

What is your biggest concern at this stage?

Your response should include your biggest concern and the reason why you are including it.

52. State your biggest concern at this stage and the key reason why. *

Expert Tips

These are recommendations from an expert supervisor on dealing with a surprise visit:

1. Establish that you are in charge and that they are on your tracks.
2. Say, "Anytime you want to investigate something on our tracks, you should let us know."
3. Conduct a safety briefing.

53. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Code Disagreements

The railroad company's top operations guy is there. He wants to categorize the derailment as an engineering/track issue with the FRA. You know that your tracks are in great shape, so you disagree with his assessment.

You realize the railroad company tried to get a lower level inspector, who might not be as comfortable pushing back to them, to meet them instead of you. They wanted to intimidate your employees and get them to report the derailment as an engineering issue. You tell them, "If you do that, there is going to be an issue."

They try to blame the frogs and the right curve for the derailment, but you show them the facts. It was a 17-degree curve and a number 9 switch. The entire yard consists of number 9 frogs and the same degree of curvature, so their argument does not hold. They are just throwing out scenarios to see if anything sticks. You talk to the railroad company's engineering guys, and they agree that their operations representative does not know what he is talking about.

Despite your disagreement, the railroad company submitted their report to the FRA citing track defects. You submitted your own report with a different cause code. You cite the train makeup code, arguing that the way the train came in was not conducive to the normal operation.

FRA Involvement

The FRA comes back and says there is a discrepancy between the owner railroad and the operating railroad codes. Although you do not know how this situation will play out, you want to prevent these derailments from happening again. You create an operational instruction plan and send it to the railroad company.

Challenge

What is one strategy to prevent this type of derailment from happening again?

You response should include your strategy and the reason why you are including it.

54. State your strategy and the key reason why. *

Operational Instruction Plan

To prevent these derailments from happening again, your organization talks with the railroad company to create an operational instruction plan. You also provide the railroad company track measurements and instructions. The plan says that no matter how long the train is that comes in, they will cut the train so the locomotive does not go past the curve.

The railroad incorporated the plan into their operating instructions. For now, your organization does not cross that road with any long trains because you do not want to risk another derailment.

Lessons Learned

You have completed the New to Management Decision Game.

List three key lessons you learned from this case study that you can apply in future cases.

55. State the first lesson you learned from this case study and how you will apply it in future cases. *

56. State the second lesson you learned from this case study and how you will apply it in future cases. *

57. State the third lesson you learned from this case study and how you will apply it in future cases. *

Leadership Impact Skills Decision Game

This Expertise Management Decision Game primarily targets Key Impact Skills for safety leaders: the foundational non-technical skills, abilities, and competencies, such as emotional intelligence, team-building, listening, communicating, and conflict resolution that are essential in building strong safety culture. This Decision Game is intended to focus on the following:

- Building trusting relationships with employees, fellow managers, customers, and contractors.
- Managing interpersonal conflicts that arise when dealing with difficult people.
- Valuing the importance of self-awareness.
- Regulating emotional triggers.
- Recovering from mistakes.

It also imparts key lessons about systems awareness, such as managing inventory, and strategic decision-making in day-to-day operations.

* Indicates required question

1. Email *

Your Role

As Vice President (VP) of a short line railroad, your role encompasses multifaceted responsibilities pivotal to efficient and safe operations. In addition to strategic planning and business development, your role demands agility in day-to-day problem-solving, decision-making, crisis management, and enabling swift responses to unforeseen challenges that may arise in the dynamic railroad industry. Ultimately, you play a crucial role in steering the railroad towards sustainable growth, profitability, ensuring compliance with industry standards, safety, and excellence in service delivery.

Some of your biggest challenges in your VP position are dealing with people–fellow managers, employees, contractors, railroad partners, and customers. Your customers have a huge impact on your operation. Managing the railroad's relationship with its customers is critical; customer service, planning and organizing your operations to meet the customer needs form a significant part of your job.
Negotiating and communicating who will be impacted by unexpected changes to daily activities can test your patience–and the patience of others. Deciding what you can move and when, schedule disruptions due to unexpected weather changes, or changes impacting your crew base can be challenging, especially for those people who are highly sensitive or overly demanding. This is a big part of your job. Every day there is a new challenge, and seems like every time the phone rings, there is a new problem that needs to be fixed. Yes, there are technical issues that need to be addressed, but often the solution involves how proficient you are when interacting with people.

The following scenarios highlight various impact skills used in different aspects of the VP job: 1) Organizing your new position, 2) Managing Customer Relations, and 3) Managing to Employee Relations. Learning objectives have been built into each scenario; these are reached with Challenge questions, a pause for discussion, Expert Tips, and Lessons Learned.

Organizing Your Initial Tasks as a Vice President

As you start this new position at a new-to-you railroad, you are confident knowing that you came up through the ranks from other railroads, as a craft employee and former manager.

During your interview process, you learned about some of the President's concerns and some of the big issues he was facing. You also spoke with other managers and employees to get their perspectives of the railroad and its current issues. With more than 20 years of railroading experience under your belt, including several years as a trainmaster and superintendent at a Class I railroad. You are confident in how to go about your new position as VP.
During your first day on the job, the President hands you a letter with a list of things that need to get fixed and informing you that your two main job priorities are Safety and Transportation. While the list contains a range of issues to be addressed, none of them seem urgent to you.

Challenge

2. Imagine you are in the position of VP.

How would you begin organizing your daily activities during your first several weeks on the job and why?

Expert Tips

1. You realize when you walk through the door of your job as the new VP you must present yourself and get to know everyone, get to know how they operate, and more importantly how this railroad operates.
2. Because you do not see any urgent items on the list, allow yourself enough time to first understand the systems, people, customers, and infrastructure at the railroad. Take some time to think through your decisions before jumping in.
3. Make a list of whom you want to talk to, how you plan to engage with them, and why.
4. Decide how you will increase your awareness and understanding of the system and its infrastructure, then plan your first few days and coming weeks.
5. Have a face-to-face with the President and explain that you would like to get to know the railroad's system during the first several weeks on the job, when there are no urgent issues to address. Demonstrate your leadership capabilities by explaining your plan to the President, and get his feedback and concurrence before moving forward. You want an open and trusting relationship with your new boss. Begin that process by discussing the importance of relationship building with your fellow leaders, company employees, customers, and contractors.

3. **Do you understand the expert tips?**

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Meeting a Major Customer

One of the first things you did on the job was tour the switching operations with one of your major customers. You met with the General Manager, who was an accountant, not a railroader, and with his right-hand man, Joe, who managed the railroad and "spoke the same language" as you. The three of you toured the property, and you learned early on that you will need to talk with the right-hand man in future communications, not the GM. He understood the operations and knew what was what.

Another thing you learned was that this customer never knows what they are going to need. You sat in their office for two days trying to understand their demands. One yard has to stay fluid because a big interchange comes in every day. Is there a way to bring the right cars for the right time rather than relocating "as needed" just to get them out of the way? This customer can't seem to tell you what they need or when they need it.

Meeting the Company Team

In those first few weeks, you also sat down with each of the managers, getting to know them and picking their brains on the railroad's operations. You understood their perspectives about the employees as well, such as who they go to or who they don't go to, and why.

Next, you did the same thing with the employees. Crews are going out to different locations to serve different customers. You spent time with the crews, learning the operations and getting to know the customers. You rode with the crews and helped the conductors. When you spoke with your conductors, you made sure to ask, "Do you need a hand with that?" Particularly in a union shop, you have to think before doing. You recognize that there may be Hours of Service issues doing craft work as a manager. A manager that runs a train as a locomotive engineer has to report those hours to FRA as part of hours of service that regulates that position. You also realize that you can't just jump in because you don't know how someone's going to react. Some guys don't have a problem, others do. You believe that spending time with company employees and leaders is a worthwhile investment that only helps you in the future as a leader.

You made a point to tell everyone that you are there to learn the operation, and to get to know each one of them. If they thought you were spying on them, you knew it would not start off well. When you saw someone doing something wrong, you decided to take a casual approach, as opposed to the disciplinary approach. You encountered a few relatively minor situations in your first several weeks, and each time you played it off as, "Oh, hey, you guys do that here?" Then, you followed up by saying, "I'd be best to do it the way we're supposed to. There's a reason the rule is the way it is."
You know that you aren't here to make friends. When it comes down to it, you will need to make hard decisions in your position that might not make everyone happy because it is your name that will be on any investigation conducted. If you can get the employees to understand you in your role, while showing care and respect for them, maybe they won't take decisions personally.

Challenge

4. What are your key relationship building strategies? *

Expert Tips

1. Assess a situation before jumping in, particularly in a new leadership position.
2. Begin trust-building relationships by getting to know people, understanding their role at the railroad, and asking how you can help/be of service.
3. Address employee safety rules violations as a learning experience for the employee, rather than immediately taking the disciplinary or punitive approach.
4. Show respect and that you care.

5. **Do you understand the expert tips?**

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Scenario: Managing Customer Relations

Developing Customer Relations - Steel Mill

Your largest customer, a billion-dollar steel company, has a major influence on your operation. You have rail cars specifically for this customer. Unlike Class I railroads, short line railroads need to be flexible, negotiable, reasonable, and provide a variety of special services that Class I railroads would not normally provide. As an example of these special services, your railroad will hold onto empty cars in your yards, waiting for the customer's daily requests.
Your railroad is not built to have mass quantities of cars sitting idle. Your crew leapfrogs across the railroad from west to east and east to west. You rely on having some track capacity to do every-day work, but unfortunately, the customer consumes most of the track capacity right in the heart of your railroad.

The Company Perspective

The customer has their own equipment. They order specific car types and quantities based on production numbers for each location they service. Your job is to manage the car orders. Once you submit a car order, the cars come to your location. Because the customer may not need the cars for several days, the cars start accumulating in your yard, eventually clogging your system. It's a daily event. The threshold for cars sitting idle on your property is typically 300 cars. Once you start holding over 300 cars, it's time to figure out what's causing the buildup.

You must manage those orders, look at your inventory, and look how cars are being taken in, which can be challenging and frustrating. What makes matters worse is that there are several times throughout the year when the equipment sits idle on the property. These occurrences are due to the steel company coinciding with the automotive industry. You make various handoffs across where these cars are staged, and it impacts your entire operation because the switching crews must handle more cars.

The challenge is negotiating with the customer about which cars they can take and when they can take them. The repercussions are numerous. The switching crews are handling more cars. As the car inventory goes up, your railroad's productivity goes down.

Sometimes the inventory of cars gets so overloaded that you come to a complete standstill. Extra crews are often thrown on just to take cars out of the mix and drag them to the middle of nowhere, because your customer simply refuses to take them. Your director of operations has been at the railroad for two years, so he's been through this. He says, "We are spending an awful lot on crews moving non-revenue equipment around." The problem is that you have to move cars around like that to survive. It's not productive, but it keeps your company afloat by servicing everybody else.

The Customer Perspective

The steel company has so many different vendors that they rarely communicate with you. The biggest issue is that they have no idea what they're going to produce in each day. When you sit down to talk to them about how much equipment they are planning for the week, their predictions aren't even close. You try to reason with them about when to expect their car orders, but the customer doesn't like being told they can't get their inventory.

Customer Relationship

Managing customer relations and the daily car requests can be frustrating; you do everything you can to be a good partner, and often the customer makes no effort. When you try to negotiate with them, it's often with their end in mind, and rarely a cooperative effort. They know they have leverage because you are the "little guy." You know you are in a good position because the customer keeps coming to you for business, but when things get screwed up, it can get ugly.

Morning Report

Every day, the IT folks at your railroad put together a morning report for you, so you can review the inventory of all your customers across the railroad. The report is very specific and demand-oriented. The customer sees the same report every day.

Typically, the customer sends car orders on Tuesday, and you wait to submit the car order until Friday. A separate company that manages the inventory orders the equipment. Your point of contact at the inventory company is a straight shooter. He regularly sends you spreadsheets with the car types and railroads. You have his cell phone number, and you often talk over the phone.

As was typical, at 10:00 am on a Tuesday morning, the customer sends you and your customer service team an email including information about the cars they want, why they want them, and when they need them. Customer service waits for you to give them the "okay" to order any equipment.

Car Order Issue

You look at the report to see where the cars are and to get a sense of the customers' needs. Today's report shows that there are currently 150 of the customer's cars that have been sitting idle on the property for 30 days. Then, you look at the spreadsheet the inventory guy sent you. This latest car order would take you over the threshold.

You call your inventory guy and say, "You're ordering more cars, but we have all these cars that have been sitting here that haven't moved. If I start ordering these cars, I need to know what you're going to be taking."

He responds, "I don't know why the customer ordered all of these cars," leaving you with little information to go on.

Challenge

6. Given the history and challenges with this customer, how would you respond at this point?

Expert Tips

1. Because the inventory guy isn't the decision maker, you need to reach the people who are driving the decision.
2. You don't want to throw the inventory guy under the bus, so you must be tactful about it to retain your relationship.

7. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Escalating Problems with the Steel Customer

Because your colleague was not very helpful, you forward the car order to his superiors. You have good rapport with some of those folks on the production side, so you send them an email with the message, "Do you have a minute to talk about this car order? The customer is ordering these cars, and I need to understand why you guys have such a large order. This will cause a big issue with our standing inventory."

One production guy emails back and simply responds, "We really need these cars. We've got 4,000 tons of steel on the ground."

Email Chain

You have a similar email conversation with four different folks on the production side. They are all pushing back; they want the cars ordered, regardless of the limited space. After going back and forth via email, they copy the person in charge of the steel production, but he doesn't respond.

You aren't getting anywhere over email, so you pick up the phone and call the General Manger on the production side, but he doesn't tell you anything different. You are getting limited and inconsistent information, so you let him know you are going to call the person in charge of steel production.
Going into the call, you already have an idea what the response will be. When these situations have come up, it's always been the same: He is unconcerned with the impact his operation has on yours. They are the customer, and he expects you to do whatever they request.

Asking for a Favor and Escalation

You decide to ask the steel production guy for help. He already knows why you are calling because he has been in contact with the inventory and production folks.

You say, "I'm looking for help because no one seems to be able to give us an answer."

Fully knowing why you are calling, he asks, "What is it that I can help you with?"

You say, "Here's the situation: We need to get rid of some cars because nothing is moving. Our railroad is coming to a standstill. We have already moved as much traffic as we can handle."

He responds, "Well, we need you guys to do this."

You tell him, "We've reached our capacity. There is nothing else we can do at this point. I've driven cars everywhere on the railroad to get them out of the mix to try to help ourselves. *You're still ordering cars that aren't moving!*"

The steel production guy says in a loud voice, "You just need to order the f***ing cars. We are the customer, and we're telling you what we need."

Challenge

8. What are your feelings and emotions at this point in the conversation? *

9. How might you calm your thoughts and emotions? *

Asking for a Favor and Escalation (cont.)

Your temperature goes up a little bit. You can't go off on your number one customer. It's a difficult relationship you must balance. Senior people in the railroad get involved a couple times a year because there are important decisions to be made when the inventory skyrockets. Back and forth negotiations occur, something you must get used to. You know there will be some handwringing, but you must go through the right channels when you are negotiating on behalf of the railroad.

You realize when you said, "You're still ordering cars that aren't moving" that may have come across as accusatory and was probably not the best tactic to take, so you decide to rethink your negotiation strategy.

You are frustrated that you even had to have that discussion with the steel production guy in the first place. No one wanted to make the decision, so they kept pushing it onto the next guy in the organization. Most of the time, you can deal with the rail guys and not have to go further up the chain of command.

Challenge

10. What is your de-escalation strategy to keep your customer engaged but not defensive?

11. Why do you think this strategy will work? *

Expert Tips

1. Talk to colleagues to get their perspectives.
2. Be aware what your senses are telling you, and reflect on that before reacting.
3. Notice when your body tenses up, and you are having strong emotions.
4. If emotions are getting out of control, take a few deep breaths and pause.

12. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

De-escalating Problems with the Steel Customer

At this point, you change your tone of voice to make your position clearer. You say firmly but in a lower tone of voice, "I appreciate that. I'm telling you what I can and what I can't do. What you're asking us to do right now is something I can't do."

You finally reach a point of de-escalation when you redirect and *ask for help*. You say, "What I need from you is to help me get to the point where I can do what you're asking me to do."

You start negotiating about what you can hold onto and what you need to send back. The cost of returning cars adds up quickly. This means the customer must write a check for cars that were ordered and not used.

Overall, the conversation lasts 10 minutes. You finally reach a point of recognizing each other's limitations and come to an agreement about what will work best for both businesses.

Challenge

What else can you do at this point to help de-escalate this problem with one of our most important customers, the steel mill.

Expert Tips

1. Acknowledge the customer's needs while at the same time expressing your concerns.
2. Redirect when needed.
3. Be firm, but respectful.
4. Stop ordering foreign equipment.
5. Cancel active orders.
6. Ship off any cars that are sitting on the property offline. This is an additional cost to the customer. Depending on how many cars there are, it can be over $300 per car to send each empty back.

13. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Managing Steel Customer Relations - Resolution

You tell the steel production guy that you will order the cars when you can handle the cars. You explain your situation firmly, but politely, and say, "We'll order the cars, but it's not going to be on your timeline. It has to be on ours."

You tell your customer service folks to hold off on the car order until the beginning of next week. You send the customer a car order confirmation, so they know it is processed.

Even after you make it clear what you can and can't do, the inventory folks keep calling your customer service every day asking if the cars have been ordered, but you've already made your position clear.

Challenge

14. What else can be done at this point to maintain customer relations, building open, positive communications and trust?

Expert Tips

1. Be understanding, but remain firm in your communications with the customer.
2. At times, it's acceptable to wear your emotions on your sleeve, without overreacting. It shows your passion.
3. If you can't maintain restraint, take a break, step outside, and ask for an opinion from a colleague before you lose control.
4. Keep a pulse on your employees' well-being. Watch how they react to their day-to-day activities.
5. When you make a mistake, have the courage to fix it.

15. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Scenario: Managing Employee Relations

New Manager Disagreement

You have a customer manager who is relatively new with only a couple of years at the railroad, having come to his job from the trucking industry. You decide to give him an assignment that will help him better manage the structure and flow of his department. Doing so should help him with an important strategic decision he is needing to make. He didn't necessarily agree with the assignment, but he didn't say anything to you about it at the time. Instead of talking through it with you, he ignored your suggestion and just didn't do it. As a result, his operation had a bit of a meltdown because your suggested change wasn't made. You felt frustrated because the change wasn't made, and it turned into a perfect emotional storm the next day.

You went down to his office and said that you needed to talk. During your interaction with him, you didn't handle it the best way you could have, and you said some things you probably shouldn't have said. His body language was clear. He made no eye contact, and he did not want to engage in conversation, which was uncharacteristic of him. When you asked him a question, he just gave you the answer and nothing else. You knew then that you had upset him, and you decided to leave and let things calm down.

Challenge

16. How would you handle this situation?

Expert Tips

1. Step back and think about what just happened.
2. Notice your sensations, feelings, and emotions.
3. Reflect on the things that you said or did that may have contributed to the emotional distancing you experienced from the manager.
4. Think through strategies for how you will attempt to resolve this situation.

17. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

New Manager Back on Track

After sleeping on it, you took a fresh look at the situation. You knew continuing that kind of interaction wasn't going to be conducive to a healthy working relationship. Based on the behavior and body language you observed the previous day, you determined that a different approach was needed.

You decided to check back in to make sure emotions were not escalating. You went back to his office and said, "Do you have a few minutes? I'd like to talk about this whole thing. I can see that you're upset about it." You told him a story about another experience where two people got into a heated conversation, with one person ripping the phone out of the wall and throwing it at the other person. They ended up running across the parking lot after one another. You said, "This is what happens when a person doesn't completely think through how to address an issue. I never want it to come to that with us." The story alleviated the tension, and the manager seemed more open to discussion and expressing his concerns.

You said, "I didn't handle this well, but I hope you can understand my frustration because we talked about it three different times. I didn't have the best patience with the way that things unfolded when we talked, and what happened because of it."

You apologized for how you addressed it with him because you should have handled it differently. You asked him to come talk to you when he disagrees with something you say or suggest, rather than waiting until something happens, because these kinds of problems can often be avoided when clear action strategies are in place. Your manager expressed his concerns in return, and you listened.

After that, you were able to develop a strong positive working relationship with your customer manager.

Challenge

18. Overall, what key strategies do you think were most helpful in resolving your conflict and establishing a real connection with this person?

19. What would have been the result if you had not been able to forge a strong positive working relationship with this new manager?

Expert Tips

1. Notice and observe your communication style with others, how you relate with your colleagues.
2. Notice and observe your internal sensations during communications with others.
3. Notice when you are sensing a change in yourself or with others. Identify your feelings. Name your emotions.
4. Develop a positive, engaging, and caring communication style that helps you relate and resonate with others, and builds trust.

20. **Do you understand the expert tips?**

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Managing Employees' Reactions to High Pressure Demands: Double Track Project

Part of your job as a VP is to manage major complex projects, as well as the people problems, that are often generated due to changes in employees' regular day-to-day operations, including planning, crew scheduling, training, and the like.

You have a major project going on right now that involves about 26 miles of double tracks being installed on the main passenger train service line that runs through your system. While the passenger railroad company can mitigate most of their disruptions by bussing around everything, your operations are directly impacted every day by what they're doing. Every week, you have strategy meetings to talk about all of the pieces of the project that are either reaching fruition or unfolding next. Since the beginning of the project, you've had to re-do your entire operation including the times that crews are working, what you're doing and when, and customer service schedules. You hope it's only a two-year project, but the feedback you're getting is an estimated two and a half years, unfortunately. It's already rolling into the next year.

When the second project phase started, you had to push back on certain elements of what could be done, because of how your railroad works. From a construction perspective, train operations or how your trains were moving were not being considered. Your decisions must be agile and flexible. Some track outages have been able to be worked around. Planning around those outages depends on what you can move and when, which customers are going to be impacted, and how your schedule is going to have to change.

Your greatest concern is the impact to your customers and your crew base. Crews typically work a regular early morning schedule, but now everyone is working afternoons and nights. Your entire operation has been turned upside down because of this project.

You're the one who must make decisions with the least amount of disruption. You know that your crew schedules won't improve until the entire project is done, and you've already lost employees because of the chaos. Your current crew base is very stressed and reaching a point where their patience is thin.

Challenge

21. Given the increased level of stress building up with the employees, particularly train crews, what would you plan to do, if anything?

Expert Tips

1. Think about ongoing system changes that are impacting employees and how you can help employees adapt to these changes.
2. Look for signs of stress that employees may be experiencing, like quick to anger or just not acting themselves.
3. Do what you can to accommodate employees' needs while still getting the job done.
4. Consider some efforts to show your employees how much you see and value their work and dedication.

22. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Dealing with a Frustrated Employee

You have an engineer/conductor who is rather boisterous, and quick to express his opinion on everything. Very rarely is he in agreement with what the railroad, the customers, or fellow employees are doing.

Your most recent interaction with him was on Friday. In the eyes of this engineer/conductor, he's been forced to take this job because of the schedule changes due to the double track construction project. Ironically, he has 20 years seniority and could have chosen other jobs that have a much better schedule, or he could work Monday–Friday on the day lines, but more work is involved in those jobs. For various reasons, either there's someone he can't seem to work with on one job, or he doesn't like the work that has to be done on another, so he chose to be on this particular job. He seems to enjoy playing the victim.

The crew gets the paperwork for their job, which includes the track list and any dangerous commodities that may have to be handled. A cover sheet is included with the work schedule outlining what's on every track, and the cars needed for the train, so that they have that reference of what their work will be for the day.

He's frustrated because the job that he's on already has a lot of work. By contract, you have two jobs that have three people on each job. This is one of those jobs, and because there's a lot of switching involved, the third person helps with efficiency by expediting the moves. On Friday, there was only one conductor and one engineer on this job. His regular engineer didn't work on that day, so it was just the two of them, meaning he had to work as the engineer instead of the brakeman, which he didn't like. As a result, he will be doing less physical work, because he went from being a brakeman on the ground to sitting in the seat as an engineer. He spent 15 minutes complaining about how long they had to work and all the work they had to do.

He said to you, "This is ridiculous, I can't believe you're making me do this. This is totally unacceptable." This escalated to the point where the President overheard the conversation in the crew office and stopped by to listen in. He just looked at you and rolled his eyes.
During the 15-minute conversation, you find out that his folks are coming the next day to join the family to watch the college football national championship game. In his mind, he expected to have a short shift, which would leave him time to prepare for his college football party. The revised work schedule ruined that for him, giving him all this work as well as a long shift. They were on duty at 1500, and with the amount of work to get done (and with only two of them), he was probably going to work 12 hours.

Challenge

23. What would you decide to say or do at this point, if anything, knowing that his family plans for the day will likely be disrupted?

Expert Tips

1. Acknowledge his disappointment in and his frustration with having his family plans disrupted at the last minute due to the schedule change.
2. Identify any changes you can make that will lessen the crew's workload and get them home sooner, or at least help mitigate the sting from the unexpectedly long shift and extra workload.

24. **Do you understand the expert tips?**

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Mitigation Strategy

This is an almost everyday occurrence with this individual. Knowing that, his response to the schedule change was not a surprise. You knew the bad news walking into the crew office, that he didn't have an engineer and it would be a two-person job. Customer service had already put together the paperwork.

You walked down there knowing you were going to be the one to break the news to him. You knew he wouldn't be happy. You knew you were going to get a negative reaction. You just had to plan for that reaction. He always throws curveballs, so that can make him a little challenging. Despite his reputation as a difficult employee, you have a lot of respect for him because he is a good employee. He's also very good with your new hires. He knows how to do his job, it just comes with a price which includes listening to his venting and frustration. Other folks are feeling the stress as well, he's just more vocal about it than most. When his pushback is challenged, he senses the resistance and expands it. You have to be careful not to fall into that trap, because it will never end. You can either bring him back around, or choose to let him lead the conversation and have a debate about everything that's wrong with the railroad. If you go down that path, you know it will be a lengthy ordeal.

You said to him, "Let's walk through this and see what we can take off this worksheet because there's only two of you. I'm not going to have you guys do everything we had planned."

Eventually, he did calm down, but was still expressing his frustration and discontent about the whole world in general, and why he had to live through this. You informed him that this was his decision, reminding him, "You made a personal choice to be on this job, when other less disruptive jobs were available." You went through all the other jobs with him, and he gave various reasons why he couldn't work on any of them because of personnel or the type of work. In the end, it was his personal choice.

You said, "Apologies, I just found out about this. I know there's a lot of work out there. This has been a challenging time for all of us, as a company, and we value everything that you all have done to keep us up and running while we get through this. We're going to walk through this and see where we can take off some of the work." You told the guys two or three times what we needed to focus on today and what they needed to do, and how we were going to make it as easy as possible. The conductor was sitting there not saying a word. He's a newer conductor who loves his job, and knows how to manage the engineer, because he just tells him what to do. He focuses on work. It helped shut this conversation down.

The conductor said, "You know what's important to me?" He picked up his phone and showed me a picture of his daughter. He said, "This is why I come to work every day." Then he showed another picture of his whole family with their dog. He just looked at the engineer and turned off his phone.

You said, "That's an excellent way to look at it." Then, you said to the engineer, "Are we going to have a good day? Maybe we can focus on the positives somehow."

You didn't want to minimize the amount of work they had to do because they only had two people, and he didn't want to hear that. You finally said, "You really made a choice to be on this job, so let's walk through that." It was only after you posed that logic to him that he brought up the fact that he had people coming into town for the football game.

When he eventually said that he was frustrated because of his plans for the next day, you said, "This is why we're trying to reduce the amount of work you have." He said, "We're still gonna be out here, this isn't going to help."

You said, "Well, I can leave it all for you. And that's not going to help. Or we can try to make this a little simpler so you have a better chance of getting back earlier."

Because he chose to mentally prepare for an "early quit," he had set himself up for failure. It's never going to happen that way on that job. He knows that but doesn't want to accept it. There's consistently a heavy load of work Monday through Friday.

It's something different every day, but his reaction is the same. Everyone knows what's coming, it's just to what degree.
He finally gave up. In his mind, it's still the railroad's fault that he's in the position he's in. He has convinced himself of his rationalization of why he does not want to be on any of the other jobs. You must acknowledge the situation as it stands and move on.

Challenge

25. Reflecting back, what communication strategies helped calm down the situation?

Expert Tips

1. Start with understanding the employee's frustration.
2. Acknowledge the situation and their feelings about it.
3. Probe or discuss to identify if there is a deeper issue at hand that could be intensifying the emotional reaction.
4. Offer to help by lessening the load and lower the expectations for the job that day, under the circumstances.

26. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Train Crew Workload Issue

Friday was a hectic day. You called in an extra crew due to extensive workload from track outages related to the double track project. The crew callers had called people in on the prior weekend to do clean-up work as well, because everything was slowed down. The week had gone by, and you still weren't getting trains and cars over the railroad.

After being given their daily worksheet, two young crewmen came into the office and the conductor told you, "We're not going to get all of this done. It's impossible." You knew what kind of day it was going to be with those two. You said, "I need you to do the best you can. The night crew will relieve you where you end up." One of them complained, "It's going to be a 12-hour job anyway." You responded, "I would like it not to be, but if there's so much work that you feel like it's going to be 12 hours, then I'll do what I can to help you guys." What needed to be done was to go down south and complete some industry work that didn't get done the previous day. Then, some cars had to be grabbed and taken out east. When they looked at the worksheet that said south *and* east in one day, the obvious thought was that this was an impossibility. This was completely outside of the norm of the regular operation. One crew typically goes south and one crew typically goes east. You tried to talk them off the emotional rollercoaster they seemed to be on, knowing that if they didn't get their assigned work done, it would impact multiple crews later that evening. If they fell behind, other crews would have to pick up their work, impacting the crews the *next* day too.

Monitoring the Crew and Train Movements with Technology

To help you monitor your trains and car movements, the railroad has a system called Wi-Tronix, which is on all the locomotives. The system is similar to GPS, only with a great deal more information. You are able to see the trains' direction, speed, fuel, and other information. You can see where everyone is and whether they're moving or not.

As you monitored the trains with Wi-Tronix, you could tell this crew was close to completing everything down south, but they weren't moving as timely as you thought they should be.

Challenge

27. Thinking there may be a slowdown or stoppage somewhere, what's your next move?

Expert Tips

1. Listen closely to what the crews are saying about the workload they were assigned.
2. Notice if the crews seem cooperative or resistant.
3. Think how you can get them to be more cooperative if they are resistant.

28. **Do you understand the expert tips?**

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Virtual Observation of the Crew and Train Movement

You decided to hop in your truck and ride down there to visually observe for yourself exactly what was going on. You saw the train stretched out on the mainline. You sat and waited for a couple of minutes, but there was nothing moving. After about five minutes, you called the conductor on the phone and said, "Are you guys all done down south?" The conductor said, "Yeah, we're waiting to hear back from the track department because they needed permission for a Form B." You said, "Do you need help getting that permission?" He said, "No, we're just waiting to hear back." You said, "Okay, let me know if you don't hear back from them in a couple of minutes."

As soon as you hung up the phone, you called Maintenance of Way and said, "Did you get a request from this crew?" He said, "Yeah, the conductor called me, and we told him they could go."

You called the conductor back and said, "You sure you didn't get that permission from Maintenance of Way?" He said, "We just got it." In a few minutes you saw the wheels started moving.

You got in your truck and went back to the yards.

Challenge

29. The crew seemed to be purposely sitting there not moving the train until the VP interjected. What do you do?

Expert Tips

1. Think carefully about what you do and how it may impact the crew for the rest of their shift.
2. Give them the benefit of the doubt, but explain the ramifications of their inaction on the other crews coming after them.

30. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Talking Through the Remaining Tasks

After the crew got back, you approached them and said, "Let's walk through what you have to do for the rest of the day. We both want you back here and tied up tonight." The conductor ran through the list, and you told him to scratch something off the list because you already had someone else taking care of it. You just needed them to go East, and tried to lighten the load on them so they could get back. He said he still didn't know if they'd get it all done.

They made pretty good time getting back out to go east. They needed to grab the cars about a mile east, and kept going. You were pleased

You live not far from the industry where the crew was working. After you finished everything else you needed to get done for the day, you decided to head out to the industry where the crew was. You had your radio on, and overheard the engineer ask the conductor, "Did you hear from the VP anymore?" You were about a mile away from them at that point. The conductor said, "No, but I think because of the timing he's at home having dinner." You let the conversation die down. You waited a couple of minutes. Then you got on the radio and said, "Do you gentlemen need some assistance?" There was a pause. You called the conductor, and he told you he had a couple more moves to make. You said, "OK. I'm here to help. What can I do for you?"

The engineer responded and said, "Would you be able to help my conductor with a brake test?" You said, "Absolutely. I want to get you guys back as badly as you want to get back."

You talked to the conductor and said, "I get you're having to pick up someone else's work, but because of the way we're working right now, we need everyone to do as much as they can. I'm asking for everybody's understanding. I just need you guys to get this done."

He said, "We'll be done." He finished up the air test, came back to the car, and said, "The dispatcher isn't going to let us move." You called the dispatcher on the phone, and the dispatcher said there was a passenger train departing there soon. You asked if the dispatcher could move them up to the siding. The dispatcher said that he could do that.
You put quite a bit of effort into helping these guys out. The conductor even made a comment saying, "That was pretty funny what you did on the radio."

Challenge

31. What else do you say or do at this point? *

Expert Tips

1. Acknowledge the load they have had to carry that day.
2. Show what you are doing to lighten their workload so that they can get back that night.
3. When you feel they are procrastinating and assuming that you weren't hearing their communication, find a way to let your presence be known, using levity if possible to keep the situation positive.

32. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Wrapping up the Day

They arrived back in the yards with 40 minutes left to work. All their work got done!

You had anticipated how it would unfold, and you wanted to be there. You believe that part of the success in ensuring the job got done was your knowledge and experience, and part of that was truly knowing your employees.

Expert Lessons Learned

1. After years of dealing with difficult employees and spending the majority of your career in prior jobs with a variety of people and personalities, you realize the key is to make an effort to understand your employees and get a perspective of why they are the way they are. Unfortunately, sometimes you will just have to say, "Guys, I know you don't like it, but this is the way it is."
2. If it's out of character for someone to vent about something and they do, you should know that they're saying something for a reason. In those cases, it's worth exploring what's going on with them before jumping in too quickly.
3. As you get to know and understand employees, what makes them tick, you begin to anticipate their reactions. There are very few people you can deal with the same way. The more you understand how they each look at things, the more it helps how the dialogue goes.
4. Especially with the double track project going on, a lot of the process is just listening to them vent. Some of them have good ideas about doing things differently; if you don't take the time to listen, they won't be very receptive to anything you have to say.

Lessons Learned

You have completed the Impact Skills Decision Game.

List three key lessons you learned from this case study that you can apply to future cases.

33. State the first lesson you learned from this case study and how you will apply it in future cases. *

34. State the second lesson you learned from this case study and how you will apply it in future cases.

35. State the third lesson you learned from this case study and how you will apply it in future cases.

Rollout Decision Game

You are a project manager, and have just been tasked to manage the rollout of an extensive electrical equipment project. Your supervisor has confidence that you are the right person for the job.

* Indicates required question

1. **Email** *

Electrical Equipment Rollout

There is a new rollout of electric railcars in the Northeast Corridor; however, the process has been stalled for 14 years. You have been called in to get the new equipment up and running.

Your railroad has operated and maintained track in this area as a commuter service with diesel equipment since 1990. 10 years later, the railroad installed electric wires over the train lines while still operating diesel equipment. In the mid-2000s, the Department of Transportation bought new equipment for their services. The plan was to buy enough equipment to also electrify the equipment that your railroad operates.

The new equipment arrived in 2008; however, there were many technical issues that had to be fixed in order to operate the new equipment on your railroad's territory. In addition, the railroad required every train to be equipped with a PTC system in 2008, which was 8 years before federal legislation requirements. The new electric equipment did not have PTC, so they could not operate on your tracks until they did.

There were some other technical issues with the power on your railroad's lines. They had to conduct a bunch of studies to make sure the power infrastructure could handle the extra commuter trains. People bumped along with the studies, but no one was focused on completing the rollout. Meanwhile, the Department of Transportation really wanted to get the new trains up and running.

Fast forward to 2020, there was a major federal deadline to implement PTC on all trains. The new equipment got the PTC systems working, but they still had to do additional testing on your railroad's territory. No one is taking charge of the project implementation, so you enter the situation…

Challenge

What are the top three pieces of information you need to know before you can move forward on the equipment rollout?

Your responses should include the pieces of information and where you can get that information.

2. **State the most important piece of information you need to know and where you can get that information.** *

3. **State the second most important piece of information you need to know and where you can get that information.** *

4. **State the third most important piece of information you need to know and where you can get that information.** *

Expert Tips

These are recommendations from an expert:

1. Determine any restrictions and technical issues.
2. Figure out who to talk to and what everyone has to do in order to create an acceptable plan.
3. PTC touches across all departments. Cross-departmental networks and knowledge can help speed up the process.

5. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Wire System

The new equipment is very good, but it is difficult to integrate with the physical layout of the tracks. The equipment is better suited for starting and stopping rather than sustained running. Furthermore, the wires were designed differently because they did not think about electric equipment when they were built. When your organization purchased the new equipment, people assumed it was designed to work with the current wiring system. Changing the wire system to accommodate the new equipment leads to increased maintenance costs, risk of failure, and equipment damage.

There are restrictions regarding the power supply and physical layout of the wires. People can blow up the whole system if they do not conduct everything correctly. You also do not want to rely on a GPS signal because of liability issues. You want to find a way to mitigate the risk out of the system so there are no machine or human failures that blow everything

up.

Power System

The power system is complex. Your railroad hires a power consultant to conduct studies regarding interference, withdrawal, and contingency situations. The studies highlight some risks: if certain substations are offline, a single point of failure can take the whole network down.

Operating with a big train is out of the question because it would blow out the power grid. There is a certain combination of cars that would cause a dead shortage in the wire. Therefore, the issue is figuring out how to keep the electric sections isolated. In the meantime, your railroad hires contractors to redesign the system to be more compatible and remove the physical hazard in the wire for the future.

Challenge

What is a *short term* alternative to get the ball rolling?

Your response should include the short term plan, the reason why you are including it, and any concerns you have.

6. **State a *short term* alternative to get the ball rolling. Include your plan, the key reason why you are including it, and any concerns you have.** *

Challenge

What is a *long term* alternative to get the ball rolling?

Your response should include the long term plan, the reason why you are including it, and any concerns you have.

7. **State a *long term* alternative to get the ball rolling. Include your plan, the key reason why you are including it, and any concerns you have.** *

Expert Tips

These are recommendations from an expert:

1. When you bring a new piece of train into service, it is about safety first and reliability second.
2. The first question is, "Does the car physically fit?" If the equipment is too big, it is a non-starter. If it fits, you must check compatibility with the signal system, power system, door system, and train platforms.
3. You can shorten the train and run four cars without a problem or they could use a GPS.
4. Run four-car trains. In the meantime, hire contractors to redesign the system to be more compatible and remove the physical hazard in the wire for the future.
5. The larger the fleet, the less of a spare margin is needed because the equipment is compatible and there is more flexibility.

8. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Regulatory Hurdles

The new equipment had already been operating for 10 years and was proven safe. However, because it is operating on a new piece of track, you are constantly being roadblocked by regulations. For example, the FRA requires a noise exposure test for the new track. You cannot see why the engineers would have a different noise exposure on a railroad that was 20 miles away, but you are not allowed to run the trains until you test the hearing data. In addition, the FRA asks you to run more training to operate the trains on the track even though they run the same commute with the same railroad principles. You never tell the FRA you will not do the training requirements, but you inform them that there will be delays.

Expert Tip

This is a recommendation from an expert:

1. Try to work with FRA representatives logically and patiently. If this approach does not work, it can escalate. Sometimes it is not worth it to push back.

9. **Do you understand the expert tip?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Third Rail Train Shoes

The new equipment has rail shoes that stick out too far and hit different things on the railroad. You decide to look at the constraints yourself. The surveyors cannot be there because they are busy, and you are the only qualified person to do the tests and get the measurements. You invite a conductor engineer, supervisors, observers, and mechanics to join you. You use lidar drawings and maps to identify potential hotspots. You find 12 different locations. While going slowly at a bridge location, the train fits with the shoes with two inches to spare.

Challenge

Is two inches enough room for the train to avoid damage during normal operations?

Your response should include your answer and the reason why you think that.

10. **State if you think two inches is enough room and the key reason why you think that.** *

Expert Tips

These are recommendations from an expert:

1. The train can avoid damage at a slow speed, but on a regular basis, the equipment would hit the side.
2. Three options: 1) Take the shoes off; 2) Put the mechanisms on the train to lift the shoes up (but it's expensive); 3) Do not run the trains.

11. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Starting Service

You come to an agreement that the fleet will temporarily remove the shoes. Service finally starts two months later. The shoes are off, and the trains are running. There are about 16 cars set aside with the shoes removed because it is a pain to take them off and put them back on. The trains look the same except for the number, so you have a procedure to prevent the cars from getting mixed up. Because the fleet is so big, carving out 16 cars is not a big deal. The larger the fleet, the less of a spare margin is needed because the equipment is compatible and there is more flexibility.

There are other procedures in effect to ensure the crews know when the shoes are off. You do not want the crew sticking their heads out of the window to see if the shoes are off or on. They now have paperwork that tells them the equipment they are riding. There are other things the crew has to check anyway before leaving, so you leverage some of the other inspection processes and simply added an extra step.

Screening Program Rollout

Nice work! Your performance on the electrical equipment job has been noticed. Your supervisor calls you in to talk about your next project -- but this time, they ask you for ideas.

You convey that you've noticed the prevalence of sleep related incidents occurring in the railroad industry. Many railroads do not recognize the danger of these incidents or the need for a solution. You decide to launch a program that trains, tests, and treats sleep related issues, such as obstructive sleep apnea (OSA).

You first became aware of the need for a sleep related program when you hear about a series of collisions related to people falling asleep on the job. There are currently no federal regulations regarding sleep related incidents. There is also constant pounding from the unions about employees' quality of life. They want to know when they have to come to work so they can plan around their schedule and get adequate rest.

Your supervisor agrees this is a need worth exploring. You head off to your office and get to work right away.

Voluntary Approach

Over the next few days, you reach out to various research experts and committees to search for countermeasures without introducing regulatory requirements. You reach out to doctors researching and writing reports about sleep-related topics.

For example, they are researching napping strategies where they let train crews nap on the train. This method strays from the norm in the rail industry because people have never encouraged "sleeping on the job." They are also creating rest facilities for employees with La-Z-Boy recliners at various locations.

Challenge

What are three potential challenges to a voluntary approach?

Your responses should include the challenges and a mitigation strategy to address each challenge.

12. **State your biggest challenge and a strategy to address the challenge.** *

13. **State your second biggest challenge and a strategy to address the challenge.** *

14. **State your third biggest challenge and a strategy to address the challenge.** *

Expert Tips

These are recommendations from an expert:

1. A voluntary approach allows you to focus on a singular issue and be effective without the downsides of a "sledgehammer" approach.
2. It is critical to have medical professionals support the process.

15. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Developing Training

You relay all of the newfound information back to your organization. You create training programs for employees and provide briefings at meetings. You share the dangers of sleep related issues and ways to combat the problem. You bring in experts to give presentations to your senior leadership team for credibility.

Some folks blame the people who experience fatigue instead of other explanations for sleep-related incidents. Although workers have the responsibility to be rested when they come to work, it can be difficult because life can get in the way. Railroaders' quality of life often suffers because of their work hours. It is hard for anyone to sleep from 6 am until noon because of their biological clock. Therefore, it is critical for people to know when they have work so they can plan in advance. You also want employees to understand different ways to help them get quality sleep.

You request a meeting with a railroad that has successfully implemented a sleep related program to see if it is possible in your organization. You believe a meeting like this will help get your organization's leadership on board. The railroad gladly takes the opportunity to meet.

You plan to deliver training for employees in transportation, mechanical, and maintenance of way. These training sessions highlight the wise use of caffeine, the importance of rest before work, exercise, and healthy foods that improve quality sleep and lifestyle.

You receive pushback from different organizations, saying the training is a waste of time, it is too expensive, and there is not enough data to show that fatigue is the root cause of these incidents. You are frustrated that the industry does not want to face the issue like you think they should.

Challenge

What is your recommendation regarding pushback?

Your response should include your recommendation and the reason why you are including it.

16. **State your recommendation regarding pushback and the key reason why you are including it.** *

Expert Tips

These are recommendations from an expert:

1. Discuss your plans with people who pushed back both individually and in groups.
2. Let them know what is happening across the industry to show that other railroads are already implementing safety programs elsewhere.
3. Point people to academic resources to add credibility to your efforts.

17. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Strategic Implementation

You put together a carefully written contractual document. In developing the contract, you had a lot of engagement with expert medical attorneys to ensure you are legally covered before moving forward with the program.

At the behest of your organization leaders, the training requires your employees to take a sleep test outside of work hours. You previously went to the FRA's Chief Safety Officer to ask if this was a problem, and he gave you assurance that it was not a concern.

Then, you plan which properties you will visit to roll out the program. You will start at locations that tend to be less adversarial, and you will end with locations that you anticipate pushback. If you successfully implement screening and training programs at the first few properties, you can be successful in the more contentious places.

You and the Chief Medical Officer both spend time at the different railroad properties. You speak with labor leaders and employees. Most importantly, you educate the management team on the importance of the program. You know the power of face-to-face interactions, especially because you can make sure everything goes as planned and answer any questions.

Challenge

What can you do to generate interest in the program? Craft three strategies and sketch out an execution plan for each.

Your responses should include the strategies, the reason why you are including it, and an execution plan for each strategy.

18. **State the strategy you have the most confidence in, the key reason why you are including it, and your execution plan for the strategy.** *

19. **State the strategy you have the second most confidence in, the key reason why you are including it, and your execution plan for the strategy.** *

20. **State the strategy you have the least confidence in, the key reason why you are including it, and your execution plan for the strategy.** *

Expert Tips

These are recommendations from an expert.

1. Create briefing guides and spread postings and links to information sharing sources.
2. Use your network to communicate with organizations.
3. Get the leadership from different organizations involved so they can set the tone for their employees.

21. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Challenges

Sleep related training is still not a regulatory requirement, and you do not have the FRA behind you. Without the support of a federal organization, it is less likely that railroaders will cooperate.

There is also difficulty with the unions in certain locations. They are contemplating litigation. The unions are resisting original screening because they know they will find people with sleep apnea. They feel that screening invades their medical privacy, and labor groups fear that they will be fired if they have sleep apnea.

Furthermore, railroaders will be required to do things that were never required before, such as wearing an APAP machine while they sleep. Wearing an APAP device is not pleasant, so it will be a lifestyle change for people who need to wear it.

Challenge

What are three approaches you can use to make it easier for people to comply with the program?

Your responses should include the approaches and the reason why you are including them.

22. **State the first approach you will use and the key reason you are including it.** *

23. **State the second approach you will use and the key reason you are including it.** *

24. **State the third approach you will use and the key reason you are including it.** *

Expert Tips

These are recommendations from an expert.

1. Provide at-home sleep studies so they don't have to travel for the exam.
2. Pay for treatment, and give everyone a free APAP machine.
3. Include a third party company to provide counseling for everyone involved in the program. The third party company can educate people on different ways to wear the APAP machine and different styles that can improve comfort.
4. Send the APAP device directly to their homes, so it is confidential.

25. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Screening Success

Because of the education and information that you disseminated, three of your company's senior executives asked to get screened, tested, and treated for sleep apnea. All three of them had severe sleep apnea, and they all wore the APAP machine voluntarily. The organization took care of the costs for them, and they received supplies annually. Their life, health, and ability to perform improved. They became advocates for the program and openly talked about their sleep apnea diagnosis.

You have witnessed a number of people start exercise routines, see their health improve, and drop out of the program because they live healthier lives.

Lessons Learned

You have completed the Rollout Decision Game.

List three key lessons you learned from this case study that you can apply in future cases.

26. **State the first lesson you learned from this case study and how you will apply it in future cases.** *

27. **State the second lesson you learned from this case study and how you will apply it in future cases.** *

28. **State the third lesson you learned from this case study and how you will apply it in future cases.** *

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Roadmaster Decision Game

This Expertise Management Decision Game primarily targets Key Impact SkillsSM: foundational non-technical skills, abilities, and competencies, such as systems awareness, emotional intelligence, team building, listening, communicating, and conflict resolution that are essential for building strong organizational impacts. This Decision Game focuses on:

- Developing self-awareness,
- Systems awareness, and
- Building relationships with employees, customers, and contractors.

It highlights the interpersonal challenges that arise coordinating complex tasks and rail inspections. It also imparts key lessons about the technical skills involved in work prioritization and effectively managing day-to-day tasks.

This Decision Game targets technical and Key Impact SkillsSM through five scenarios: 1) Getting Organized, 2) Team Relations, 3) Inspecting Company Tracks, 4) Inspecting Customer Tracks, and 5) Derailments.

* Indicates required question

1. Email *

Your Role

As Roadmaster for a short line railroad, your role is a multifaceted and encompasses various responsibilities, including customer relations, contractor relations, and team building. You are responsible for track inspections, repairs, and coordinating maintenance crews. You play a crucial role in maintaining safety standards and regulatory compliance. In terms of customer relations, you serve as a liaison between the railroad and its clients, addressing concerns, ensuring timely deliveries, and maintaining positive relationships. You collaborate with shippers, addressing logistical challenges and striving to enhance customer satisfaction.

In terms of contractor relations, you are tasked with hiring, supervising, and coordinating external contractors for specialized maintenance projects. This involves negotiating contracts, overseeing work quality, and ensuring adherence to safety standards and project timelines.

Team building is a critical aspect of your role, involving the leadership and motivation of internal track maintenance crews. This includes fostering a safety-first culture, providing training, and promoting effective communication within your teams. You must inspire collaboration, creating a cohesive and efficient workforce capable of addressing track maintenance needs promptly.

Ultimately, your role in a short line railroad involves a delicate balance of technical expertise, customer-focused communication, adept contractor management, and effective team leadership to ensure the smooth operation and success of the railroad.

Scenario 1: Getting Organized

Learning Objectives

- Improve systems awareness.
- Improve self-awareness.
- Understand the role of emotions in decision-making.
- Understand personal limitations and emotional reactions to complex tasks.

Organizing Your Initial Tasks as a Roadmaster

A lot sits on your shoulders. But you are prepared. You have been in the rail industry for over 30 years in a variety of roles, including as a contractor serving this very company as well as a subcontractor for one of this company's customers. Some might say that you were not approachable in your early days, but experience has taught you a lot of lessons. You have learned to stay calm, think things through, and be well-organized. Your first year on the job as roadmaster has a steep learning curve because there is a lot of responsibility, and many people will be breathing down your neck for information and solutions to problems.

Challenge

2. How will your organize your job as a new Roadmaster and why? *

3. What organizing tools might you employ and how? *

4. Where, how, and why will you schedule your inspections? *

5. What is your role in the inspections compared to your crews? *

Expert Tips

1. Decide what your routine will be before coming to work each day.
2. Install a whiteboard in the crew office, and list current and ongoing projects for your maintenance crews to see.
3. Hold daily morning briefing meetings with your foreman and the crews to update the list.
4. Add to/subtract from the "rolling list" as the day (week) evolves.
5. Tend to out-of-service track or equipment immediately, and adjust the list accordingly (i.e., move regular service things down the priority as you tend to immediate needs).
6. At the end of every day, make time to sit down with the list and carry over items to the next day. Enter those items into TrackAsset or whatever tracking system your company uses.
7. Be mentally prepared to adjust as needed: Keeping your lists up-to-date will make you more mentally prepared for the inevitable adjustments.
8. The tasks and responsibilities may feel huge. And it should, because it is. But people all over the industry do this job every day.
9. Share the burdens of your tasks with your team.

6. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Daily and Weekly Checklist

As you brief your assistant on the day's activities and describe what needs to be done, you note that the day before a Maintenance of Way guy called you about a rail crossing issue. You told the maintenance guy, "You can't pull a crossing, so just take the broken piece out, and slide the piece from outside so you don't need the road closure." You let your assistant know that you were able to avoid the whole road closure with one phone call. Often, it's emergency stuff like this that everyone has to deal with. You keep kept him informed throughout the day as you did your site inspections.

The checklist builds all day long. At the end of the day, you sit down and reviewed what still needed to be done to decide what carries over into the next day, including things you need to inspect. You check off and entered what was done on TrackAsset. Anything that carried over will be a topic for discussion with your assistant the next day. There are usually one or two items that you can take care of in the morning. Because you are on 30-day inspections right now, you have the ability to move the crew around. You like to start the 30-day inspections on the 20th of the month and have them done by the 25th. FRA requires track inspections every 30 days. There is a prescribed to-do list on TrackAsset that you start with. It usually only takes 3 days, but you plan for 5 days because you add other things to the list if you have to, such as a 57 ½ inch gate or a missing bolt. You note items like that and put them on the list. Anything that's out of service you tend to right away. The list also includes regular maintenance items needing attention.

There's a great deal that comes up during the day. You were making the road wider, and he was pushing the line. All of a sudden, bees just started hitting his window. He sent you a picture, and the windshield was covered in bees. You had to go and spray the windshield and cover the hole with mud. It really startled him.
Situations like that come up every day. Locks missing. Gates left open. Recently, there were 3 gates left open. People wander in because there's a walking path nearby, so you had to shut all those locks. It's a never-ending cycle and can be very frustrating at times.

Whiteboard

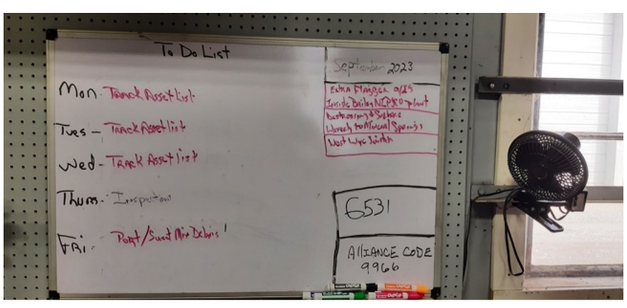
The whiteboard changes daily, but you try to stick to it as much as possible. That's where the maintenance crew meets at 0700 for your briefings. Each job site also has a briefing.

When you write on the whiteboard, it's your wish list for the day. You have the trainmen and other crews review the checklist, too. You keep them informed and they tell you what they think needs to get done, and you check it off. You keep a rolling record and remind everyone when things need to get done. Your assistant helps get your items done for the month.

You get to the office at 0600. You get calls through the night that also change things for the next day, depending on who calls. You got a call at 1730 last night about an additional flagger, so you had to get another guy to go over there.

Efficiency testing, site assessments, and calls from the train coordinator occur every day. There's enough here for 12 hours a day, but you try to get everything done in 8. Capital projects are outsourced to other contractors because they are large projects, and you can't have your MOW tied up doing those while everything else is still running. You have a CDL group that fixes signals.

Example of a Roadmaster Whiteboard



Regular Inspections

You have a routine for inspections; you go to certain areas each week that you know will have issues. Not that they should, but there are hotspots. In one area, there is a lot of traffic every day and every night. You want to make sure you hit that twice a week. You want to ust make a trip to the port once a week. You try to put yourself in a routine where you know you're going to do everything west of a particular location one day. Another day, you're going to go south. You usually have the lists on your notepad.

You go to each switching yard weekly and check if the switches are hard to throw. You just want to be ahead of your crew. You list the items you want to take care of each week. That's been a good thing because there used to be backlogs, but you are pretty much on top of things right now. There has been a good deal of shuffling because a major double track project is occupying a lot of your time.
You're a week ahead, so you make your list and put your priority items first. You look at the trouble reports from the trainmen every morning. You want to see what issues they had or anything like that from the night before. If it's a priority, you want to take care of that first thing. Maybe somebody from the train crew turned in a gaffy point or had to throw a switch or there was a broken rail. You want to make sure that is taken care of first thing in the morning. You get up at 4:00am and look on your computer for issues overnight. This is a 24/7 job. You want to be ahead of the guys and have your plan together before you even go to the shop in the morning.

Personal Inspections

Track maintenance on the steel mill is done by a separate contractor, but you still want to make sure that your trains can operate there and make sure it's up to your standards. The steel mill's policy is, "You break it, you buy it." You want to check your customer's track. You know where the issues are, but the steel mill was a big issue when you got here. Somebody was having an issue every week, and it was really costly. The last big derailment was in 2014. The contractor isn't a great rail contractor, they do enough to get by. You look at their work and tell them when it can't be run on. You've shut them down a few times.

You can go through an inspection in a couple of hours, but you only go to a certain area. You'll pick the yard you want to inspect for a day, or you'll go over to another yard for a day, but the maximum amount of time you'll do an inspection is maybe four hours on any given day. You focus on different yards on different weeks, so it's a pretty good routine.

Challenge

7. What are the high priorities areas for you to inspect on your mental inspection checklist? *

8. What are you looking for? *

9. How will you use the organizing tools you created to engage with others to help fix problems that have been identified from your inspections? *

Expert Tips

Priority Items

1. Check gauges, gaps in switch points, and broken rails.
2. Check the curves, switch points, frog points, and frog guards for wear and tear. Look for other "hot" areas.
3. Always carry your tape measure.
4. Visually look at straight tracks. Most of the time you can see if there's a wide gauge. *If you look down the track at the head wear on the rail, you can see if it's shiny in one place and not in another. You know that's spread because the wheels aren't contacting as much rail as it should.*
5. Inspect cars and tracks as the cars are rolling by. There should be full contact all the way across the rail. You can look at the side car for plate cuts and ties. If that thing is moving, you'll know because that tie is cut from where it's pushing in and out. The rail sits in a tie plate. If the spikes are moving, it slides against it and cuts the tie. There are splinters where the plate shoves into the tie; you can measure from that to the edge of the plate. If you see a plate moving or see something unusual on the head of the rail, you know you have problem.
6. Keep your eye on any areas that are heavily used.

Team Engagement

1. Give your team copies of the list and put different people in charge of owning sections.
2. Have your team send you pictures of the things they've worked on.
3. Give your team and other crew members your personal cell number and encourage them to call/text when needed.
4. If your team catches things that need fixing while they're working on other things, you may as well have them take care of it then. Keep track of it all!
5. Communicate with the team, keep them in the loop, and spread the responsibility. Sharing responsibility builds ownership and commitment.

10. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Treating People Well

The train crews have your phone number. You have no problem answering their calls. You tell them, "Call me if you have any issues." If you don't come out, one of your guys will be out there. You can guarantee that. You don't want anyone getting hurt here. There's no reason someone should get hurt here.

The trainmen wouldn't approach the person in your position before you because he was grouchy and mad every day. Most of the train crews like your guys.

Challenge

11. Why do you think it is important to give your crews your personal cell number? *

12. What are some things you can do, verbally or otherwise, to demonstrate you appreciate what your crews do? *

13. How do you think it makes others feel when you show them you care and appreciate what they do for you with small, or large, gifts? *

14. Why do you think these things are important to your company? *

Expert Tips

1. Identify several ways of showing your appreciation to your crews, verbally and otherwise.
2. Let people know you are concerned for their safety, and that regular two-way communications about issues needing fixed is part of keeping everyone safe.
3. Talk to the guys whenever you can. Get to know the new guys, especially if there are a lot of students or people new to the job.
4. Encourage everyone to help each other out.
5. Do little things for your team to build respect and teamwork. Take them out to lunch or buy them a gift card for Christmas dinner.
6. Give people larger gifts on occasion, especially when someone goes out of their way to support you. Consider giving your Customer contractors (i.e. MOW) a Christmas bonus of $1,000. No one else does that. They work 40 hours a week here, so you take care of them. You show them that you appreciate what they do for you here, and it goes a long way. Save enough money in your budget so you can give each one of our Customer contractors a $1,000 bonus at Christmas, or another special holiday.
7. Make it clear to everyone with your safety behaviors that they know you're looking out for them, that what you are doing as a team is not going to risk getting someone killed, but you are going to get stuff done.
8. Generally, let the people you work with and anyone who replaces you that that's how you do things around here. It really does help get the job done.

15. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Scenario 2: Managing Team Relations

Learning Objectives

- Coordinate and harmonize team relationships to get the job done.
- Build long-term, trusting relationships.

Team Relations

You have worked in the industry for decades and have been on many sides of different problems. One of your responsibilities includes working with contractors. You were on that side of the fence for enough years to have experienced how some companies can mistreat that relationship.

You want to build strong team relationships, not only with the company and customer contractors, but also with your railroad's employees, including those you don't supervise.

Run Through Switches

You had several derailments at one of your customer sites because your customer was throwing their own switches and not lining them back. They ran through the switches on the wrong side, which broke the rods. When you arrived to bring in train sets, your locomotives kept hitting the ground because the points were gapping. They never would've called about it. This had been going on for a couple of months, so you decide to go up there.

You could see that someone had welded the hangers; fresh welds were visible, and the rest was rusty. When it's welded together, it creates a gap in the points. You asked them who welded it, and they said, "It wasn't us!" Finally, the owner called and said that one of their maintenance guys did it.

Challenge

16. How will you engage with your customer after learning that they denied their responsibility for a safety problem? *

Expert Tips

1. Tell the owner they need to call you when stuff like that happens, and you would be happy to come and inspect it to make sure it's safe for your company to run there. The problems begin when they don't tell anyone.
2. Since then, you haven't had that problem because they are training their guys on running through switches. Now they label each track, so they know which way they are going. There has been a big improvement, but it used to happen almost every month.
3. Make time to stop in and thank them in person.

17. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Customer Contractor's New Superintendent

There have been many new rail contractor superintendents with your customers.

After doing an inspection one day, you called the new superintendent. You said, "I have a track issue, can you please come out here and take a look at it?"

He came out. You introduced yourself and told him who you were. You told him you weren't going to have trains coming in with an issue you found that was left unfixed. He said, "This isn't your railroad, this is our steel mill." You said, "I know, but I can stop my trains from running here. That's what we need to discuss."

He said, "I don't take orders from you."

You said, "I get it. I know. I'm just telling you the issue we have. We may not be able to run trains here at this point if you want to run that by your supervisor."

He said, "You're trying to go over my head."

Challenge

18. When you meet resistance like this, what are your next steps? Explain your rationale. *

19. How would you get the Superintendent to cooperate with you? *

Expert Tips

1. Be firm but polite.
2. Acknowledge his position.
3. Focus on resolving the issue.
4. Find ways to build a trusting amicable relationship that helps you get the job done and ensure safe operations at the same time.

20. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Your Response

You said, "I'm not trying to go over your head. I'm trying to resolve a track issue. If you want to work with me, great. But if you want me to call your Y&T, I will."

That pissed him off. You called the Y&T guy that you knew. You said, "I'm not trying to be an a-hole, but this issue needs to be resolved, and the superintendent is giving me a hard time."

The Y&T guy said, "I'll take care of it." Later, the Y&T guy told you, "He just didn't know who you were. I worked it out with him."
Two weeks after that, the Superintendent was more receptive when you talked to him about repairing a frog. He called the Y&T guy and said that they would take care of it later that day. The next day you brought the Superintendent a submarine sandwich to let him know you appreciated what he did; your relations with him got much better after that.

Challenge

21. What else might you have done to get the Superintendent on board? *

22. In retrospect, what was it about your conversations with the Superintendent and the Y&T guy that enabled you to develop a stronger more collaborative relationship? *

Expert Lessons Learned

You didn't like being abused when you were in a contractor's position, so you treat them with respect. You want to build a cooperative relationship that creates a pleasing collaborative atmosphere based on mutual respect and trust.

You can't be iron-fisted and try to rule the world from your position. You can't be in charge of everyone. You have to go into relationships with respect, and not go into a place and tell people what to do.

One of your pet peeves is people who don't take take care of safety notifications when they come their way. You don't want them hanging over your heads, you want them dealt with now. When your train guys turn in safety notifications, you have them taken care that day or the next morning. They fill out the paper, it comes to you, and you give it to the maintenance workers. After it's done, you turn it in to the responsible party. It says what your crews did and how they did it. Everyone sees you and your team took care of it. You demonstrate your concern for safety.

You also demonstrate that you do more than just direct others to get the job done. Often, you are the one doing the work. For example, when a tree was down, you walked the track with your chainsaw to get it off the track if you need to. When the guys see you doing things like that now they get out to help you. When that happens, you might buy them a $50 gift card the next day. Everybody helps everybody here. You helped foster that atmosphere. As a result, the other crews don't get as aggravated with you or the track guys like they used to.

As a new roadmaster, you are likely to have a bunch of problems and people breathing down your neck almost daily. It will take time to see the results of your trust building and positive engagement with individuals and your teams. In fact, it may take 2-3 years before you begin to see major changes of employee engagement and a stronger commitment across the board to safety and efficiency. You know that building an atmosphere of mutual respect goes a long way in the railroad industry. You may not be the guy writing checks, but you are the guy that keeps trains running smoothly and safely.

Scenario 3: Inspecting Company Tracks

Learning Objectives

- Develop systems awareness and self-awareness capabilities.
- Understand one's "sense-making" abilities.

Inspecting and Maintaining Track

You are responsible for inspecting and maintaining over 200 miles of company track. Every week, you make time to travel and inspect most of your track. When you first arrived on your job as Roadmaster over a decade ago, derailments were a weekly occurrence. The railroad had them almost every day because there were people who didn't care. You've worked on hundreds of derailments since you started here and know what to inspect for potential problems.

You are aware of environmental changes, including hot and cold weather. Rail grows in the heat, and you must record this for the FRA anyway. Once your rail temperature gets above 95 degrees, you record it, and keep it on your track reports. When the temperature is colder, the rail will pull apart or sometimes break if there are flat spots on the rail because the cold temperature makes the rail more brittle. You want to look for things beforehand if there's movement or any anomalies. If it's something that can wait for tomorrow, that's what you're going to do. You know trains are running that day, you want to get the maintenance crew out there right away.
There are a few different ways you can inspect the track. You can ride on a train that is heading down a piece of track, you can drive a rail-situated truck (high railing), or you can even walk the track.

Challenge

23. How often should track inspections be done, and why? *

24. What types of defects are you looking for? *

25. What senses might you use in your assessment process? *

Expert Tips

1. Notice things that intuitively arise in the body telling you when tracks need attention.
2. Encourage your train crews to also keep an eye on the tracks, and report the hazards they identify.
3. You can't walk the track during switching operations, so you need to schedule your travel around those operations.
4. Looking, listening, and feeling…the sounds of the rail should be consistent.
5. Anytime the temperature gets above 90 degrees around here, you know you need to do heat inspections. When the temperature is around 20 degrees start doing cold inspections after. You can be more proactive by doing cold inspections on the first day the temperature dips below freezing.
6. Riding the train gives you a different experience from riding a truck or walking. Each has its place, depending upon the track's location and maintenance history.

26. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Trees, Brush, and Dealing with the Locals

People dump stuff on the railroad tracks. It seems to be a garbage dump for everybody. There's a tree nursery down on your South Line, and they regularly dump pine cuttings on your track. It affects the drainage on the track, and it's a tripping hazard. You've tried to ask them to move it three or four times, but no one spoke English. You and your crew go down there with a plow and roll it all back.

A guy from the tree nursery sees this, gets upset and says, "You can't do that."

Challenge

27. How would you handle this? Why? *

28. What emotions arise when you consider taking this action? *

29. How do you want your company to be perceived by the other companies that border your property? *

Expert Tips

1. Pause and reflect on how best to handle emotional outbursts from others before reacting.
2. Be firm but civil in your response.
3. Be a good role model for others, and recognize they will likely follow your actions.

30. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Representing Your Railroad

You keep your cool. Pause. And say, "The railroad owns 25 ft. from the center track. You can't dump on my track. If you want to dump it outside of 25 ft. of my track, have at it." You could have pushed it all the way over into their property with a bulldozer if you wanted to, but you were nice enough to only roll it off your railroad track.

You took matters into your own hands; not being a smart ass, just taking care of your track.

Being good stewards of your property while still being professional is an important value you and your other managers uphold. You've found that your team will reflect the emotions you put off. In other experiences when you've had run-ins with locals, your negative responses had triggered similar comments from your crew.

In this interaction you chose to be civil and considerate, and you noticed that later your crew was less caustic towards the nursery guys in their reflections. How you present yourself matters not only to the public, but also to the team you're building.

Scenario 4: Inspecting Customer Tracks

Learning Objectives

- Develop self-awareness tools to sense when tracks need attention.
- Increase awareness, understanding, and skills related to team harmonization and integration of their company's needs with the customer needs, that make the system run more smoothly.
- Understand how to use one's technical knowledge to improve systems-awareness skills.
- Improve tactical communication skills.
- Use technical knowledge to improving communication & team-building skills.

Customer Relations

Your roadmaster role is crucial in customer relations. Acting as a liaison between the railroad and clients, you address customer concerns, coordinate logistical requirements, and ensure timely deliveries. By maintaining positive relationships with shippers and stakeholders, you contribute to customer satisfaction and the overall success of the railroad. Effective communication and problem-solving skills are paramount to navigate customer needs and uphold the railroad's reputation for reliability and service excellence.

Your railroad is the switching railroad for a steel mill, one of your largest customers. You previously worked for the steel mill as a subcontractor rerailing trains for years, so you know there are always issues with the track. You also know that this customer doesn't treat his contractors who do track maintenance with much respect. Although a separate contractor does track maintenance for the steel mill, you want to make sure your trains can operate there, and that it's up to your standard. While you have no direct authority to instruct the customer or their contractors as to what to fix on their track, you have a strong influence over them.

You do have authority, however, over the lead switch at the entrance to the customer's yards, which you can take out of service if deemed necessary for safety reasons. The steel mill meets the industry standard, but your expectations are higher. Because your trains run on the track, you pay close attention to defects and let the steel mill know when your trains can't run there. You have a lot of connections at the steel mill, and you go there on a regular basis. Your contact at the steel mill, who runs the contract rail department, knows that when you call there's likely a problem.

Going to the Steel Mill

You arrive at the steel mill for a routine inspection. Your railroad brings in 120 coal cars a week from a Class I track to the steel mill track, and there is only one way into the steel mill. If there are track issues, the lead switch into their yards is the first place they are likely to occur. Almost immediately upon arrival, something dangerous catches your eye as you are watching a train enter their yards from the mainline.

Challenge

31. What types of defects are you looking for? Explain your rationale. *

32. What would be most noticeable simply from a visual inspection? *

33. Where else might you look other than the usual places to find issues? *

Expert Tips

1. Look at gauges, curves, switch points, frog points, frog guards, and broken rails. These are the "usual suspects."

1. Look at gauges, curves, switch points, frog points, frog guards, and broken rails. These are the "usual suspects."
2. If you look down the track, at the head wear on the rail, you can see if it's shiny in one place and not another. You know it's spreading because the wheels aren't contacting as much rail as it should. There should be full contact across the rail.
3. Look at the side car for plate cuts and ties. If it's moving, you'll see the cut tie where it's pushing in and out.
4. Don't be afraid to pull out your checklist and look beyond the usual suspects.

34. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Finding the Issue

You watch the plate cut and the ties, and you know something is going on. The gauge spot is about 50 feet.

Challenge

35. What are some possible explanations for this issue? Explain your rationale. *

Expert Tips

1. The tie plate can move when the spikes are loose.
2. Look for rails spreading when it goes under load.
3. Confirm your visual inspection with your tape measure.
4. Even if the rails are within specifications, the plate cut under load can move a couple more inches.
5. Take out your tape measure, and measure the head of the rail.

36. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Observing the Tracks

The tie plate was moving because the spikes were loose. Sometimes they stick up, sometimes they don't. If you see a half inch cut or the plate has been going back and forth, you know it has been spreading when it goes under load. You ask yourself, "So how many of those do I see in a row and how much does that cut? 1 inch? 2 inches?" If it's 1 ½ inches, you know there will be some gauge issues. You can measure the rails, and it might say 56 ½ inches, but you can see a plate cut under load is moving to 58 inches. You can also measure how many plate cuts are in a row, and measure the plate cut to see how much it's moving.

You took out your tape measure, and measured the head of the rail. The actual gauge itself is 57 ½ inches, but the plate cut adds to the measurement. With the plate cut, the gauge is over 58 inches, which is beyond the limit. You knew you had to take that track out of service.

You realize you can't run your trains on the track because of the wide gauge right at the gate. The trains might make it across the rail a few times, but you know it's spreading. Trains are going to hit the ground if you don't fix this problem.

You took pictures with your cell phone. You marked the spot on the side of the rail with soap from your vest pocket, in case you lost track of where it was.
While walking the track, you see someone eyeing you. Folks at the steel mill are slightly concerned when you do inspections because they don't want you to take your trains out of service there. If you take the trains out of service, the steel mill can't move anything.

Challenge

37. What do you do next? Explain your rationale. *

Expert Tips

1. Take a picture of the wide gauge with your cell phone.
2. Mark the spot on the rail so you don't lose track of where it is.
3. Call your railroad's vice president (VP) and tell him that the track needs to come out of service.
4. Go through the chain of command at the steel mill to let them know you have to take the track out of service.
5. Contact the rail contractors who work for the steel mill to come over and fix the rail.

38. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Making Calls

You call your railroad's VP and tell him, "I need to take this track out of service." He should know you're taking the track out of service before anyone else.

The VP says, "But that's the only way in."

You push back, telling him "It's not safe to run trains in. I need to take it out of service." You ask the VP to stop your guys from going into the steel mill. Because you know folks at the steel mill, you let your VP know you will get in touch with them. He agrees to move forward with taking the track out of service, and he tells you he'll put in a call to the Yard & Transportation (Y&T) foreman at the steel mill–he knows him well.

You start working your way through the chain of command at the steel mill. You contact the rail contractor supervisor who works for the steel mill; he's usually responsive. He picks up, and you tell him, "There's a wide gauge issue. I can't bring trains in." You send him a picture of the issue, ask him to have people come fix the track, and ask him to call you right back.

The rail contractor supervisor tells you he'll need to call the Y&T guy to talk to him about the issue and the service stoppage. The rail contractors need permission from the steel mill to go in and fix the rail.

The rail contractor supervisor hangs up with you and calls the Y&T guy. He says, "Hey, the roadmaster found this issue. They're not going to come here. What do you want us to do?"

The rail contractor supervisor calls you right back and says the steel mill Y&T guy says to come over.
You radio the engine crews to let them know about the track issue, then you lock out the switch.

Meeting on the Track

Twenty minutes after your call, the rail contractor supervisor meets you out on the tracks. You also call and ask the Y&T guy to meet you, but he says he doesn't need to be there. You can just tell him what you want but you can't direct the rail contractors what to do. It's up to them how they fix the track.

Challenge

39. What are your recommendations to fix the track? Explain your rationale. *

40. How would you go about presenting your recommendations? *

41. How can you communicate to the contractor supervisor his value to you and your company? Why is this important? *

Expert Tips

Fixing the Track

1. The fix needed is a gauge correction.
2. You would prefer to spread the ties throughout the curve. And you know the rail contractors have a bad habit of putting 10 ties in a row. They are notorious for only fixing the ties in one spot. The rail contractor suggests putting five ties in a row in the spot where the gauge is wide.
3. The minimum standard is a good tie every third tie in a curve to limit plate movement. For a straight track, the minimum standard is a good tie every fifth tie. Nobody is going to change out every tie every time, so you want to develop a good rotation.
4. Be proactive to prevent other issues from occurring in the future.

Presenting Your Recommendations

1. Show all the rail contractors mutual respect. Ask for their thoughts and suggestions.
2. Explain the wide gauge issue and that the plate cuts are causing it. Tell the rail contractor, "I'm looking for the gauge correction, but if you throw a handful of ties at this curve, it will probably help us both in the long run." Suggest changing some of the ties because they are spongy and spreading the ties throughout the curve.

Encouraging Ownership and Validation

1. After explaining what won't work, thank the contractors when the fix is completed.
2. Encourage them to think about being proactive in fixing safety problems before they arise.
3. Thank them for their work in getting the operation back up and running.

42. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

New Rail Contractor

When the rail contractor arrives, he asks you what you're looking for. You show him the track issue and explain what was causing it. You say, "I'm looking for the gauge correction. You can meet minimum standards by just fixing a few ties, but if you throw a handful of ties at this curve, it will probably help us both in the long run." The rail contractor supervisor usually goes with your opinion because he trusts you. You've known each other for a long time, and you respect each other's opinions. To prevent this situation from happening again, you gave them some recommendations, including spreading new ties throughout the curves to prevent them becoming spongy.

You worked as a contractor for this same company a long time ago, so he knows that you are aware of what's expected. You also know how the steel mill treats rail contractors. There is a stigma that everyone hates contractors. You used to do contract work. Your boss didn't treat you well; you couldn't do anything right, and you got the brunt of it from the customers. It was embarrassing. That's why you chose to show the rail contractors mutual respect for their work and ask for his opinion. You ask him, "What are your thoughts? What do you think?" You wanted him to feel involved. His suggestion was to put five ties in a row in the spot where the gauge was wide.

You say, "That's a good idea, but how about we spread out the ties throughout the curve, and we take care of all of the tie issues at once with a plate cut tie?" You want to be proactive, but you also want to show respect to the contractors.

It's not your job to babysit the rail contractors. You want them to have proactive maintenance. Their usual habit is putting 10 ties in a row; they are notorious for only fixing the ties in one spot. The minimum standard is a good tie every third tie in a curve to limit plate movement; however, for a straight track, the minimum standard is a good tie every fifth tie. Nobody is going to change out every tie every time, so you want to develop a good rotation.

Fortunately, the rail contractors take your ideas into account. They're good to work with, and they're good people. They thank you for working with them and making suggestions. You try to get them to think like you. If you can get that thought process in their head, you don't have to worry as much. The place was a nightmare when you first got there, they are being much more proactive now.
You try to show them respect so they feel like they make their own decisions. You share your opinions with each other. You tell them they did a great job and thank them for their hard work. Occasionally, you'll buy them lunch, or you'll give them a box of donuts, but it's worth a million dollars to get that stuff done.

Stopping Service and Fixing the Track

The rail contractor supervisor thanks you for your suggestions and asks you when you need the track back in service. You say, "I needed it yesterday, but I'll take it today." The contractor discusses progress with the team lead and says he can get it done in the next two hours.

You tell him you're going to another site, but you'll be local. Within an hour, the contractors have a crew working on the gauge and the track. The quick response shows how important it is for the trains to get into the steel mill. A couple hours later, the rail contractor supervisor gives you a call and says, "We got it done. Do you want to come take a look?"

He is waiting for you when you get there. You walk the track and look at the repairs together.

The contractors replaced about five ties. You take out your tape measure and measure the ties. You want to ensure everything on the track is ready for operation. The track looks good to you.

While you're standing there, you call your VP to give him an update. Then, you call the engineers to release the trains. They are standing by waiting to move. You unlock the switch, and the operation is up and running again.

Fixed Track

The whole process from finding the defect to operating again takes about four hours. The four-hour delay stops your AF1 crew from operating there, and that's not a good thing. That's where the revenue comes from. But you either put a bunch of cars in the ground, or you get it fixed right away. You prefer the latter.

The former Y&T superintendent is very responsive to your calls because he knows your experience. The new guy isn't used to you yet, but he's getting warmed up. He says, "Every time I see you, there's something wrong." You say, "I'm just trying to make it safe for everybody."
When everything is fixed, you open the track back up. When you take something out of service, it has your name on the lock; you must be the guy to remove it.

Follow-Up

The first thing the next morning, you email the rail contractor owners and send a personal text to the rail contractor supervisor thanking them for their quick responses and for getting the issue resolved. Saying "thank you" goes a long way.
They have to report their hours. You don't have to do that because it is not your track. You don't track your customer's track because that would be too much to keep track of. You keep track of all of your documents using TrackAsset.

Future Changes

After taking their track out of service, you negotiate getting another lead into the steel mill, and that is awesome. The second lead eliminates problems like this one because you still have access to the steel mill. As things progress over the years, you make a lot of improvements like changing access points.

You tell the steel mill your trains aren't coming in, somebody responds to you within an hour. Gauging is an easy fix. You can pull a spike and pull a rail and put a few ties in. It makes people more responsive when you can show that. You have too many years around here not to carry a lot of authority, so you get quick responses now. It pays off. You don't have as many derailments as you used to either. Occasionally you'll have a tight gauge or a gaff point.
The rail contractors are responsive to you now compared to the first few years after you arrived. You have a partnership now.

Cultivating Relationships

During one of your routine customer site visits, you contact the rail contractor and the Y&T supervisor. You had already established a working relationship with these people. You tell them you want to talk with them if they have the time. They seem receptive to your request.

You tell them high priority things to look at and ideas for preventative maintenance to keep their track in service. You tell them you have a list of rail contractors who are happy to help them. You refer a lot of work to others because you came from working as a contractor.

You are nice and show them respect. You say, "Let's look at what *we've* got. Let's see what we can do to make this work."
You try to establish a sense of respect, so there isn't negative, non-productive banter back and forth.

Challenge

43. What might you do to ensure that future issues like this go as smoothly? Explain your rationale. *

Expert Tips

1. Throughout the entire process, show the contractors respect. Be encouraging but not directive. They need to know that they are making their own decisions.
2. Tell them when they do a good job, and thank them for their hard work.
3. Occasionally, show your appreciation for their good work by treating the contractors to lunch or a box of donuts.
4. The first thing the next morning, email the rail contractor owners and text the rail contractor supervisor to thank them for their quick response and for resolving the issue.
5. Because the lead switch is the only way into the steel mill, negotiate getting another lead. The second lead will eliminate problems like this situation because you will still have access to the steel mill when the track is taken out of service.
6. Emphasize that this is a collaborative effort, stressing your respect for their job.

44. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Scenario 5: Managing Derailments

Learning Objectives

- Develop self-awareness
- Develop self-management tools to focus your attention on applying your technical skills during trying circumstances (e.g., derailments).
- Develop communication and engagement strategies with colleagues, teams, and others who interact with the system during derailments to effectively and efficiently manage the impacts created by a major derailment.

Assessing and Fixing Track Damage After a Derailment: Public Relations

While rerailing might be the responsibility of the chief mechanical officer, as Roadmaster, you are a senior member of the company's management team and you have the experience to be in charge during derailments. When you get the phone call, you want to know where the derailment is, then assess and look for the cause. Then, you have to rerail and determine what materials you need to get the track back in service.

Getting the Call

Your phone rings at 0500 on Sunday morning in the middle of December. It's your railroad's President. He says, "We have a mess. Get up here." A derailment just occurred on the mainline going into one of your customers plants.

You leave your house immediately. When you get to the site, you see that the general public is watching from the highway, newspaper reporters are asking questions, the FRA is already onsite, and a state helicopter is flying overhead. It looks like a major disaster.

Challenge

45. What are your biggest concerns at this point? Explain your rationale. *

46. How do you prioritize your concerns? *

Expert Concerns

1. Human injuries
2. FRA response
3. Public response
4. Hazmat issues

47. **Do you understand the expert concerns?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Assessing the Damage

As you get closer to the derailment, you see they've spilled 10 coal cars. The derailment has shut down the passenger rail's mainline track into the plant and the highway because of a road crossing.
They had power at each end of 120 coal cars. From the look of the rail, you surmise that the locomotive bound up in the middle of a curve, spread the track, and the cars tipped over like an accordion. You don't see any human injuries–it seems to be all equipment damage.

Challenge

48. What information do you want to collect at this point? Explain your rationale for wanting the information. *

49. Who can provide that information? *

Expert Tips

1. How much damage is done?
2. How much/what equipment do you need to fix the track?
3. Is hazmat involved?
4. What do we need to clean up?

50. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Answering Questions

Everyone starts pointing fingers and blaming your track, but you know that's not the case because you oversaw the extensive rail and track rebuilding of this very track just two months ago. It's all brand-new track. Both rail and track were rebuilt, and the rail was tested two months ago. All the rails and ties were replaced. The crew had realigned the curve and took the sharpness out of the curve because there were gauging issues. You are confident the track is not at fault.

You park your vehicle, start to walk the scene, and notice that your phone is blowing up with calls. People from other railroads are calling you, leaving voicemails. The first one asks, "What'd you guys do?! I'm seeing it on the news." The second one asks, "How fast were you guys flying through there?" Even though it's a 10-mph track, and you know your team would only push the cars at walking speed.

A third call from a passenger line starts with, "Your f—ed up tracks caused all of this. You don't keep your tracks in good condition" because some of the cars fell onto the passenger rail's main line. You don't own that track, but you'll have to fix it because the derailment tore it up.

You see your railroad's President approaching. His mandate is clear: "You only have to talk to the FRA representative. Tell everyone else to come talk to me." Your President heads off to take questions from the newspapers and general public.

Challenge

51. How might you feel in this situation when everyone seems to be blaming you and your tracks for the derailment? Describe as best you can the emotions you might be experiencing. *

52. Given how you might feel, what next steps might you take? Describe your rationale for the steps. *

Expert Tips

1. Direct anyone who is asking questions to your President.
2. When strong emotions arise, pause, take a few deep breaths, and reflect on things. Take some time for yourself to think. Find somewhere you can be alone and plan your next steps.

53. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Gathering Your Thoughts

You recognize that you're feeling pretty wound up right now. So many things are swirling around in your head, including some guilt for the accident (even though you and your track are not at fault, it's hard to shake the feeling), responsibility for the clean-up, and confusion that comes when something so complex lands on your lap: "How are you going to move forward in the immediate moment?" So you go to your truck, shut the doors, and roll up the windows. You silence your phone. You drink your coffee, and think about your next steps. People are knocking on your windows asking questions. You just say, "Leave me alone. I'm thinking."

Challenge

54. After you have calmed down and gathered your thoughts, what are your recommendations for the next steps in dealing with this situation? Provide your rationale. *

Expert Tips

1. Get your records for the FRA.
2. Assess the damage and necessary equipment.
3. Determine what you need and prioritize who you need to call before making any calls.
4. Call the Maintenance of Equipment crew to push the cars away from the track.
5. Call the rerail company to help rerail the cars.
6. Put a crew on track repair as soon as possible, to start preliminary work.

55. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Getting Back to Service

You spend the rest of the morning enacting the first steps in your plan. Snow is coming later this week, so you want to get the track back in service within two days. You will have an even bigger mess on your hands if you can't get it done before the bad weather hits.

You text the rail team lead to ask how your track material inventory looks. He tells you that you don't have the material on hand to rebuild the track, so you start making calls to vendors and contractors to get help on site.

Challenge

56. Who are you calling to meet the urgent need of material? *

57. What will you say to them? *

Expert Tips

1. Call the vendors and tell them you what you need.
2. You have a connection with a nearby yard. You call them and ask, "How many 80 ft. 115 lb. rails can you get me *now*?"
3. You also know some local guys who have stock ties, so you call them and say, "I need 300 ties. Can you help me?"

58. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Calling Your Contacts

Once you've secured materials, you call the Maintenance of Equipment crew to check on their progress. They've pushed the cars to the side of the hill, so that the rerail company can deal with them.

You call the oncoming track repair team lead to tell them to focus on this issue for the next few shifts. You let him know that there are hard things to do, but everyone just does it. Your small group takes care of each other. You set the tone and say, "We've got 8 hours. Let's get it done."

FRA Investigation

The FRA representative knows you recently redid the track, but you show him all of your records anyway. You print out all the maintenance and capital project records from TrackAsset. You are in the clear.

The results of the investigation show that the derailment was caused by a transportation handling issue.

Challenge

59. What do you do to help you focus your attention on getting the task done and not get caught up in the frenzy of questions being asked by others? *

Expert Tips

1. Give yourself time to pause and reflect before responding to others.
2. Take a few deep breaths to calm your mind.
3. Isolate yourself if necessary to allow yourself time to think.

60. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Lessons Learned

You have completed the Roadmaster Decision Game.

List three key lessons you learned from this case study that you can apply to future cases.

61. State the first lesson you learned from this case study and how you will apply it in future cases. *

62. State the second lesson you learned from this case study and how you will apply it in future cases. *

63. State the third lesson you learned from this case study and how you will apply it in future cases. *

Electrical Repair Decision Game

You are the lead electrical technician at your organization. Your organization has a computer-based locomotive system, so you mostly use software to diagnose and repair electrical issues.

A train has come in overnight...

* Indicates required question

1. **Email** *

Speed Sensor Failure

An engineer saw a problem with the speed sensor on his screen. The display showed a - - instead of showing the speed of the locomotive. The engineer wrote the issue on the Map 100 and notified the train controller to call mechanical to create a work order. The engineer knew a speed sensor failed, but he did not know which one. Once the engineer reported the failure, they took the locomotive out of service.

The locomotive has 11 speed sensors. There are four axles, and each axle has two speed sensors. Another speed sensor is attached to the #3 axle in the form of a generator, which monitors the ATC and ACSES PTC systems. The other speed sensor is for the event recorder. The sensors monitor the pulses and send information to the computer. If the vehicle is slacking or over speeding, the computer uses that information to put the locomotive into failure. If one speed sensor fails, the system reports a problem, but the locomotive will still get to the final destination.

When the locomotive gets to your shop, they ask you to take a look at it.

Challenge

What are the top three information sources you consult before looking at the problem yourself?

Your responses should include the information sources and what information it gives you.

2. State the most important information source and the information it gives you. *

3. State the second most important information source and the information it gives you. *

4. State the third most important information source and the information it gives you. *

Expert Tips

There are recommendations from an expert locomotive technician on information sources:

1. First, check the Map 100 to see the engineer's initial notes. The Map 100 condition reports vary a lot from engineer to engineer. Sometimes engineers do not put many details, which adds more time to the diagnosis and repair process. The most helpful information the engineer can write down is the time, the location, and any additional details.
2. Second, check the work order.
3. Third, check your email to see if the operations center sent an email about this particular incident.

5. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Gathering Information

You first check what the engineer wrote on the Map 100, which says, "excessive - - every 10 to 20 miles." The Map 100 includes enough information that you understand what the engineer experienced on the locomotive. You take a picture of the Map 100 on your phone so you can carry it around with you.

Since you are working with a computer-based locomotive, you use the computer software to analyze the data. When you log into the system and type in the train number, you see the work order. The Train Control System (TCS) gives you remote access to diagnostic information from the locomotives. You can look up the downloads, but that information is not sufficient.

The - - on the display can be caused by several things.

Challenge

Given the information you have, what are three possible causes for the speed sensor failure?

Your responses should include the possible causes and the reason why you are including them.

6. State the cause you have the most confidence in and the key reason you are including it. *

7. State the cause you have the second most confidence in and the key reason you are including it. *

8. State the cause you have the least confidence in and the key reason you are including it. *

Expert Tips

These are recommendations from an expert locomotive technician on what to look for in this situation:

1. The speed sensor failure on the display could be caused by several things: 1) If the system failed to read the transponder on the track, 2) If the radio communication failed, 3) If there was an intermittent loose connection, 4) If the transponders had corrupt information.
2. Damage can be external or internal, so there may not be any visual signs of damage. Pull the logs regardless of obvious physical damage.
3. Check for grounds. If there are leaking grounds in the system, it can cause signal failures.
4. Once you clear the grounds, read the sensors to make sure the values are correct.
5. Next, check the connections on the display unit.
6. Download the log to check each axle.

9. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Detecting the Problem

The only way to tell which speed sensor failed is to pull the entire log from that particular trip.

You download the log to check each axle to find which one failed. Each speed sensor produces its own data system, and the log shows the speed of each axle. The data usually goes back about four days. This information gives you an idea as to what was going on before and during the sensor failure. If the speed sensors are red, you know there is an issue with the speed sensor. You search for the - - in the software. You see that one axle's speed was off, so you know that is the one that failed.

You remember your organization has been having a lot of issues with their PTC equipment in the past six months. The manufacturer introduced new cables, but this particular locomotive had not received the new cables yet.

Cause of Failure

You suggest that the old cables caused the intermittent issue. Once they are swapped out, you send the locomotive back out for service. You follow up and track the data to make sure the locomotive works weeks after the problem was fixed.

Expert Tips

These are recommendations from an expert locomotive technician at this point in the scenario:

1. After the locomotive is repaired and sent back out for service, send an email to all the technicians, engineers, and foremen so they are aware of the locomotive's condition and repairs.
2. There is no particular plan for dealing with these types of issues. When looking through the computer software system, you can rule out everything that is not failing and go from there.

10. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Battery System

Just as you're wrapping up the speed sensor problem, another train pulls in...

A locomotive's battery died. The crew used another locomotive to send power to the dead locomotive and charge the battery; however, the charger did not work. They call you to look at it.

Since the battery system is huge, there is so much wiring and a lot of pins. If the cells are bad, the battery will not hold any charge. A couple of bad cells will take the whole battery down, which would require replacing the entire battery.

Challenge

What is one cue that tells you that a cell is bad?

Your response should include the cue and the reason why it tells you that a cell is bad.

11. State what cue tells you that a cell is bad and the key reason why. *

Expert Tips

These are recommendations from an expert locomotive technician on dealing with a dead battery:

1. In this case, the least amount of volts a cell should have is 30 volts. If one cell is below 30 volts, check each individual cell.
2. If the charger over charges, water will boil and the cell will lose water and start to bend.
3. Look for cells that are dry because all of them should be filled with a certain amount of water.

12. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Cause of Failure

You check the batteries and the cells. Everything looked fine on the outside, but it was still not charging. You charge the locomotive for two hours.

Then, you play with the powers coming in and out. When you touch one of the plugs, it starts working but goes off again. You find a loose connection in the plug. When you open the plug, one of the pins is pushed back. As soon as you fix the pin, the battery works again.

Lessons Learned

You have completed the Electrical Repair Decision Game.

List three key lessons you learned from this case study that you can apply in future cases.

13. State the first lesson you learned from this case study and how you will apply it in future cases. *

14. State the second lesson you learned from this case study and how you will apply it in future cases. *

15. State the third lesson you learned from this case study and how you will apply it in future cases. *

Mechanical Repair Decision Game

You are the head locomotive technician at your railroad. Any locomotives that break over the weekend are left for you to examine and fix on Monday morning.

It is Monday morning, and there are three different locomotives with problems waiting for you to solve...

* Indicates required question

1. Email *

P32 Diesel

There is a P32 Diesel locomotive that moves track equipment at an outlying point in another town. During a 24 hour inspection, the inspectors noticed this particular unit recovers after a penalty, but it takes almost 3 minutes every time.

The mechanics at the outlying point moved the handle to suppress the penalty, but it kept taking 3 minutes to recover. They replaced the P2A valves, which control the penalty to get the brake application, but it did not fix the recovery time. The mechanics tried their best to correct the brakes, but they did not have the ability, time, facility, or availability of parts that you have at your shop. After sitting out of service for a few weeks, they sent the P32 to your shop for you to look at the problem.

You get a heads up that the P32 Diesel is coming to your shop a couple of days before it arrives.

Challenge

What are the top three information sources you consult before looking at the problem yourself?

Your responses should include the information sources and what information it gives you.

2. State the <u>most important</u> information source and the information it gives you. *

3. State the <u>second most important</u> information source and the information it gives you. *

4. State the <u>third most important</u> information source and the information it gives you. *

Expert Tips

These are recommendations from an expert locomotive technician:

1. Go into the computer and read the notes from the work order to see what the previous mechanics did.
2. Read the Map 9 and the turnover sheet.
3. Talk to the foreman to see if they have any other information for you.

5. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Locomotive Arrival

The locomotive arrives dead at your shop. You go into the computer and read the notes from the work order to see what the mechanics previously did to correct the problem. There is a Map 9 defect on the P32, which explains the penalty brake issue. The foreman puts the Map 9 defect on the turnover sheet so you can access it. You have seen situations where locomotives never get a penalty or they never come out of a penalty, but this one just takes too long. You haven't seen anything like this before.

You run the locomotive through the 24 hour inspection again to verify the problem. When you get to the penalty test, you try to recover half a dozen times. Then, you let the locomotive sit in penalty until the light goes out to signify it meets the criteria to release and recover. You confirm that it takes almost 3 minutes to recover.

After the inspection, you replace the P2A valve and the H5 relay that could have caused the penalty brake issue. Sometimes you just throw parts at the equipment to see if it fixes the problem. Once you exhaust this solution, you realize this is an anomalous situation.

Challenge

What is your recommendation for next steps?

Your response should include your recommendation and the reason why you want to include it.

6. State your recommendation for next steps and the key reason why. *

Expert Tips

These are recommendations from an expert locomotive technician:

1. Get out the locomotive's schematics and check all the piping in the system.
2. Laminate the locomotive's diagrams to trace all the lines in the system.

7. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Locating the Airlines

Based on your experience, you decide it's a good idea to locate all the airlines on the physical equipment. You want to put your eyes on the parts to trace the entire system. You tape the lines in red electrical tape so you know which ones are part of the penalty system. Using the process of elimination, you remove every line and work your way through all of the valves. For every valve, there is another one attached to it, and there are several pipes intersecting underneath.

Challenge

During this process, what are the top three pieces of information you are paying attention to?

Your responses should include the pieces of information and the reason why you are including them.

8. State the <u>most important</u> piece of information you are paying attention to and the key reason why. *

9. State the <u>second most important</u> piece of information you are paying attention to and the key reason why. *

10. State the <u>third most important</u> piece of information you are paying attention to and the key reason why. *

Examining the Piping

During this process, you listen for air leaks. You take soap and water, spray the surface, and look for bumps. If there was an air leak, it would start bubbling like crazy. This trick has fixed hundreds of problems for you because minute air loss happens regularly. Then, you check the pressure relays and the pressure switch to make sure they operate correctly. A lot of times, there is an electrical side to the air system, especially in newer equipment. You do not find any issues, so you are stumped for a while. Overall, you examined about 20 feet of piping.

Detecting the Problem

You see that every valve bolts to a manifold. There are five different manifolds through the air system, and you check every manifold. You pull off the piping between the manifolds to ensure there is not any rot, rust, or debris inhibiting air flow. You remove every choke and check them by holding them up to a light and blowing through them. The choke diameters are less than ⅛ of an inch.

Eventually, you find a choke plugged with cotton. You cannot see through it. You immediately know this is the issue. Over the years, the cotton filter deteriorated and blocked the orifice. All you have to do is poke out the cotton. After pinpointing the problem and reassembling the problem, you feel confident sending the P32 Diesel back to its original location.

Expert Tips

These are recommendations from an expert locomotive technician:

1. Throughout the repair process, take notes and relay information to the foreman to put into the work order.
2. Reassemble the locomotive and run the brake test a multiple times to make sure the problem is solved.

11. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

P42 Diesel

Just as you send the P32 Diesel back out for service, there is another locomotive to deal with. It's the middle of the summer, and a P42 Diesel locomotive comes into your pit for a 24 hour inspection. The engineer says there is a strong smell of diesel fuel. After his daily morning call, your superintendent also tells you that several other locations have noticed the same smell on their P42 locomotives. These locomotives had been in service for years. All of a sudden, they started having the issues with the fuel smell at the same time.

Challenge

What is your biggest concern at this stage?

Your response should include your concern, the reason why you are including it, and a mitigation strategy to address the concern.

12. State your <u>biggest concern</u>, the key reason why you are including it, and your mitigation strategy to address the concern. *

Expert Tips

These are recommendations from an expert locomotive technician:

1. You should never smell fuel on a locomotive. The cab should be a completely sealed system. The locomotive should should immediately be taken out of service and taken to the shop.
2. When the windows are shut and the air conditioning is running, the fumes can cause incapacitation.
3. There cannot be a smell without a leak.

13. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Tracing the Lines

You locate the fuel pump and look at the pressure and return lines. You put gauges on different areas to check the fuel pressure. You do not see any drop in fuel pressure, and you do not see any physical leaks.

The fuel pump sits over the fuel tank, so you start tracing the lines. You refer back to the manuals to trace and track the entire fuel system. After tracing the lines, you find a small trickle of fuel on the underside of the locomotive. The trickle's location does not necessarily suggest a particular source because it is nowhere near where the refueling occurs.

Challenge

What is your recommendation for next steps?

Your response should include your recommendation and the reason why you want to include it.

14. State your recommendation for next steps and the key reason why. *

Locating the Issue

You put an air nozzle onto the return line with a regulator and feed air into it to see if you can hear a leak. When you put air into the return line, you hear it throughout the body, so you know the line is eroded somewhere. You determine that the crossover line deteriorated over the years and allowed the fuel to enter the framing of the equipment, which gave off the gas fumes. You located the issue, now you have to remove the existing fuel.

Expert Tips

These are recommendations from an expert locomotive technician:

1. Call the other facilities that experienced the same problem and let them know you located the source of the smell.
2. Get rid of the existing fuel that was trapped in the lines. Drill certain areas of the line to allow the fuel to escape.

15. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Yard Switcher

You feel confident after dealing with the P32 and P42 Diesels, and it has been a long day. Just as you're preparing to leave, you hear about another locomotive that needs your help.

A yard switcher, built in the 1950s, keeps having issues with the application and release of the yard engine. The switcher does not apply all the way or release all the way. Whenever someone makes an application, they get a brake application; however, the release takes a long time.

Mechanics working on the problem thought the issue was the service portion valve or the automatic brake control lever. Based on your experience, you know that changing these parts fixes the problem 80-90% of the time. In this case, changing the parts did not make a difference. You see the work order that says they already changed the control portion, the automatic brake control portion, and the CDW valve.

Challenge

What are three other pieces of information that would be helpful to know?

Your responses should include the pieces of information and the key reason why you are including them.

16. State the <u>most important</u> piece of information that would be helpful to know and the key reason why you are including it. *

17. State the <u>second most important</u> piece of information that would be helpful to know and the key reason why you are including it. *

18. State the <u>third most important</u> piece of information that would be helpful to know and the key reason why you are including it. *

Cracking the Lines

Even though the mechanics changed out the control portion, the automatic brake control portion, and the CDW valve, you put in new ones to ensure they were not bad. Then, you conduct your normal routine to see what piping connects the system. You trace the airflow. There are specific numbered lines for specific jobs, and the lines do not all go to the same valve. The last place that the air pressure goes is the brake cylinder.

You crack the lines going from the automatic brake control lever to the service portion. When you crack line 16, water pours out like a garden hose. You do not expect it to have that much water in it.

Challenge

What is your recommendation for next steps?

Your response should include your recommendation and the reason why you want to include it.

19. State your recommendation for next steps and the key reason why. *

Challenge

Do you have any concerns at this point?

Your response should include any concerns you have and the reason why you are concerned.

20. State any concerns you have at this point and the key reason why. *

Expert Tips

These are recommendations from an expert locomotive technician:

1. Before taking the lines apart, there was no way to tell there was water in there. However, be cautious because breaking things apart can lead to even more issues, and you might have to fix everything you touch.
2. Crack every single line, 40 total, and remove them to ensure there is no water anywhere else.

21. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Detecting the Problem

After the water stops, you reconnect everything. You realize that, over time, the drops of moisture built up. The piping had a little trap of fluid. Whenever the air came in, it moved the fluid to the valve and would not allow it to do its job, so the fluid moved backwards. In this situation, the spring could not overcome the liquid, so it stalled.

Challenge

What can you do to prevent this issue from happening again?

Your response should include your prevention strategy and the reason why you included it.

22. State your prevention strategy and the key reason why you included it. *

Expert Tips

These are recommendations from an expert locomotive technician:

1. You should never see moisture, which is why locomotives have air dryer systems.
2. If they had drained the main res every day, this problem would not have occurred. As long as they do regular maintenance, the locomotives are fine to operate.
3. There are test ports that you can put in a gauge that tell you how much air pressure there should be.

23. Do you understand the expert tips? *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Lessons Learned

You have completed the Mechanical Repair Game.

List three key lessons you learned from this case study that you can apply in future cases.

24. State the <u>first lesson</u> you learned from this case study and how you will apply it in future cases. *

25. State the <u>second lesson</u> you learned from this case study and how you will apply it in future cases. *

26. State the <u>third lesson</u> you learned from this case study and how you will apply it in future cases. *

Derailment Decision Game

You are training to be a first responder in your organization to investigate derailments. The role will place you in charge of gathering evidence and determining the root cause of the incident.

You have the good fortune of training under a true master, who challenges you with a series of cases drawn from experience.

Carefully think through the information you receive, then meet the challenges!

* Indicates required question

1. **Email** *

Derailment #1

A train derailment killed seven people and injured several others. The vehicle went over a track defect, but only the sixth car in the train derailed. The first five cars and the last three cars went over the track without an issue.

Challenge

What might have caused the sixth car to be more susceptible to the track anomaly than any of the other cars in the train?

Your response should include your answer and the reason why you think that.

2. **State what might have caused the sixth car to be more susceptible to the track anomaly and the key reason why you think that.** *

Challenge

What pieces of information you are paying attention to?

Your responses should include the pieces of information and the reason why you are including them.

3. **State the <u>most important</u> piece of information you are paying attention to and the key reason why.** *

4. **State the <u>second most important</u> piece of information you are paying attention to and the key reason why.** *

Expert Tips

These are recommendations from an expert derailment investigator:

1. The vehicle defect and the track defect had to come together for the incident to occur.
2. A lot of people look at everything in isolation, but you must look at all the elements performing as a system.

5. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Cause of Derailment #1

Vehicle inspectors look for certain things that make the vehicle unsafe, but they might not look at issues related to Vehicle/Track Interaction.

All vehicles have harmonic frequencies associated with their geometry. The vehicle's harmonic frequency is a natural function of its design.

The elements of vehicle dynamics factored into this derailment because the harmonics and natural frequencies of the vehicles and their suspensions reinforced the same shape into the track surface, creating worse conditions.

For example, there are elements of the highway that affect how a car responds to the surface because of the time-distance connection. If you're driving down the highway at 60mph (88 ft. per second), and the natural frequency of the suspension system is 1 hertz (which is typical), the vehicle's natural frequency is 1 hertz in 1 second. If there is a dip in the highway that is exactly 88 ft. long, the car will react badly to that dip. If the dip is 60 ft. long or 100 ft. long, the car won't react as much.

When the rail cars travel at the same speed, at the same location, over and over again, a dip can form in the track. The track gets dents and starts relating to the natural frequency of the vehicles. The harmonic frequency of the passenger cars was 1 hertz. The car bounced at its maximum rate when there was a dip.

The sixth car bounced off the track and experienced hysteresis.

Derailment #2

An electronic locomotive has a propensity to derail, but no one can figure out why. Every once in a while, mostly in yards or terminals at low speeds, the locomotive pops off the track for no apparent reason. Everything on the electronic locomotive was brand new because it just came out of the shop. The locomotive derailed on a brand new switch and all the measurements were within spec, so no one could figure out what was wrong.

You learn that the locomotive has a very soft primary suspension, which is pleasing for the engineers because it lowers the impact of the locomotive on the track; however, the suspension is only soft until it reaches a hard stop. The engine reaches the hard stops at a lower level than most other pieces of equipment.

Challenge

What other pieces of information would you like to know?

Your responses should include the pieces of information and the reason why you are including them.

6. **State the <u>most important</u> piece of information you would like to know and the key reason why.** *

7. **State the <u>second most important</u> piece of information you would like to know and the key reason why.** *

8. **State the <u>third most important</u> piece of information you would like to know and the key reason why.** *

Expert Tips

These are recommendations from an expert derailment investigator:

1. Every spring has a limit. They can only expand and compress so much.
2. Particular shapes of track are bad for particular designs of suspension.
3. When investigating derailments, find the shape that the vehicle doesn't like and then find that shape somewhere on the track.

9. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Cause of Derailment #2

If you think about the four wheels of a train car, they have to be able to accommodate the bumps and dips on the track independently of each other. The whole design is around equalization while still keeping weight on the rail to keep the train on the track.

At certain points, one of the train's corners would reach its limit. The springs could only expand and compress so much. When it reached its limit, the suspension went solid and picked up the wheel in the air.

This all depends on how the suspension is designed and how it interacts with the four elements of suspension within the same track and correspondingly with the four elements of suspension on the vehicle. If the track condition creates a certain element, it can cause the wheels to lift off of the track.

A similar phenomenon occurs in new front wheel drive cars, particularly Volkswagens. When the front tire goes onto the sidewalk, the rear tire comes up off of the pavement, too. Most of the weight is in the front of the car, so the front of the car dictates how the body moves.

Derailment #3

You arrive at a derailment location about an hour after it occurred. You see all kinds of broken equipment; however, the pile of equipment is not where the derailment actually occurred. No one knows why the train went to the ground. Other investigators point to track issues.

You find a broken wheel with growth rings on it next to the track. As you walk further along the track, there are dents in the rail every 10 feet. You are curious if the broken wheel caused the derailment of if the track caused the broken wheel.

Challenge

Based on the limited information you have, what do you think caused the derailment?

You response should include the cause of derailment and the reason why you think that.

10. **State what you think caused the derailment and the key reason why.** *

Challenge

What is the most important factor you are considering?

Your response should include the factor you are considering and the reason why you are including it.

11. **State the most important factor you are considering and the key reason why.** *

Expert Tips

These are recommendations from an expert derailment investigator:

1. The pile of broken equipment usually isn't where the derailment actually occurred because of inertial momentum.
2. Look for marks on the rail until they aren't there anymore.
3. Look for more pieces of the wheel until you find them.
4. Try to understand why the wheel failed.

12. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Cause of Derailment #3

The growth rings meant that the initial fracture was inside the wheel. The wheel had about 100,000 miles on it before it failed. The broken wheel started banging on the track and damaged the track. It was like a 35,000 lb. sledgehammer banging on the axle bearing, and the bearing gave up.

The point of derailment actually occurred where the axle gave up and dug the car into the ground. The car instantly stopped, and 70 loaded coal cars crashed into it.

In this case, the wheel's defect would have been discovered if they performed an ultrasonic inspection of the wheel before the train departed; however, the inspection costs more than the wreck itself.

Derailment #4

The two middle cars in a four car passenger train with 25 passengers derailed and destroyed a lot of track. The engineer missed a switch. He should have either climbed over the rail or turned left, but he did a little bit of both.

The engineer and the conductor were in the front of the train when it came to an abrupt stop and came off the track. They thought it was a propulsion problem, so they reset the controller and went after it. The locomotive hit the bridge above them.

The train was nowhere near the point of derailment. It was about 1,500 feet away. When you got to the site, you saw flange marks on the rail. The flange marks were the first place the wheel touched the ties, but it was not where the wheel derailed. The wheel actually derailed by the signal, ran along the top of the rail, then fell over. The lead wheel of the third car was the first one to derail.

Most people pinpointed the flange marks as the point of derailment.

Challenge

What are three other pieces of information you need to know to determine the cause of derailment?

Your responses should include the pieces of information and the reason why you are including them.

13. **State the <u>most important</u> piece of information you need to know and the key reason why.** *

14. **State the <u>second most</u> important piece of information you need to know and the key reason why.** *

15. **State the <u>third most</u> important piece of information you need to know and the key reason why.** *

Expert Tips

These are recommendations from an expert derailment investigator:

1. The flange marks mean a wheel was touching the ties.
2. Most people pinpoint the flange marks as the point of derailment, but that is not always the case.
3. The Nadal Formula is an equation for determining at what point a wheel flange will climb over the rail and derail. The forces required for the wheel to climb the rail are lateral force and friction. The elements that prevent it from climbing the rail are vertical force and friction. As the friction goes down, the tendency of the wheel to climb the rail goes down. As the friction goes up, the tendency of the wheel to climb the rail goes up. As the weight on the wheel goes up and down, it has the same effect with the weight of the lateral force on the wheel.

16. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Cause of Derailment #4

There were many circumstances leading to the derailment.

Low speed derailments are caused by a combination of things that affect the suspension of the car and how the wheels equalize. As the car negotiates the undulations on a piece of track, it has to twist and roll. The wheel's weights change based on how the suspension is compressing and relaxing. The car came around a curve at 7 mph, and the weight transferred towards the back of the car. When the car came around a hill, there was an increase in weight on the high rail. When the track dipped, the lead wheel lost weight, and the spring extended.
There were two other extenuating circumstances in this situation. The car wheel had recently been resurfaced, which increased the friction by a huge amount. A freshly trued wheel has marks on it from the billing machine, so there are grips like snow tires. Once the wheel wears in, it gets better. In this instance, there was a substandard 67-degree flange angle on the new wheel. The 27 degrees gauge face angle and the 67 degrees flange angle correspond against each other because the only trains that ever use this route are the same trains. The gauge face angle should be no less than 30 degrees. There is an actual standard that says a flange angle on a new wheel should be 75 degrees and no less than 72 degrees. The particular railroad resurfaces their wheels to 67-degree flange angles, so train after train runs over this particular track and wears the rail to the shape.

The railroad had substandard conformal contact being driven by a wheel maintenance practice that is out of standard. The railroad's wheel shop never updated from the old AAR wheel standards. They just kept doing what they were doing because they said it worked for them, which is one of the biggest problems in the railroad industry. The railroad was still cutting their wheels to a substandard degree. The old milling machines all produce the 67-degree flange angle even though it was considered unsafe.

Lastly, the Nadal formula is a ratio of lateral to vertical force in combination with the friction on the rail. There is a number between 0 and 1 called the L/V Ratio. You always want the L/V ratio to be less than 1. At 1, the lateral force = vertical force, so they cancel each other out and friction completely takes over. You have these diametrically opposing elements trying to derail the wheel and trying to prevent the wheel from derailing. As long as the L/V ratio of the actual wheel is less than the L/V ratio calculated by the elements of the gauge face angle and friction using the formula, the train does not derail. If the L/V ratio of the wheel force exceeds the L/V ratio calculated by the Nadal ratio, the train will climb the rail and derail.

Overall, there was a brand new wheel, the back of the car was in a sag, and the lead wheel unloaded the wheel in a low joint. The L/V ratio was lower than the actual L/V ratio generated by the train itself. The 67-degree flange angle allowed for a convenient ramp, and the new wheel created high friction. Interestingly, if it was raining or there were 100 passengers on the train, the derailment would not have happened.

Derailment #5

A commuter train came into a station around a sharp curve. It was a push-pull train with a locomotive on the rear, a bunch of cars in the middle, and a cab car in the lead.

The dispatcher had the engineer stop and wait for another train to clear before going into the station. The engineer stopped at the stop signal. This particular diesel derailed itself on the curve. The locomotive was sitting on the ground, but the engineer had no idea the train derailed because he was 12 cars ahead of it. When he got the clearance signal, the train did not move. The ground fault relay tripped out, so the engine did not load. The engineer tried resetting it, but it would not go. As a result, the engineer called a locomotive failure.

They evacuated all the passengers and brought a rescue engine down and coupled it up with the locomotive. The locomotive would not get pulled. This went on for 45 minutes before anyone even knew the train was derailed.

Challenge

How could this derailment have been avoided?

Your response should include how the derailment could have been avoided and the reason why you think that.

17. **State how you think this derailment could have been avoided and the key reason why.** *

Cause of Derailment #5

Diesel trains have power braking, so there is slack between the cars. Engineers try to work against the slack action, so they keep the train bunched or stretched. In the case of a push-pull train, they usually have the engine push against the train while the brakes are on to keep it bunched so people do not get jerked around. This particular diesel spun out and derailed itself on the curve.

If the lead car loads faster than the trailing car and it pulls the car to the right, it might jerk the wheel and pull it back to engage, but the derailment would never happen.

Lessons Learned

You have completed the Derailment Decision Game.

List three key lessons you learned from this case study that you can apply in future cases.

18. **State the <u>first lesson</u> you learned from this case study and how you will apply it in future cases.** *

19. **State the <u>second lesson</u> you learned from this case study and how you will apply it in future cases.** *

20. **State the <u>third lesson</u> you learned from this case study and how you will apply it in future cases.** *

MW1000 Decision Game

You recently completed your MW1000 training, and you are officially a track foreman. It's your first week on the job, and you are ready for your new responsibilities.

* Indicates required question

1. Email *

Derailment #1

It's Monday morning, your first official day as a track foreman. Before you get settled in for the day, you are notified that there was a fatal derailment over the weekend. The derailment killed seven people and injured several others. Investigations revealed that the train went over a track defect, but ***only the sixth car in the train derailed***. The first five cars and the last three cars went over the track without an issue. Everyone is confused why only the sixth car derailed.

In your new role, people are turning to you to help determine the cause of the derailments.

Challenge

What might have caused the sixth car to be more susceptible to the track anomaly than any of the other cars in the train?

2. **State what might have caused the sixth car to be more susceptible to the track anomaly and the key reason why you think that.** *

Expert Tips

These are recommendations from an expert derailment investigator:

1. A lot of people look at everything in isolation, but you must look at all the elements performing as a system. The vehicle defect and the track defect had to come together for the incident to occur. Consider track surface and harmonics of the car.
2. All vehicles have harmonic frequencies associated with their geometry. The vehicle's harmonic frequency is a natural function of its design.
3. Sometimes, the track defect or conditions are made worse due to equipment issues like wheel flanges.

Cause of Derailment #1:

- The elements of vehicle dynamics factored into this derailment because the harmonics and natural frequencies of the vehicles and their suspensions reinforced the same shape into the track surface, worsening conditions.
- When the rail cars travel at the same speed, at the same location, over and over again, a dip can form in the track. The track gets dented and starts relating to the natural frequency of the vehicles.
- In this derailment, the car bounced at its maximum rate when there was a dip.
- The sixth car bounced off the track and experienced hysteresis.

3. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Derailment #2

You are confident that you determined the correct cause of the first derailment, and you are ready to move on to more routine tasks. After a long first week, you are looking forward to the weekend when you get a call. There's been another derailment, and everyone is concerned about two derailments in such a short period of time. Following the first, most people immediately blame the track.

You are told that the two middle cars in a four car passenger train with 25 passengers derailed and destroyed a lot of track. Apparently, the engineer missed a switch. The engineer and the conductor were in the front of the train when it came to an abrupt stop and came off the track. They thought it was a propulsion problem, so they reset the controller and went after it. With all the bucking and booming and crashing of the train, the engineer and conductor kept after it until the locomotive hit the bridge above them.

When you get to the site an after hour you received the call, the train is nowhere near the point of derailment. It is about 1,500 feet away. You see flange marks on the rail. People are pinpointing the flange marks as the point of derailment...

Challenge

What are three other pieces of information you need to know to determine the cause of derailment?

Your responses should include the pieces of information and the reason why you are including them.

4. **State the __most important__ piece of information you need to know and the key reason why.** *

5. **State the __second most important__ piece of information you need to know and the key reason why.** *

6. **State the __third most important__ piece of information you need to know and the key reason why.** *

Expert Tips

These are recommendations from an expert derailment investigator:

1. The flange marks mean a wheel was touching the ties.
2. Most people pinpoint the flange marks as the point of derailment, but that is not always the case.
3. The Nadal Formula is an equation for determining at what point a wheel flange will climb over the rail and derail. The forces required for the wheel to climb the rail are lateral force and friction. The elements that prevent it from climbing the rail are vertical force and friction. As the friction goes down, the tendency of the wheel to climb the rail goes down. As the friction goes up, the tendency of the wheel to climb the rail goes up. As the weight on the wheel goes up and down, it has the same effect with the weight of the lateral force on the wheel.

Cause of Derailment #2:

- The flange marks were the first place the wheel touched the ties, but it was not where the wheel derailed. The wheel actually derailed by the signal, ran along the top of the rail, then fell over. The lead wheel of the third car was the first one to derail. The wheel finally hitting the ground is not always the point of derailment, especially when switches are involved.
- Low speed derailments are caused by a combination of things that affect the suspension of the car and how the wheels equalize. As the car negotiates the undulations on a piece of track, it has to twist and roll. The wheel's weights change based on how the suspension is compressing and relaxing. The car came around a curve at 7 mph, and the weight transferred towards the back of the car. When the car came around a hill, there was an increase in weight on the high rail. When the track dipped, the lead wheel lost weight, and the spring extended.
- There were two other extenuating circumstances in this situation. A freshly trued wheel has marks on it from the billing machine, so there are grips like snow tires. Once the wheel wears in, it gets better. The gage face angle should be no less than 30 degrees. There is a standard that says a flange angle on a new wheel should be 75 degrees and no less than 72 degrees. This particular railroad resurfaces their wheels to 67-degree flange angles, so train after train runs over this particular track and wears the rail to the shape. The car wheel had recently been resurfaced, which increased the friction by a huge amount. In this instance, there was a substandard 67-degree flange angle on the new wheel. The 27 degrees gage face angle and the 67 degrees flange angle corresponded against each other because the only trains that ever used this route were the same trains. The railroad had substandard conformal contact being driven by a wheel maintenance practice that is out of standard. The railroad's wheel shop never updated from the old AAR wheel standards. They just kept doing what they were doing because they said it worked for them, which is one of the biggest problems in the railroad industry. The railroad was still cutting their wheels to a substandard degree. The old milling machines all produce the 67-degree flange angle even though it was considered unsafe.
- Lastly, the Nadal formula is a ratio of lateral to vertical force in combination with the friction on the rail. There is a number between 0 and 1 called the L/V Ratio. You always want the L/V ratio to be less than 1. At 1, the lateral force = vertical force, so they cancel each other out and friction completely takes over. You have these diametrically opposing elements trying to derail the wheel and trying to prevent the wheel from derailing. As long as the L/V ratio of the actual wheel is less than the L/V ratio calculated by the elements of the gage face angle and friction using the formula, the train does not derail. If the L/V ratio of the wheel force exceeds the L/V ratio calculated by the Nadal ratio, the train will climb the rail and derail.
- Overall, there was a brand new wheel, the back of the car was in a sag, and the lead wheel unloaded the wheel in a low joint. The L/V ratio was lower than the actual L/V ratio generated by the train itself. The 67-degree flange angle allowed for a convenient ramp, and the new wheel created high friction. Interestingly, if it was raining or there were 100 passengers on the train, the derailment would not have happened.

7. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Inspecting and Maintaining Track - Looking for "Hot Spots"

With your first week and two derailments behind you, you turn your focus Monday morning to inspecting and maintaining the 200 miles of company track that you oversee. You have a set schedule and frequency to inspect different parts of your track every week, and you are starting to recognize certain hotspots to inspect for potential problems.

During your inspections, you look for any movement or any anomalies. If you see something concerning when trains are running that day, you want to get the maintenance crew out there right away.

Challenge

Are there any particular areas (hot spots) on the track that you are paying closer attention to than others?

8. **State the hot spot you are __most concerned__ about and the key reason(s) why.** *

9. **State the hot spot you are __second most concerned__ about and the key reason(s) why.** *

Challenge

Which senses might you use in your assessment process?

10. **State which senses you might use in your assessment process and the key reason(s) why.** *

Expert Tips

These are recommendations from an expert on inspecting the track:

1. As the train travels over the tracks, the sounds of the rail should be consistent.
2. Consider how the weather affects the track. Anytime the temperature gets above 90 degrees around here, you know you need to do heat inspections. Rail grows in the heat, which you record for the FRA. When the temperature is around 20 degrees start doing cold inspections after. The rail will pull apart or sometimes break if there are flat spots on the rail because the cold temperature makes the rail more brittle. You can be more proactive by doing cold inspections on the first day the temperature dips below freezing.
3. The Geo car inspects the track as a train runs and provides data for each territory.
4. Encourage your train crews to also keep an eye on the tracks, and report the hazards they identify.
5. Notice things that intuitively arise in the body telling you when tracks need attention.

11. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Pushing Back

During one of your routine inspections, you find a major track defect on one of your tracks. You come up with a plan to fix the track and continue inspections; however, you have a feeling you should notify the FRA of the issue.

Before contacting the FRA, you have a meeting with your manager to discuss the track defect and your plans moving forward. He is old school and often tries to talk track foremen out of putting up restrictions and taking tracks out of service. You tell your manager that you want to notify the FRA. He responds, "If they find out about the defect, we can tell them. But I don't think we should say anything before that." Your manager doesn't want the FRA to take your entire track out of service.

You push back. You are a little nervous because you disagree with your manager. You could lose your job if you tell the FRA and they ground the entire operation until it is fixed.

However, you think of the worst-case-scenario: a train could derail and injure or kill the passengers. You tell your manager about your previous experience with a different organization where you never lied to the FRA. You also have a friendly relationship with the FRA representatives in your area. In your opinion, they are level-headed and reasonable people.

Despite your manager's concerns, you call your FRA representatives and ask them if they have time to come to your property tomorrow. You tell them you want to show them something you found on your track.

Challenge

How confident are you in your decision to tell the FRA? Explain your rationale.

12. **Rate your confidence on a scale of 1 - 5** *

Mark only one oval.

1 2 3 4 5

Not ○ ○ ○ ○ ○ Very confident

FRA Visit

The FRA comes to your site the next morning, and you tell them about your situation. You walk them to the track and show them the issue. You also provide additional pictures and inform them of your plan to repair the track.

You ask the FRA representatives, "Where do we go from here?"

They tell you that they are comfortable with your plan and to let them know when you repair the track. You are happy with your decision to tell the FRA about the issue, and your manager is not upset with you.

Expert Tips

These are recommendations from an expert supervisor on relationships with the FRA:

1. Safety comes first. Then, you can fix the track so no trains derail and no one gets hurt.
2. Be proactive and transparent with your plans (daily inspections, standard operating procedures, etc.)
3. Do not hide things from the FRA because they will likely find out one way or another.
4. When you are truthful and honest with the FRA, they are more likely to stay out of your business and trust you.

13. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Trees, Brush, and Dealing with the Locals

Just as the track issue winds up, you start to notice people dumping stuff on your railroad tracks. During a routine inspection, a section of your track looks like a garbage dump. There's a tree nursery down on your South Line, and they regularly dump pine cuttings on your track. It affects the drainage on the track, and it's a tripping hazard.

You head down to the tree nursery to ask them to move their pine cuttings, but you can't find any who speaks English. You and your crew decide to go down there with a plow and roll it all back. While you're moving the trash, a guy from the tree nursery sees this, gets upset and says, "You can't do that."

Challenge

What is your recommendation for next steps?

14. **State your recommendation and the key reason why.** *

Challenge

Which emotions arise when you consider taking this action?

15. **State which emotions arise when you consider taking this action.** *

Challenge

How do you want your company to be perceived by the other companies that border your property?

16. **State how you want your company to be perceived and the key reason why.** *

Expert Tips

These are recommendations from an expert on dealing with this situation:

1. Pause and reflect on how best to handle emotional outbursts from others before reacting.
2. Be firm but civil in your response.
3. Be a good role model for others, and recognize they will likely follow your actions.

17. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Company Relations

You tell the guy at the nursery, "Our railroad owns 25 ft. from the center track. You can't dump trash on my track. If you want to dump it outside of 25 ft. of my track, you can do that." You let him know that you are just trying to take care of your track, and you would appreciate it if they stopped dumping their trash on it. If they do it again, you will bulldoze the trash all the way onto their property next time.

You leave the nursery a little worked up, but you have to complete a routine inspection at another location the same day. Almost immediately upon arrival, something dangerous catches your eye as you are watching a train enter the terminal from the mainline.

Challenge

What types of defects are you looking for?

18. **State the kind of defect you are __most concerned__ about and the key reason(s) why.** *

19. **State the kind of defect you are __second most concerned__ about and the key reason(s) why.** *

20. **State the kind of defect you are __third most concerned__ about and the key reason(s) why.** *

Expert Tips

These are recommendations from an expert on routine inspections:

1. Look at gages, curves, switch points, frog points, frog guards, broken rails, bolts out of a joint, mud, and high spikes. These are the "usual suspects."
2. Look for surface issues, such as profile or cross level in the switches coming off the main into a siding, maybe reverse elevation.
3. If you look down the track, at the head wear on the rail, you can see if it's shiny in one place and not another. You know it's spreading because the wheels aren't contacting as much rail as it should. There should be full contact across the rail.
4. Look at the side car for plate cuts and ties. If it's moving, you'll see the cut tie where it's pushing in and out.
5. Don't be afraid to pull out your checklist and look beyond the usual suspects.

21. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Finding the Issue

When you get closer to the track, you watch the plate cut and the ties. You know something is off. The gage spot is about 50 feet.

Challenge

What is a possible explanation for this issue?

22. **State __one possible explanation__ for this issue and your rationale.** *

23. **State __a second possible explanation__ for this issue and your rationale.** *

Expert Tips

These are recommendations from an expert on detecting the problem:

1. The tie plate can move when the spikes are loose.
2. Look for rails spreading when it goes under load.
3. Confirm your visual inspection with your tape measure, and measure the head of the rail. Always use Amtrak's dynamic measurement - consider speed and measurement under load - because it is a judgment call situation.
4. Even if the rails are within specifications, the plate cut under load can move a couple more inches.
5. Amtrak has a maximum plate cut that makes ties ineffective, so the gage spot could turn into a spot with excessive, ineffective ties until plugged and spiked or replaced.

24. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Observing the Tracks

You determine that the tie plate is moving because the spikes are loose. Sometimes they stick up, sometimes they don't. If you see a half inch cut or the plate has been going back and forth, you know it has been spreading when it goes under load.

You take out your tape measure and measure the head of the rail. The actual gage itself is 57 ½ inches, but the plate cut adds to the measurement. With the plate cut, the gage is over 58 inches, which is beyond the limit. You know you have to take that track out of service.

You can't run trains on the track because of the wide gage right at the gate. The trains might make it across the rail a few times, but you know it's spreading. Trains are going to hit the ground if you don't fix this problem.

Challenge

What are __three__ recommendations for next steps?

25. **State your __first recommendation__ and the key reason why.** *

26. **State your __second recommendation__ and the key reason why.** *

27. **State your __third recommendation__ and the key reason why.** *

Expert Tips

These are recommendations from an expert on

__Observing the tracks:__

1. A plate cut over 1/2 inch makes the tie ineffective.
2. A gage over 58 inches takes the track out of service.
3. More than 3 ineffective ties in a row also takes the track out of service.
4. With one defect, you could put a 213.9(b) on the siding track for 30 days to keep it running, but with the ties *and* the gage seeming to be bad, you should take the track out of service to avoid derailments.

__Next steps:__

1. Take a picture of the wide gage with your cell phone.
2. Mark the spot on the rail so you don't lose track of where it is.
3. Call the Train Dispatcher (or block operator) and tell them that the track needs to come out of service.

28. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Taking the Track Out of Service and Working with a New Group

You call the Train Dispatcher to take the track out of service, and you have a chat with your supervisor about what is going on with the track.

Within minutes, your supervisor sets up a group to repair the track. Another foreman shows up with a gang to fix the track. You haven't worked with this particular group before. They introduce themselves and ask you questions to gather all the necessary information for the repair.

After showing them the issue and explaining the cause, you overhear the gang discussing their plan to repair the track. They want to put five ties in a row in the spot where the gage is wide.

You disagree with their plan. You must communicate how you want the track fixed to ensure it is done correctly.

Challenge

What is your recommendation to fix the track?

29. **State your recommendation and the key reason why.** *

Challenge

How will you communicate to the gang that you disagree with their plan to repair the track?

30. **State how you plan to communicate to the gang that you disagree with their plan to repair the track?** *

Expert Tips

These are recommendations from an expert on:

__Fixing the Track:__

1. The fix needed is a gage correction.
2. You prefer to spread the ties throughout the curve, rather than only fixing the ties in one spot.
3. Ties must meet Amtrak's minimum requirements depending on the class of track. In this situation, the *minimum* standard is a good tie every third tie in a curve to limit plate movement. For a straight track, the *minimum* standard is a good tie every fifth tie. Nobody is going to change out every tie every time, so you want to develop a good rotation.
4. Be proactive to prevent other issues from occurring in the future.

__Presenting Your Recommendations:__

1. Show the gang respect. Ask for their thoughts and suggestions.
2. Explain the wide gage issue and that the plate cuts are causing it.
3. Suggest changing some of the ties because they are spongy and spreading the ties throughout the curve.

31. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Working with the Foreman and His Gang

You pull the foreman to the side to talk to him privately. You ask him, "What are your thoughts? What do you think?" You want him to feel involved. He repeats his gang's plan, which is to put five ties in a row in the spot where the gage is wide.

You say, "That's a good idea, but how about we spread out the ties throughout the curve, and we take care of all of the tie issues at once with a plate cut tie? I'm looking for the gage correction. You can meet minimum standards by just fixing a few ties, but if you throw a handful of ties at this curve, it will probably help us both in the long run." You want to be proactive, but you also want to show respect to the foreman and his gang so they feel like they are making their own decisions.

Fortunately, the foreman takes your ideas into account. He is good to work with, and he's a good person. He thanks you for your suggestions.

Fixing the Track

The foreman asks you when you need the track back in service. You say, "I needed it yesterday, but I'll take it today." The foreman discusses the plan with his gang and says they can get it done in the next two hours.

You tell the foreman you're going to go about another site, but you'll be local. Within a half hour, the gang is working on the track. The quick response shows how important it is for the trains to get into the terminal.

A couple hours later, the foreman gives you a call and says, "We got it done. Do you want to come take a look?"

The foreman is waiting for you when you get there. You walk the track and look at the repairs together. You want to check the gang's work to make sure everything works properly before returning the track to service.

The gang replaced about five ties. You take out your tape measure and measure the ties. You take pictures with your cell phone. You mark the spot on the side of the rail with soap from your vest pocket, in case you lose track of where it was. The track looks good to you.

You tell the foreman and his gang that they did a great job. You thank them for their quick response and hard work.

Fixed Track

The whole process from finding the defect to operating again takes about four hours. The four-hour delay stops your crew from operating there, which is not good. That's where delays, accidents, and customer complaints come from. But you either put a bunch of cars in the ground, possibly injuring passengers, or you get it fixed right away. You prefer the latter.
When everything is fixed, you call the Train Dispatcher to open the track back up.

Challenge

What might you do to ensure that future issues like this go as smoothly?

32. **State your recommendation to ensure that future issues like this go as smoothly and the key reason why.** *

Expert Tips

These are recommendations from an expert on handling this situation:

1. Throughout the entire process, show the gang respect. Be encouraging but not directive. They need to know that they are making their own decisions.
2. Tell them when they do a good job, and thank them for their hard work.
3. Emphasize that this is a collaborative effort, stressing your respect for them.
4. Occasionally, show your appreciation for their good work by treating the gang to lunch or a box of donuts.

33. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Dealing with a Hot-Headed Employee

It's been a busy few weeks, but you feel like your operation is going smoothly. You are gaining confidence as a track foreman. Overall, you are happy with your crew, but you are slightly concerned about one crew member in particular.

His previous manager said he was a great worker but warned you that he could be a hothead sometimes. Within the first few weeks, you noticed his irritability, but it wasn't a major problem.

You witness his anger culminate as you walk the track today. While fixing a difficult switch, he gets aggravated. He yells a cuss word and throws a switch point clamp across the yard.

Challenge

What is your recommendation for dealing with this situation?

34. **State your recommendation for dealing with this situation and the key reason why.** *

Expert Tips

These are recommendations from an expert supervisor on dealing with an employee in this situation:

1. Ask the employee to step away and take a walk.
2. After the employee cools down, tell them it is okay to get frustrated, but it is not okay to cuss and throw things.

35. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Ignoring the Rules

You handle the situation with the hot-headed employee by telling him to step away and take a walk. After he cools down, you let him know that it is okay to get frustrated, but it is unacceptable to cuss and throw things across the yard.

After that incident, you start paying attention to other behaviors among the crew members. As a track foreman, you see a lot of things from across the yard. You start to notice some inconsistency between the rules and what some train crew members are doing. For example, the rulebook states that employees cannot get on and off moving equipment, yet you see people getting on and off moving equipment all day long.

You mention that to your track crew members to make a point, asking, "Why are they getting on and off the equipment when the rule says they can't?" One of your crew members responds, "They've probably been doing it that way for years. If everyone else is doing it that way, I wouldn't follow that rule either." In your experience, you know that practices are learned through word of mouth, and the less experienced workers will think it's okay for them to ignore the rule, too.

You go to your manager and tell him what you're seeing with the train crews. He says they changed the rule to allow people to get on and off moving equipment, but they never updated it with documentation. This whole situation isn't sitting well with you because you want to ensure a safe operation for all the crew members. You wonder if the safety rules for track crews are out of date, too.

Challenge

What are three things you can do to sort out this situation?

36. **State the option you have the <u>most confidence</u> in and the key reason you are including it.** *

37. **State the option you have the <u>second most confidence</u> in and the key reason you are including it.** *

38. **State the option you have the <u>least confidence</u> in and the key reason you are including it.** *

Expert Tips

These are recommendations from an expert supervisor on dealing with rule inconsistencies:

1. When practices are inconsistent, it is important to update the rules structure and make sure everyone is on the same page.
2. You can put out a General Order to change the rule. Be specific about when people can and cannot get off moving equipment.
3. Tailor training based on who you are working with, and have more experienced people help teach the trainees based on the most current rules as a standard of practice.

39. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Employee Disagreements

At this point, you feel like you're getting to know all of your crew members except for one inspector. He's not very communicative with you or his coworkers. It's hard to get to know him because he keeps to himself, but he's great at his job.

When he writes up defects on the track, the crew often complains that he is wrong. The crew thinks a lot of the defects are subjective. The inspector's feelings get hurt when the crew questions his authority and expertise, and it has been an ongoing issue.

Both the inspector and the crew report their frustrations with you, so you must address the situation.

Challenge

What is your recommendation for dealing with this situation?

40. **State your recommendation for dealing with this situation and the key reason why.** *

Challenge

What is your biggest concern at this point?

41. **State your biggest concern and the key reason why.** *

Expert Tips

These are recommendations from an expert supervisor on dealing with employee disagreements:

1. Listen and empathize with others. Try to understand why both sides are upset. Let each side know you will talk to both sides about the issue.
2. Not everyone has to agree, but people need to be able to disagree and still have a relationships.
3. Most of the time, when people come to you to talk, they are not even looking for a response. They just want to tell you how they feel.
4. Let your employees know you are there to talk, and they can always come to you.

42. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Dealing with a Frustrated Employee

There is a senior crew member who is rather boisterous and quick to express his opinion on everything. He is known for trying to talk his other crew members of out doing work. To make matters worse, the weather is changing and temperatures are dropping. This particular crew member is complaining even more than usual.

On Friday, your supervisor gives you the day's work assignment, and you take your crew out to discuss their tasks for the day. The crew is set to replace a bunch of ties around a curve.

This particular crew member is frustrated because it's freezing outside and the ground is hard, so digging and replacing ties is more difficult. He spends 15 minutes complaining about all the work they have to do in front of the entire crew.

He says, "This is ridiculous, I can't believe they're making us do this. It's too much work, and this weather is miserable." This escalates to the point where your supervisor overhears the employee complaining and stops by to listen in. He just looks at you and rolls his eyes.

Challenge

What can you say or do at this point, if anything, to manage this crew member's frustration?

43. **State what you want to say/do and the key reason why.** *

Expert Tips

These are recommendations from an expert on dealing with a frustrated employee:

1. This type of situation will be a daily struggle with some of the crew members. People are always trying to get out of work or shorten the work day.
2. Acknowledge his disappointment in and his frustration with having to do hard work in the cold weather, but let him know the work has to get done.

44. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Mitigation Strategy

This type of behavior is an almost everyday occurrence with this individual. Knowing that, his response to today's work assignment is not a surprise. You knew the bad news walking into the crew office: there is a lot of work to do and it is cold outside.

You say to him, "I know there's a lot of work out there, and the weather isn't ideal. We value everything that you do to keep us up and running." You remind the crew members what they need to focus on today.

Another crew member is standing next to you not saying a word. He's a newer employee who loves his job, and he knows how to manage the difficult crew member, because he just tells him what to do. Eventually, he says, "You know what's important to me?" He picks up his phone and shows the entire crew a picture of his daughter. He says, "This is why I come to work every day." Then he shows another picture of his whole family with their dog. He just looks at the frustrated crew member and turns off his phone.

You say, "That's an excellent way to look at it." Then, you say to the frustrated crew member, "Are we going to have a good day? Maybe we can focus on the positives somehow."

Because the frustrated crew member chose to focus on the amount of work he had to do and the cold weather, he set himself up for failure. After the conversation with the entire crew, he finally gives up complaining. In his mind, it's still the railroad's fault that he's in the position he's in. You acknowledge the situation as it stands and move on.

Challenge

What is your plan to "move on" from this issue?

45. **State your plan and the rationale behind it.** *

Expert Tips

These are recommendations from an expert supervisor on mitigating issues with employee frustration:

1. Start with understanding the employee's frustration.
2. Acknowledge the situation and their feelings about it.
3. Probe or discuss to identify if there is a deeper issue at hand that could be intensifying the emotional reaction.

46. **Do you understand the expert tips?** *

Mark only one oval.

- Yes, I understand and don't need more information.
- Yes, I understand, but I'm interested in learning more.
- No, I don't understand and feel like I need help with this part.

Lessons Learned

You have completed the MW1000 Decision Game.

List three key lessons you learned from this case study that you can apply to future cases.

47. **State the <u>first lesson</u> you learned from this case study and how you will apply it in future cases.** *

48. **State the <u>second lesson</u> you learned from this case study and how you will apply it in future cases.** *

49. **State the <u>third lesson</u> you learned from this case study and how you will apply it in future cases.** *

Job Aids

Job aids provide an overview of a task or process with expert strategies and details to pay attention to.

Job aids can be implemented into the organization in whatever format is most beneficial to them. For example, they can be put on employee's clipboards, laminated, and posted throughout physical workspaces, and/or introduced into training during onboarding.

TECHNICAL LOCOMOTIVE REPAIR
Job Aid

Step 1

REVIEW DOCUMENTATION

Read the work order and Map 9 to understand the locomotive's history and problem.

Why difficult: some documents don't provide sufficient information
Where: daily turnover sheets

Example: Brake Penalty Recovery

The Map 9 explains that a P32 Diesel locomotive recovers after a penalty, but it takes 3 minutes every time. The locomotive should recover after 30-40 seconds, so something is wrong.

The previous mechanics replaced the P2A valves, but the new parts did not fix the recovery time.

Step 2

INSPECT

Run the locomotive through a 24 hour inspection and verify the issue.

Listen: air leaks

Look: moisture, oil leaks, cracks, rust, debris, discoloration

Smell: smoke, diesel fumes

Example:

Let the locomotive sit in penalty until the light goes on. If you rush the recovery by going to release and putting it back in suppression, the time will start over.

Check the pressure relays and the pressure switch to ensure they are operating correctly.

Step 3

LOCATE AND TRACE THE SYSTEM

Find the locomotive's shcematics manual and trace the entire system (i.e., piping, airflow).

Why difficult: manuals do not always include detailed information about the parts and their functions

Action:
- Laminate the diagrams so you can trace the lines and write notes
- Tape the lines with red electrical tape
- Using the process of elimination, remove the lines and work your way through the system

Important:
- Physically see and touch the equipment to trace the system
- Look for any signs of leaks, failures, damages, etc.
- Most newer equipment has an electrical side to the air system

Example

Find the locomotive's schematics to check all the piping in the P2A system. Amtrak's manual for the P32 provides a drawing of the locomotive with the valves and their functions.

For every valve, there is another one attached to it. There is about 20 feet of piping to examine. In addition, every valve bolts to a manifold. Pull off the piping between the manifolds to ensure there is not any rot, rust, or debris inhibiting air flow. Take soap and water, spray the surface, and look for bumps. If there is an air leak, it will start bubbling like crazy.

Remove every choke and check them. Over the years, things can block the orifice.

Step 4

REPLACE AND REPAIR

Remove any blockages and replace any deteriorated parts. Reassemble the locomotive.

Test and inspect before the locomotive leaves the shop.

Tip: Throughout the diagnose and repair process, relay information to the foreman to create work orders

Example

While checking the chokes, you find a piece of cotton blocking the opening. Hold the choke up to a light and blow through it. Clean the choke with something like a torch tip cleaner and poke out the cotton.

Reassemble the piping system. Run the brake test to see if the locomotive recovers in 30-40 seconds.

ELECTRICAL LOCOMOTIVE REPAIR
Job Aid

Step 1

REVIEW DOCUMENTATION

Why difficult:
- Information can change from the Map 100 to the work order
- Engineers don't always write detailed information on the Map 100
- Technicians rarely have access to talk to the engineers themselves

Tip:
- Take a picture of the Map 100 to carry with you

Example: Speed Sensor Failure

An engineer noticed a problem with the speed sensor display. The display showed -- -- instead of the speed of the locomotive.

The Map 100 says, "Excessive -- -- every 10 to 20 miles."

Step 2

COMPLETE SYSTEM CHECK

Perform a regular inspection to rule out any external damages or failures. Then, run a computer test for all the components. Sometimes, simply rebooting the locomotive fixes the issue.

Why difficult:
- Sometimes, there are no visual signs of internal damage
- There are many different possible causes for electrical failures

Look for:
- Damaged external parts
- Leaking gounds
- Loose plugs
- Dry cells
- Broken cables
- Air pressure

Example:

A speed sensor failure can have many causes. Check if...
- there are leaking grounds
- the antenna is damaged
- the system fails to read the transponder on the track
- the radio communication fails
- there is an intermittent loose connection
- the transponders have corrupt information

Step 3

PULL SOFTWARE LOGS

Log into the computer and download the specific log from the computer software system.

Why difficult: Only qualified technicians have access to the computer software

Important:
- Pull the logs regardless of physical damage to the locomotive
- Timestamps help pinpoint when the failure
- occurred

Example

Amtrak uses a TCD system that monitors the movement of the train, so it shows what time the train is in a particular location.
The train control system gives remote access to diagnostic information on the locomotives.
This data gives you an idea as to what was going on before and during the sensor failure on the locomotive.

Step 4

ANALYZE DATA

Based on the data, rule out everything that is not failing. Focus on the abnormal data to determine where the failure is.

Why difficult: Must understand what the data mean

Look for:
- Red sensors
- Abnormal values

Example
Each speed sensor produces its own data stream. The log shows the speed of each axel. If one speed sensor shows up red in the software, you know there is an issue with that specific sensor.

If one axel's speed is off, you know that is the one that failed.

Step 5

REPLACE AND REPAIR

Remove and repair any damaged equipment.

Important:
- Perform a complete system check to ensure the equipment runs well
- Send an email to all the technicians,engineers, and foremans about the locomotive's condition and any repairs

Example

After external and software inspections, you realize that old cables probably caused the intermittent speed sensor signal failure. Swap out the old cables with new ones. Make sure the equipment runs correctly. Follow up and track the software data to ensure the locomotive works a couple weeks later.

Expert Content

Based on knowledge captured during the CTA interviews, expert content provides a deep dive into a given topic. They contain more information than a cursory review of a topic, particularly details that are not widely known within the organization. These details include history, technical knowledge, and things novices tend to miss.

Organizations can deliver the expert content as stand-alone content or carve out particular pieces of the material to augment existing training.

Example of Expert Content: Vehicle/Track Interaction

- In the railroad industry, there are track people who design, build, maintain, and inspect the Track. They know how the track is put together and how it functions
- On the other hand, there are people who design, build, maintain, and inspect the Rolling Stock (cars and Locomotives). They know everything there is to know about the equipment. Rolling stock includes the locomotives and vehicles used on the railroad.
- These two functions generally operate in their own silos and there is no crossover of learning or information between the two disciplines.
    - The interaction between the track and the rolling stock is called the **wheel-rail interface, or Vehicle/Track interaction (VTI)**. The design and construction of the track interfaces with the design and construction of the vehicle. There is a direct connection between the two, and they must coexist in the physical space between them. A lot of people on opposite sides of the equation do not think about how the two components affect each other.
    - The causes of poor vehicle performance are owned by both the vehicle AND the track. With instrumentation, people can measure that interaction between the track and the vehicle that often causes the physical manifestation of a good ride or a bad ride

Track Inspection

- One of the biggest problems of inspection from the track perspective is that people are creatures of habit
    - The same inspectors inspect the same piece of track at least twice a week, so the track does not look any different to them each time they inspect it. The track changes so slowly that they don't notice anything going badly
    - People get so myopic about what they look at. They don't see the changes that occur over time and miss the transition from "Condition" to "Defect".

American Railroad Track History

- The United States had a lot of good track until the railroads started losing money
    - In the old days, the railroad was maintained by "section hands"
        - Railroad workers were responsible for maintaining their miles of track before the advent of mechanized track work.
- In the 1950s, machinery started replacing the section hands to increase productivity and save money
- The 1950 -60s turned out to be one of the worst decades for the American railroads. Three things happened that really hurt the industry:

- 1) The interstate highway system created competition because of highway trucks transporting goods
- 2) Prior to 1950, public utilities were exempt from local and state level property taxes by the interstate commerce laws
    - Therefore, railroads owned a lot of land for track, and they did not have to pay any taxes
    - President Truman signed a bill (The revenue Act of 1950) that rescinded the exemption. As a result, public utilities had to pay local property taxes
        - Local jurisdictions pounced on the railroads because they owned so much property
            - This prompted mass abandonments, and railroad lines started disappearing
            - Grand train stations were torn down
            - Property was sold
            - There was a massive exodus in the rail industry because they were saddled with taxes that they did not have to previously pay
- 3) The opening of the St. Lawrence Seaway particularly affected Northeastern railroads
    - Prior to the St. Lawrence Seaway in the mid-1950s, there were no less than seven railroad companies making a profit moving materials, merchandise, and people between the Atlantic Ocean and the Great Lakes
    - When the St. Lawrence Seaway opened, that business evaporated
        - The first railroad to fall was the New York, Ontario & Western, all the railroads lost business because they previously went from the ports of Baltimore, Philadelphia, New York, and Boston to the ports of Buffalo, Cleveland, and Erie
        - The St. Lawrence Seaway was probably the worst thing that happened because it caused the grand collapse of the Northeast railroads, leading to ConRail and mass abandonments on the main line
- All of a sudden, the railroad had to pay higher taxes, they had competition from trucks on the interstate highways, and they lost a lot of their business to the lakes because no one had to pay a toll to operate on the Seaway
    - The industry had to cut money, so they spent less on maintenance
    - By the late 1960s, the whole Northeast railroad system basically collapsed

Track Recording Car History

- Track recording cars are designed to measure the shape of the track
    - Those shapes determine how the train reacts to it
- A French man named Emile Hallade invented the method for surveying track geometry and the original track measuring car in the early 1900s it was referred to as Machine Hallade
    - You could push the cart down the track to record the various parameters of the track shape.
- In the 1920s, another French man named Mauzin took the original, rudimentary cart and enhanced it to create the Mauzin car, which became the standard track recording car in Europe for decades

    - There are still Mauzin cars operating in Europe today
    - The mechanical system used cranks and chains and measuring buggies to record the shape of the track
        - There was a piece of paper and a pen physically connected to the buggies. The pen traced the paper to make a determination of the measurements
- In the 1970s more modern electronic systems were developed using measuring buggies.
    - The original buggy machines were locked into the chords
        - The vehicle had measuring wheels with a distance of between 62 and 31 feet between the front and back wheel
        - As the buggy moved up and down in relation to the running wheels, they got the delta measurement which was the mid-chord offset (MCO) used in track surveying
        - The wheels were interconnected by cables, they had strain gauges on spring bars that bent, and the strain gauges output a voltage to get the measurement
- In the late -1970s, companies started electronically recording the values and storing them in computerized systems
- In the early 1980s, Amtrak, the FRA, and ENSCO came up with the idea of utilizing an IMU (inertial measuring unit)
    - IMU's are very common today
        - All smartphones contain an IMU, which keeps track of where people are
        - The concept was to develop a track recording system that could operate on a high speed passenger car, or any piece of railroad equipment, without creating any restriction in train operation
        - The point of the IMUs was to do the tests at high speeds and get accurate measurements
        - The use of inertial measurements freed up those measurements form the standard chords and allowed for true space curve geometry meaurments.

The ARMs System

- Invented in 1998; "Autonomous Ride Meter"
    - There was a mandate from the FRA to monitor the ride quality on the new Acela high speed trains
    - The FRA believed they would have a person ride the train once a day and collect measurements froma portable RQ meter and write a report about it
    - Instead, Amtrak thought to take a group of accelerometers and mount them on the cars in the fleet to record and automatically report the car body and truck accelerations during the trips
    - The accelerometers measure the actual motion of the car body
    - The accelerometers measure the amount of vibration and put a numerical value on the motions of the vehicle
        - The accelerometers collected and reported data 24/7, and we wound up with a lot of information
        - The ARMs system allowed us to look at the vehicle/ track system holistically

            - what was wrong with the car that caused it to ride poorly versus what caused it to ride well
            - Conditions in the track that caused rough rides
- At the time, the FRA track safety standards had almost no relationship to ride quality
    - A piece of track could have a safety exception according to the track standards, but the trains ride perfectly fine over it
        - There are places where the trains produce a horrible ride, but the measurements of the track are nowhere near any of the safety limits
        - The ARMs system broke out the science of looking at vehicle track interaction and what it meant for ride quality and train safety

Track Geometry

- There are two sets of geometry in track: microgeometry and macrogeometry
    - Micro= the track's internal shape
    - Macro= how the track sits on the earth
- Railroad track *should* be a straight line
    - **Cross-level elevation, gage, alignment and surface**
        - You want to know the distance between the two rails and the relative height of the two rails to each other
        - You want to know how straight the track line is because it is never perfect
        - You want to know about any bumps on the track
    - If there is a curved piece of track and you want to determine the macro geometry (how it sits on the earth), you need to know the **radius**
        - 1) Break the curve into segments
        - 2) Draw a straight line **chord** from across each segment
        - 3) Measure the distance between the midpoint of the chord to the arc of the segment, called the **mid-chord offset (MCO)**
            - Formulas can tell you the radius of the curve based on the MCO
            - In the imperial measuring system, if the length of the segment (Chord) is 62 feet, the MCO measurement in inches is the same as the degree of curve of the track
            - If you know the MCO, you can determine the radius of the curve 5729.65 divided by the degree of curve (MCO) tells you the radius in feet
            - The FRA put limits on how big the MCO can be in order to provide safe or good riding characteristics for the track
                - The MCO for Class I's at 15 mph can be as much as 3 inches
    - For alignment or profiling, you can do the same thing and create MCO measurements to determine whether the track is safe or not by its shape
        - When you measure this by hand, you eyeball and mark the maximum points to get the individual measurements
    - The track recording car measures continuously at each individual point
        - As the machine gets to each point, it creates a measurement where the offsets represent the maximum points

        - Then, you look at the values to determine the worst points
- Tracks can take on various shapes
    - Railroads twist, warp, and buckle
        - In a perfect world, the track is a straight line connected by radius circles
        - In reality, the track includes a bunch of bumps and wiggles
            - The track geometry becomes critical for how the vehicle suspension system reacts to it

Decision Requirements Tables

Decision Requirements Tables (DRTs) extract, organize, and analyze the key elements of expertise that were captured in the CTA interviews. DRTs can augment existing training and sensitize learners to the cognitive elements required to perform particular tasks.

We organized the DRTs based on topics rather than experts.

Impact Skill Topics	Technical Skill Topics
• Building & Managing Teams • Training • Relationships with Outside Utilities (FRA, OSHA, fire departments) • Incident Response & Investigation	• Track Reconfiguration & Construction • Locomotive Repair • Onboard Mechanics • Vehicle/Track Interaction

Building & Managing Teams

Critical Decision, Judgment or Action	Why Difficult?	Common Errors	Cues and Factors	Strategies	Information Sources	Suggested Changes
Managing hot-headed employees	Not knowing how the worker might respond– could become physical	Not understanding how each individual worker responds to situations Escalating the situation by showing frustration Not intervening at all and setting a precedent that this behavior is acceptable	Use of profanity and physical outburst Hard problems tend to lead to frustration	Tell the worker to step away and take a walk Create a familial working environment while demanding respect	Prior incidents Previous employer knowledge- advanced warning	
Hiring a young, inexperienced worker	Not knowing their skill level or how quickly they will pick things up Have to spend extra time, effort and resources into training them	Not hiring someone just because of their inexperience can restrict you from meeting and hiring great people Even though it looks appealing to hire people with more experience, they can bring bad habits with them	Personality traits: drive, attitude and motivation Look at educational background and previous experience in other fields (if applicable)	Mentor and coach new hires If they show potential and motivation in the hiring process, it is worth it to put time and effort into new hires	In-person interviews Talking to previous employers (if applicable)	
Fixing a specific location's culture	One city was having a lot of injuries at a particular terminal	Taking a downstream approach rather than an upstream approach	Leadership was inadequate Train master did not have any influence over the workers, what they did, and how they did it "You guys are just trying to get us terminated…"	Visit the terminal and speak with the hourly employees Talk to the VPO about the situation Bring in a different train master New safety plans	Listen to the hourly employee's experiences and stories	

Critical Decision, Judgment or Action	Why Difficult?	Common Errors	Cues and Factors	Strategies	Information Sources	Suggested Changes
			"You threaten our jobs and our livelihood…" Not a respectful relationship between the hourly workers and the train master or the mechanical person High injury rates			
Including field workers in the decision making process for a major project	The workers in the field are most affected by big decisions– they are actually doing the work It is critical to understand the granular level of day-to-day operations that make everything run smoothly Missing important details could add extra hours to get things done Getting buy-in from everyone can be challenging The industry does not reach down far enough among employees when designing projects	Disregarding the work/feelings of the workers in the field Not asking their opinions about major projects Simply surveying the employees rather than talking to them face-to-face Many companies do not think about the employees enough when building a track, which is a disservice to the industry	Workers want to be in the loop Operations taking extra time because the design is flawed	Put every phase of the project in front of the employees to pick their brains and answer any questions Ask people in the field (yardmasters, conductors, etc.) if they have any suggestions or tweaks Talk to people one-on-one about their individual challenges Actually listen to what they have to say– it boosts morale Give people the trust and ability to make decisions Use "mistakes" as learning opportunities– give them confidence to keep making decisions	Employee input Design plans	
Having a difficult conversation with an employee	A company will not be successful if the frontline workers are constantly angry/upset Personalities are challenging Working in the field brings out people's true personalities	Letting emotions take over and getting upset, too Not asking questions to understand why they are upset in the first place–employees typically have more going on beneath the surface Jumping to conclusions about the situation Assigning blame without the full story	Watch for/pay attention to triggers with different employees	"Facts are feelings" Try to understand *why* the employee is upset before getting upset with them Focus on one problem at a time, but come back to their other concerns later No matter how tense the situation gets, always give them a compliment You do not have to		

Critical Decision, Judgment or Action	Why Difficult?	Common Errors	Cues and Factors	Strategies	Information Sources	Suggested Changes
		Spreading rumors and adding fuel to the fire Getting defensive Formulating an answer before they finish talking		agree, but you have to be on the same page Let them know you appreciate their work Take time if you need to regroup or think about something– it's better to take your time than to say something in the heat of the moment Go into the field and talk to the employees about something other than work Be upfront and honest throughout the conversation Be empathetic to their needs, even if it seems ridiculous		
Starting a management role and dealing with employees	Have to make decisions that affect you and others Give guidance instead of taking it	Insecurity in a new role– feeling like you have to show you are in charge Management saying employees "should have known better" Immediately firing an employee for putting themselves in that position Arguing with employees Coming into work angry and complaining sets the tone for the rest of the employees	Recognizing people's behavior at work	Understand that employees do not *want* to mess up or get in trouble Understand the root cause of the mistake (it might be the system rather than human error) Have an open and honest conversation with the employee Think about how you, as a manager, can teach them to understand better and prevent similar mistakes from happening Find the best ways to teach people because everyone learns differently Pull employees to the side to discuss recurring issues Help employees rather than punish them	Listen to your employees and their complaints, even if it seems silly Learn the facts of the situation (especially before jumping to conclusions)	

Critical Decision, Judgment or Action	Why Difficult?	Common Errors	Cues and Factors	Strategies	Information Sources	Suggested Changes
				Treat employees as humans rather than "tools" for the railroad Explain the bigger picture to employees Show up to work in a good mood More information will help employees perform better, so it is better to overshare in job briefings and meetings Give employees information in advance, so everyone is on the same page and prepared Explain who they benefit when they do their job– give them purpose Make work a fun place to be everyday Be consistent and trust your process– not everyone will like you Get to know your employees personalities If you get upset in front of a group of people, make eye contact with everyone so you know how people are feeling– it is usually best to ask particular people to talk later, rather than a group of people who might not feel the same way about the issue Making demands "because you can" is not good leadership		
Mentoring a less experienced employee	It takes a long time to gain expertise in the railroad industry	If you do all the work and the hard tasks, the mentee will not learn how to do	Identify the skills that you can build upon in less experienced employees	Encourage the mentee to build their own relationships	Mentor knowledge and expertise	

Critical Decision, Judgment or Action	Why Difficult?	Common Errors	Cues and Factors	Strategies	Information Sources	Suggested Changes
	How do you share all your knowledge with someone? Experts have so many things to do, it can be hard to add mentoring less experienced employees into the mix	important things	Willingness to learn Motivation Mentee asking questions	The best way to learn is to give someone a task and have them do it Check up on the mentee to see how they are doing and point them in the right direction if necessary Create an individual development plan Start with basic tasks, then gradually throw harder things at them		
Interviewing potential employees	Interviewing is an important part of building a team People can say they know stuff, but asking them about what they actually have done says a lot about them If someone can mesh in a company's culture, they can learn everything else People can present themselves one way in an interview and perform differently on the job The lifestyle for the engineering side of the railroad industry can be tough– difficult work and difficult hours	Getting fooled about experience and skills	Passion for the industry and railroading Persistence Motivation Examples of working well with others and having morals and integrity Kind and respectful manners Interviewee not trying to be someone they are not	Look for favorable personality traits Determine what they know about the railroad Ask for specific examples of *how* they perform particular technical skills or social skills– real examples or scenarios Talk to the interviewees about the possibility of extensive travel Be upfront and transparent about the benefits and disadvantages of working on the railroad Involved different people in the interview process– supervisors, peers, VP, President (depending on the role) Try to find people with strengths in different areas If the interviewee says something general, ask deeper questions	Resumes	

Training

Critical Decision, Judgment or Action	Why Difficult?	Common Errors	Cues and Factors	Strategies	Information Sources	Suggested Changes
Implementing programs across organizations/the industry	Industry not recognizing the urgency for implementing these programs– not FRA regulated Getting people from different organizations on board People not wanting to spend money on interventions It is hard to create a new norm across the industry	Not having enough data to back-up implementation Not having strong relationships across the industry	Industry accidents/data that supports the program Credible research to back up the data Union workers/employees' stories and concerns Pressure from the FRA	Have medical professionals present research and information to different organizations Uplift the unions' voice and their frustration Engage with senior leadership and employees to get them on board Maintain a strong network throughout the industry and building trust Take a voluntary approach, rather than introducing regulatory requirements Briefing meetings/guides Information sharing Postings Links to websites Conduct a pilot program Strategically roll out the program at different locations Face-to-face interactions	Educational research/credible websites Incident data across the industry (i.e., NTSB reports) Industry committees Personal stories Attorneys– legal coverage	
Preventing faulty radio incidents	Miscommunication Mistaken instructions Plant manager would not replace the radios Manual verbiage Lack of documentation Lack of testing while training	Not waiting for a radio beep	No explicit instructions for rail communication "Stand by Bob" training procedure No railroad quality radios	Speak with individuals and listening to their stories Plant managers and procedures in the nuclear regulatory commission	Incident report Witnesses Other manuals Similar problems/situations and how they were handled	
Hazmat emergency responder training	Incident not an emergency, but workers required to	People perceive hazmat material as extremely dangerous	AAR has a hazmat plan in place and how to handle the situation	Contact AAR to begin the hazmat plan	Previous incident - must dial 911 if derailment involving	

	call 911 Reputation on the line	 Too many responders and representatives at the scene		Build trust with emergency response teams and stakeholders	an LPG car Locals experiences Emergency responders & FRA representatives	
Implementing safety action plans	Safety action plans are not required by regulations Certain railroads use threat-based approaches to safety enforcement– clash of culture There are so many rules, so employees in the field are typically blamed for incidents rather than the process or system that led to them to getting hurt Must have buy-in from management to change the culture around safety There are many players involved, including management, union ownership, hourly employees, and federal agencies Some railroads have less than 10 employees, so they do not have the horsepower or talent to put these plans together	Not involving railroad leaders in the implementation– safety depends on leadership Rules-based safety training Using operational testing against employees to put marks on their record Rushing is one of the biggest problems for new hires in the industry– the combination of rushing and minimal experience leads to errors, such as derailments, chemical leaks, and turning cars over Poorly structured and dense rulebooks Underreporting injuries– fear of punishment or termination	High injury ratios	"Zero injury" mindset System-wide approach Provide sample safety action plans Encourage people to take ownership Raise the training standards Remedial training Share training ideas/practices across divisions Focus on upstream activities to get downstream results Hold everyone accountable to the safety standards Quality job briefings Prioritize safety over production Let employees review the plans before implementation so they have input Electronic communication boards with new rules, policy changes, and general notices Put the safety action plan check-list on a shareable drive Key rules that are well enforced make a safer railroad Develop safety committees	Meetings with senior leadership about other ideas within the industry Quarterly industry meetings Leadership videos	
Developing a new rulebook	Traditional rulebooks hold employees accountable for formal investigations	Too much depth Lacking clarity and consistency		Get feedback from hourly employees and management employees to hear their opinion	Compare new rulebooks to traditional rulebooks to see possibilities for improvement	

	Rules are written differently in different parts of the same rulebook	Redundancy		Bring in a third-party firm to engage with everyone Write simply and concisely Core rules that can apply to all people at all locations	Listen to employees and what makes their lives easier	
Teaching rules training classes	The railroad industry has so many rules, so employees have to learn and retain a lot of information Everyone learns differently Quality rules training depends on the teacher, but good teachers are limited Rules training can be expensive– bosses might not see the importance of training classes and spend money elsewhere Training is usually the first to go when cutting costs Railroads need people in the field as soon as possible, so they do not want to spend so much time training when they could start working	Reading out of the rulebook “Box checking” Giving tests straight from the rulebook– fill-in-the-blank and multiple choice Firing employees if they do not understand the rules immediately Sloppy presentations, unreadable font/font size	Employees not understanding the “Why” behind regulations Memorizing rules verbatim without knowing what they actually mean Know which employees have a background in certain areas to determine whether or not they can move through training faster	Make it casual Bring food Family Feud railroad game Scenario-based training and exams Roleplay scenarios Share personal stories Model trains Videos/calls based on different incidents Encourage discussions/questions Split employees into small groups to discuss incidents Have employees present different topics Have the employees sign a “commitment” letter to their loved ones Find rules to skip because some do not apply to all railroads Bring in people from different crafts to share their experiences Whole Brain Teaching Learn personal facts about each person so you can develop a relationship with them Bring the rulebooks and dictionaries out in the field while teaching	Feedback from employees and management Sit in on classes to see what goes well and what can improve Test scores FRA requirements GCOR	

				There is no reason to reinvent the wheel– grab resources from different places and transform it into what you need for a particular training Take pieces off of machines and ask the students if it looked right to them		
Peer training	More experienced employees might make the new employees do things they do not want to do Knowing where the new workers are in the field vs. the experienced workers to keep an eye on them Some experienced employees do not want to deal with training less experienced workers Labor positions have a lot of turnover	Making some people peer trainers when they do not have the right skills to do so	Personality– pick the peer trainer's brains to get a sense of their rules knowledge and how they interact with others	Pair each new employee with a field buddy as their point of contact Shadow the more experienced workers for a period of time Make it a big deal when the new employees "graduate" out of the new employee training Information coming from the experienced peers made it more relevant to the new workers Give people responsibility to help the new employees and give them confidence that they can be great trainers	Peer training feedback to the supervisors about where the new workers are in the process, where they need assistance, and where they should be Evaluation sheets	
Employees working on uncontrolled tracks	Regulation creates other consequences Potential to injure someone else Pressure on the worker to know what to do	Crew not shoving at a speed where they could stop within one-half of their range vision Shoving a car over derailment could lead to a fatality	49 CFR Part 214	Allow people to see further and show them what is coming up		Track Access
PTC training	PTC laws came out in 2008, and there was a deadline to have PTC installed in every piece of equipment Federal regulations increased restrictions Reading the rulebook puts people to bed	The training is pretty basic	The crews were used to operating at 125 mph, then they were capped at 79 mph once the PTC regulations came out	There should be a more robust discussion within the training process Focus on the top 5 biggest problems during the last year– trainers need to know the worst things that happened and what confuses the engineers the most PTC Users Forum– invite supervisors,	Forum feedback PTC help desk Electronic rulebooks	

				trainers, operators, and engineers to generate feedback for the PTC systems Discuss rules and procedures, updates on equipment, and what people are currently working on– have a strategic vision moving forward Get all the railroads on the same page about any issues with the PTC systems		
Changing a rule	Some general orders cancel out previous rules Different organizations interpret some rules differently	Not having a common understanding across the organization about a rule	People from different locations coming to your site and doing something differently because they followed different rules elsewhere	Know what rule structures are in place at different railroads Determine what works best for your particular railroad Ensure that people are in compliance with expectations Post the general orders on duty stations, the daily operating bulletin, and through an email Train everyone on the rule change	Call people from different organizations about their rules and parameters Speak with the VP or Operations, train master, and the crews that the general order directly affected	

Relationships with Outside Utilities

Critical Decision, Judgment or Action	Why Difficult?	Common Errors	Cues and Factors	Strategies	Information Sources	Suggested Changes
Remediate an overexaggerated emergency response in a stressful environment	Emergency response in a big city involves a lot of stakeholders– FRA, police department, fire department, Office of Emergency Management, the media, politicians, the public The public response is aggressive, and it could result in reputational damage	Not having a good relationship with the emergency responders prior to and during the response Not handling the media attention well Not getting in touch with people who understood the political environment	Understanding the incident on the tracks. What happened? Listening to the different perspectives about what happened from the stakeholders Strong public and media response	Get in touch with different players: the company's senior team, the legal team, the hazmat contractor, the fire department Chief, the FRA, the media, the Association of American Railroads, and coworker who understand the political environment Go to the town hall with the public to diffuse the situation and make in-person public apologies wherever necessary Talk to the	Mechanical workers and contractors on sight FRA AAR Legal team advice Senior management Coworkers who know the political environment Media response Public response	

				emergency responders to help them understand the situation Customize and tailor pre-existing training to local organizations		
Building a relationship (and training program) with the fire department	The fire department does not have much railroad knowledge/training It takes time, effort and resources from the fire department to do railroad training	Approaching the fire department with anger or hostility Not reaching out to the fire department and other local responders prior to emergency incidents	Whether or not the fire chief is receptive and open to building a relationship and doing railroad training Understanding the fire department's relationship to other entities, including the police department and the Office of Emergency Management	Reach out to the fire chief and get to know them on a personal level– work with them to build a training program Invite the fire department to come to the railroad for training and damage assessment Let the fire department use rail tunnels for subway rescue training Offer fire department workers rides on the trains Bring a safety train made up of different tank cars and a classroom car Provide training every month	Communication with the fire chief and other fire department employees	
Working with a construction consulting team outside of the railroad industry	The consulting team has little railroad experience, so they can miss important details	Getting frustrated with the consulting team because they do not have rail knowledge or experience Not catching details that could have major effects on the construction process Miscommunication	Recognizing the consultants do not know specific terms or the best way to handle situations in the rail environment	Share data from the railroad Walk around the yard with the consultants Use Google Earth to map out details Have regular, transparent conversations with the consultants about what they need to know– monthly meetings	Communication with the consultants and any other organizations involved Data and information from the railroad	
Dealing with inexperienced civil contractors	Civil contractors have limited experience working with the rail industry They are unfamiliar with all of the safety rules and ways to conduct themselves on the tracks, which can lead to injuries and/or fatalities if not	Not giving safety briefings before they begin working on the railroad Unfamiliarity with safety rules could lead to fatal injuries Letting this behavior go without any consequences	Contractors following tracks Contractors leaning over tracks Contractors jumping on a loader and digging next to live tracks	Talk to the contractor and tell them that they cannot have this stuff happen on the tracks Shut the operation down if this dangerous stuff keeps happening Give job/safety	Train crews voicing their frustrations Ask the contractors who the employee in charge is and why is their basic protection was not up	Briefing the workers from the get-go about what is acceptable and what is not acceptable

	taken seriously		Frustration from the train crew	briefings to the civil contractors before they start working		
Regulatory agency audits	Regulatory agencies are looking for reasons to penalize organizations A lot of railroads do not have proper documentation available for the agencies Liability and cost can really hurt an organization– fines are really costly	Giving over more information than asked for and causing organizational problems Lying to the regulatory agencies Signing off on something you do not write yourself	Regulatory agencies are usually pretty specific about what they want to see OSHA will usually drop fines if they contradict the rules in FRA's jurisdiction The nature of the incident drives who is curious about what– every situation is different	Do not give information unless asked for it Store all records and documentation in an easily accessible location Give the regulatory bodies what they ask for Involve the legal team if there is exposure Get everyone on the same page about what they should and should not say Double check if OSHA and FRA fines are valid– it is okay to pushback against the agencies and work together to reach an agreement if they are making incorrect judgements Actively look at incidents and try to prevent things moving forward– regulatory agencies recognize the effort and work with the companies trying to improve their organizations		
Maintaining a network in the industry	Time is valuable, so it can be hard to maintain relationships with people Some personalities are hard to deal with			Take any opportunity to make people feel valued and appreciated Call people and ask their opinions about different changes in the industry Ask people if there is anything you can do for them Share resources Reach out to people over social media/send interviews over		

				LinkedIn Run policy changes by regional regulatory representatives– show them you know they have authority Attend conferences/meetings Timely responses		
Dealing with an angry customers	Customers depend on railroads for their business, so customer satisfaction and communication is critical Customers can threaten to take away their business	Getting angry with the customer without listening to them Poor communication Late responses/no responses	Customer complaints	Put the customer first Set expectations from the start Listen to their grievances and let them know you want to help Timely responses If you cannot get to something immediately, call them and email them Give people permission to call you because you want to get back to them as quickly as possible Build trust and give advice based on expertise Respect their ideas, but massage them to work in your favor Give customers something in return– whether it's a listening ear or a cell phone number	Customer satisfaction reports Direct communication with the customer	
Short lines in the middle of competing Class I railroads	It is easy for the Class I's to hold a smaller track hostage and threaten them Class I's know they can hurt a short line's business Class I's argue over who gets what and which direction their trains leave The industry pins operations and maintenance departments against	Giving in to a Class I threat Not understanding the current agreement and recognizing that some do not hold water anymore Poor day-to-day relations with the Class I's	Operating rights Railroads operate under their current understanding of an agreement, and some informally change as the tracks change	Maintain a solid daily operation relationship with the Class I's Stand your ground– do not get intimidated by Class I threats Take the "side" that supports the short line's operational goals Think about scenarios if the Class I's followed through with their threat	Legal team Current and past agreements to see how the track has changed Overlap data	

	each other			Have a contingency plan		
Class I railroad showing up on your track to investigate a derailment without giving notice and submitting a faulty cause code	Class I's try to intimidate the smaller railroad The FRA is involved The Class I does not want their employees getting in trouble Contradictory cause codes– discrepancy between the owner railroad and operating railroad codes	A lower level inspector might feel intimidated by the Class I's and agree with their cause code	It is a common procedure to let a railroad know you are showing up to their tracks	Set the record straight that these are your tracks, and they will do things your way Set up a job/safety briefing Understand the track– switches, frogs, degree of curve– to prove the actual cause of the derailment Tell them you will not be intimidated For the future, create an operational handbook to prevent the same derailment from happening again	Blackbox downloads (speed, horsepower, throttle position) from the time of the derailment Track makeup Train makeup Cross communication between engineering and operations	
Creating a proactive plan to fix cracks in a married pair	Not knowing how many cracks are in the entire fleet Public concern for the safety of the passengers Could ground the entire fleet if there are cracks on multiple cars	Waiting to enact the plan instead of acting immediately Under-playing the severity of the cracks Not including the manufacturer, the GM, and the FRA in the plan to get their input and to be transparent	Consider the severity of the cracks if they worsened Seeing the cracks themselves	Monitor and fix the cracks in the married pairs as quickly as possible Meet with the GM Frequent and thorough inspections Assign a dedicated person for inspection every day Buy a borescope Contact the manufacturer immediately	Inspectors Mechanical manager who has more experience in manufacturing Manufacturer	
Decision to tell the FRA about cracks in a married pair	The FRA could ground the entire fleet Passengers could be killed if the cracks worsen Disagreement with the GM about telling the FRA (financial consequences if cars cannot be used)	Being more worried about the fleet running than the safety of the passengers The FRA could find out later and get frustrated about hiding the cracks from them (would lead to more frequent visits and a less trustworthy relationship)	Hearing about other organizations in the industry that lied and hid information from the FRA Personal relationship with the FRA representatives	Call the FRA and ask them to come to the property Show the FRA representatives the cracks, pictures, and SOPs Show the FRA how to administer the dye penetrant inspection Consider public safety	Knowing about similar situations in the industry and understanding other people's relationships with the FRA (especially how it could go wrong if he withheld information from them) FRA's advice	
New electric equipment rollout	No one taking charge of the implementation process There can be a multitude of technical issues when you	People can blow up the whole system if they do not do things the right way– a certain point of failure in the power system can take the	FRA regulations Testing results Does the car physically fit?	Come up with both short term and long term plans Cross-departmental knowledge	Electrical power department– determine restrictions and technical issues	

	introduce electric equipment in conjunction with diesel equipment– difficult to integrate with the physical layout of the tracks Wires can be designed differently in different places FRA regulations require every train to have PTC equipment– trains cannot operate unless they implement the PTC system Regulation roadblocks– additional testing is required when new equipment is introduced PTC touches on many different departments in each organization Increased maintenance costs and risk of failure A certain combination of cars can cause a dead shortage in the wire in the power system– must figure out how to keep the electrical systems isolated PMPs do not always come with a railroading background	whole network down Relying on a GPS signal No one driving the agenda or planning action items	Compatibility with the signal system, power system, door system, and train platforms	Think about how the new equipment will operate on the tracks Work with FRA representatives logically and patiently Shorten the train		
Dealing with strategic planning consultants	The consultants do not always understand the railroad industry Maintenance requirements, capital investment, loss of track time	Only thinking about the big, future projects and disregarding easier, immediate fixes– missing opportunities to improve services today	Consultants talking about future problems instead of things they could fix today	There are basic things that can be done in the near future until they can plan for the bigger changes	Ask the consultants what they are doing *now* to make improvements, rather than the larger future problems	
Dealing with the FRA	Some FRA representatives do not fully understand the railroad industry Some FRA representatives leave very little room for interpretation– rarely listen to someone	People only interested in the logic or history behind a regulation without opening up their mind Thinking you know everything		Listen to the representatives and have a logical and reasonable conversation with them Try to see things from their perspective		Requirement for FRA representatives to learn about operations so they have the full picture of what is in the field

	else's viewpoint FRA representatives are oversubscribed because they are in high demand			Explain yourself to them as best as possible Reach a common understanding, even if you disagree with each other		
Dealing with a rail equipment vendor	Have to figure out whether or not the organization should purchase new equipment People are often stove piped in railroad organizations, and there are few people who can cross disciplines– it is important to get the right people involved	Dragging people into the situation who do not need to be involved		Know the right questions to ask before moving forward: What is the budget? Is it worth it? What is the ROI? Get other folks involved to do a deep dive into additional areas for investigation	Vendor Executive team Stakeholders from different departments	

Incident Response & Investigation

Critical Decision, Judgment or Action	**Why Difficult?**	**Common Errors**	**Cues and Factors**	**Strategies**	**Information Sources**	**Suggested Changes**
Incident investigation	There are little to no investigation training courses available in the industry It is hard to relate what people learn in the classroom to incidents that occur Incident severity changes how people respond to situations There are many people/stakeholders involved after an incident occurs It is mentally tough to deal with injuries/fatalities Larger incidents often become court cases, so there are legal issues involved There is a lot of information/evidence to gather, so it is easy to miss something– the sheer size of the process can be overwhelming	Inability to control emotions Missing details– only have 10 days to get everything documented and submitted When people get into a flight or fight response, their attention is narrow Not talking to everyone involved in the incident Not securing the scene Chalking every incident up to the T111 code (point blame at Maintenance of Way)	Pay attention to every little detail Regulator agencies want as much specific information as possible At smaller railroads, there are no restrictions as to who the interviewers can talk to; At bigger railroads, there are restrictions for union people Track speed Tide plate movement Ballasts Mud Flange marks	Online investigation training course Checklist to follow during investigations (make it as simple as possible) Standard process to report incidents Everything is worth investigating, including a fallen tree or someone tripping and falling Focusing on smaller incidents can help prevent bigger ones Think about everyone's point of view and what information they would want to know Ask all necessary questions before the evidence is gone Know the incident location, including exact ties, so all the agencies involved know where the incident occurred	All of the evidence at the site of the incident Witnesses and bystanders Incident review calls (monthly) What happened before the incident, what happened during the incident, what happened after the incident (from all different perspectives)	

				Interview people involved in the incident separately and go over individual statements afterwards Offer electronic forms that translate everything into Spanish Get statements from everyone involved, even if they did not see anything Document investigation training so organizations can see what their employees learned and how many minutes they have had in particular areas Rather than telling people to focus on certain areas, ask questions that lead people to those areas Walk up and down the tracks because evidence might be away from the incident Have at least one person from each craft present at the investigation		

Track Reconfiguration & Construction

Critical Decision, Judgment or Action	**Why Difficult?**	**Common Errors**	**Cues and Factors**	**Strategies**	**Information Sources**	**Suggested Changes**
Main yard reconfiguration and construction	Major project with a lot of moving parts Must operations throughout the entire construction process and provide service to customers A nearby organization owns the ground under the tracks, so there must be communication between both parties Potential delays and employee dissatisfaction	Miscommunication among non-railroad contractors and construction workers Obtaining the right inventory Designing the entire project without missing important details Not planning far enough in advance	Understand the entire mainyard structure, layout, and constraints, including wetlands, utilities, and ditches	Communicate across all of the players involved: contractors, design team, construction team, inspectors Ask hourly workers what would make their lives easier during/after the construction process because they are the people doing the actual work Fully immerse oneself in the project so you do not have to	Hourly workers, contractors, design team Google Earth Data about the tracks– inventory, degree of curvature, where the utilities and constraints are throughout the yard	

	Main yard shut-downs			ask operations every time there is a question Pre-build switches Talk to customers and tell them your plans to continue service amidst construction		
Potential problems during reconfiguration and construction	There are many consequences for even the smallest missed details Must think beyond the main yard because there could be related issues past the scope of the main yard Must continue operations because customers need their service Tough work area– a lot of switches	Missing small details that can have major effects	Tracks Switches Types of trains Schedules Crossing blocks Degree of curvature Potential derailments Utilities Wetlands	Phase out the entire project Ask hourly workers their opinions and ideas Talk with the other contractors and teams Use Google Earth overlay to map things out Give consultants all of their data and a model of the current operation If management doesn't like the solution, propose an alternative solution	Basic knowledge of the industry and the main yard area Open dialogue with the customers, contractors, construction workers, design team, and hourly workers	
Incorrect inventory	The materials have to align perfectly for a rail construction project to work	Inexperienced inspectors or construction workers might not know what they are looking at, so they pushed (incorrect) things forward	Size and dimensions of materials: frogs, switches, etc.	Quality control– have people who know what they are looking for Communicate with all organizations so everyone is on the same page	The materials themselves Experienced workers who know the materials look wrong	Get on the same page with the manufacturer to ensure that the materials coming in are correct
Operating trains in a complex yard	In an industrial area, there are sharp curves, many crossings, and back-to-back switches One misstep can cause extra hours of work Trains must be able to turn around without blocking themselves or other cars– certain locations can pinhole locomotives with no way out Must figure out where new customers fit within the regular switching operations Adding new spurs	Trainman riding on the back of a train holding onto a ladder to get out of a pinhole (dangerous) Blocking access to different roads/buildings Any lapse in train handling, like a hard joint or a strong pull that pops the wheel off the ground, could take out major transmission lines	How long it takes to switch particular areas Headroom Track configuration Switches Resources Real estate available Customers Underground utilities and overhead power lines	Build the yard so it benefits both the crews and the customers Consider different scenarios when constructing and operating in the yard Reduce the amount of interaction between multiple trains Think about how to configure the yard to reduce the time it takes the crew to build the train Use wyes in strategic locations Fewer moves=fewer	Approve plans with customers and the crews Trainmaster, terminal manager and terminal superintendent have daily calls with customers Maintenance gets nightly switch requests Information stored and shared through a SharePoint page (when trains arrive and depart) Hour-to-hour communication about train locations	

	can alter how the crews work and how they build trains throughout the yard Diverse customers and commodities Too much traffic, not enough track Major changes take planning and budgeting– there are few immediate fixes			risks If possible, make investments that will help down the road– improves productivity and morale Provide alternate routes for maintenance if there is an outage Put siding in the yard so you can put stuff to the side without blocking crossings or impacting customers Add guardrails	RMI shows where numbered cars are located On main lines, controlled track dispatchers can tell you exact train location Weekly progress reports/job briefings	
Spur installation for new customers	There is one way in and one way out There is often cost sharing involved in spur installations Railroads have an obligation to service their customers	Many engineer firms do not understand how car types and current operations are correlated– if they build something without the railroad's approval, the operation might not work Engineer firms might miss something or put too sharp of curves in Customers might "go cheap" if they pay for the spur themselves Tight tolerances– might set employees up to damage equipment because they are in a tight work space	Which direction the customer comes in from and which direction they depart How much money the railroad will make off of the cars each night Property standards Degree of curves Elevations Crossings Permits	Set expectations at the beginning of the customer relationship Need a high level design plan from the customer before saying "yes" or "no" Understand what type of business the customer does (commodity, how many cars, how far they are going) Build trust with the customers If the customer cannot afford something, see if the railroad can donate materials to help them out	Communication between railroad, customer, operations crew, and engineering crew Engineering firm Customer satisfaction report	
Train shoes sticking out too far	The shoes can hit and damage parts of the rail It is a pain to take the shoes off and put them back on each time a train goes out The mechanism to lift shoes up while running the train in certain areas can takes years and cost millions of dollars	The clearance itself might be fine, but the rail shoes add additional width that people do not consider at first	The train shoes sticking out and hitting other things on the rail Measure the rail constraints An inch or two to spare between the shoe and the rail is not good enough clearance for operations	Use lidar drawings and maps to identify potential hotspots for damage Drive a test train to see if the train fits with the shoes Options: 1) Take the shoes off; 2) Put the mechanism on the trains to lift the shoes up; 3) Do not run the trains Have procedures to ensure the crews know when the shoes are off and when they	Test results and measurements Lidar drawings and maps Take pictures of the hotspots	

				are applied– paperwork to tell the crew what equipment they are riding		

Locomotive Repair

Critical Decision, Judgment or Action	Why Difficult?	Common Errors	Cues and Factors	Strategies	Information Sources	Suggested Changes
Finding cracks in a married pair	Not knowing how many other married pairs in the fleet have cracks, so the situation could be much worse Not having all of the equipment required to see the full extent of the cracks, including a borescope	Not inspecting both sides of the equalizer and missing the cracks Not inspecting all of the married pairs in the whole fleet Thinking finding a couple cracks is not a big deal and continuing operations as usual	Safety consequences if the cracks worsened Cracks can be a matter of life and death, especially on passenger trains	Inspect all the cars in the fleet Use a flashlight to inspect the married pairs under the cars in the shop Order a borescope to see the entirety of the cracks Conduct a dye penetrant inspection and created a SOP on how to do the process Call the manufacturers to come look at the cracks as soon as possible	Seeing the cracks themselves Inspectors and mechanical managers Manufacturer	
Fixing a broken brake hose on a train	The train may not have the correct brake hose replacement on board	Not knowing where you are located on the track or where any nearby resources are Not knowing/rememberin g timetables	Hearing the brakes go into emergency Looking at the brake hose and seeing the break	Know where you are on the tracks and which sidings had extra resources, including a replacement hose	Listen for the emergency brakes Talk to the head and the crew on the radio Remember or have timetables on hand at all times Know which sidings store materials	Stock all essentials materials on a moving train before departure Make sure there is an extra hose for every type of hose on the train because they bust all the time
P32 Diesel taking 3 minutes to recover after a penalty	The classic remedies not working– P2A valves control the penalty to get the brake application, so people first think to replace the valves Some locations don't have the ability, time, facility, or available parts to fix the problem The locomotive sits out of service and takes up space	Only focusing on the P2A valves and not looking deeper into the problem Rushing the recovery by releasing and putting the locomotive back in suppression (time would start over)	P32s are supposed to recover within 30-40 seconds, so if it's taking longer, there is an issue Penalty light that signifies recovery Listen for air leaks Spray to surface with soap and water– if there was an air leak, it would start bubbling like crazy	Perform 24 hour inspection Verify the problem Try to replace the P2A valve and the H5 relay Trace all the piping in the P2A system– look at diagrams and tape the penalty system lines with red electrical tape Remove every line and work your way through all the valves	Brake tests Work order notes Map 9 defect Manual diagrams of the system Morning meeting updates Time it takes to recover	

				Check the manifold– pull off the piping to ensure there is not any rot, rust, or debris inhibiting air flow Remove every choke– hold up to a light and blow through it to make sure it is not clogged		
Smelling P42 Diesel gas fumes but not seeing a leak	Gas fumes are never a good sign– the consequences can be serious Locomotives with diesel fumes should immediately be taken out of service If you cannot see a leak, it's hard to pinpoint where the smell is coming from Cannot see the leak without tearing the locomotive down		Smelling the fumes Fuel pressure Physical leaks The cab should be a completely sealed system In the summer, it is easier to smell the fumes when the windows are shut and the A/C is running; in the winter, the air is heavier, so it keeps the smell down Multiple locomotives across the fleet having the same issue at the same time	Talk to other locations with the same issue 24 hour inspection Verify the problem Locate the fuel pump and look at the pressure lines and return lines Measure fuel pressure Trace the lines from the fuel pump to the entire fuel system Feed air into the return line and listen for leaks Check for fuel tank leaks, fuel pipe leaks, injector leaks, and high pressure pumps Drill certain areas on the line to allow the fuel to escape Remove and repair the diesel engine	Smelling the fumes Engineer notes Cross-location management/superintendent update calls to discuss faulty equipment Manual diagrams of the fuel system	
Yard engine release taking a long time	Still doing its job, it was just taking a long 80-90% of the time, replacing the automatic brake control lever fixes the problem Breaking things apart can sometimes lead to a hornets nest of problems	Only changing the valve control Not draining the tanks during inspection	Release taking longer than it should Moisture/water in the lines Trains can run without an air dryer system, but the air is just not as clean or dry	24 hour inspection Verify the problem Change the control portion, automatic brake control, and CDW valve Trace the airflow piping system Crack the lines from the automatic brake control lever to the service portion Either have an air dryer system or drain the tanks during 24	Work order notes Know which valve controls which area– lines are numbered Test ports– gauge tells you how much air pressure there should be	

				hour inspection to prevent moisture build up		
Multiple broken pieces of equipment in the shop at the same time	Out-of-service equipment takes up space, and it is not making any money for the organization Some things are much quicker to fix than others It takes time to detect and repair equipment– some pieces sit in the shop for a couple weeks because you cannot put all of your time and energy into one piece of equipment There is not a lot of expertise across organizations for locomotive repair, so it is usually a small handful of people working on the issues Repairs become difficult when something is not absolutely broken, so it is harder to find the problem when it works on and off	Spending all your time on a difficult piece of equipment while more broken equipment builds up in the yard	Knowing which problems are easier to solve	Some problems are obvious, so it is best to fix those first and get them back on the track to make money Come back to the more difficult problems throughout the other, easier repairs	List of broken equipment and their issues Work order notes	
Speed sensor failure	There are multiple sensors on the locomotive, so it can be hard to determine which one failed Information can change from the Map 100 to the work order The failure could be caused by multiple things People can't access any of the data without a computer or the skills to do so Electrical folks cannot talk to the wayside folks, who might have more information about the transponders	Not writing detailed information on the Map 100 or the work order– adds time to diagnosis and repair Sometimes rebooting the system fixes the issues	Seeing a – – on the display instead of the track limit If one sensor system fails, the system reports a problem, but the locomotive will get to its final destination Axle speed Timestamps Red speed sensor in the log	Take the locomotive out of service Check the Map 100 and work order Look at the physical locomotive Download the logs First check for leaking grounds Check that ATC and ACSES components are free from grounds Read the sensors to make sure the values are correct Check connections on the display unit Could be: 1) If the system failed to read the transponder on	Engineer Map 100 report Work order Operations center email Computer software data logs Time of failure Axle speed sensor values TCS (monitors movement of the train) X15 form Form D (outlines the track limits) Manufacturer data	Write down the time, location, and any additional information on the Map 100 and the work order

				the track 2) If the radio communication is failing 3) If there is an intermittent loose connection 4) If the transponders had corrupt information Send an email with all the updates for anyone working on the locomotive		
Dead battery	Even if everything looks fine, the chargers still might not work Batteries are really important because locomotives cannot do anything when the battery is dead People rely on battery chargers to restart the locomotive during emergencies The battery system is huge– there is so much wiring and so many pins Electricians do not have much visibility into what happens outside of the shop	Not checking the plugs and pins	If the cells are bad, they will not hold any charge Two boxes should produce 32 volts each– anything less than 30 means the cells are not holding charge If the charger over charges, the water will boil and the cell will lose water and start to bend If the charger works, the battery is good	Check all of the cells' water levels Replace the entire battery when the cells are down	Standard maintenance procedures Cell levels Voltage values Communication with the engineer	

Onboard Mechanics

Critical Decision, Judgment or Action	**Why Difficult?**	**Common Errors**	**Cues and Factors**	**Strategies**	**Information Sources**	**Suggested Changes**
Detecting flat spots on the wheel	The crew might not know about the flat spots before departing	Not listening to different sounds while the train is moving	Wheels make a thumping noise if there's a flat spot If the flat spot is big enough, the thumping could be so hard that it could crack the rail and separate it Wheels are quiet when they are round			
HVAC system ceiling fans	When it gets to a higher altitude and climate, the HVAC can't keep up with the demand There's nothing you can do when you're on board, but it just			If you start hearing the bearing squeal, you can make notes that you need to change the fan before it quits		

	stops working because of the design					
Major air leaks	If the main reservoir pressure hose breaks, that's not going to stop the train, and you wouldn't know you needed to fix it until you go to the system that it supplies air to	Not listening to different sounds while the train is moving	Listen for major air leaks	Sometimes the air hoses break, and you have to right the pipe		
Air operated toilets	Sometimes you don't know anything is wrong until you try to use it		Because there is a lot of vibration on passenger trains, the regulators back out little by little	Readjust the air pressure to get it to flush		
Tied handbrakes	Sometimes train crews leave a handbrake on from when they first depart or maybe they forget to knock some air off. You can really burn up a wheel and put a flat spot on it. Then, that car can't go anywhere.	Not paying attention to the different smells	Smell for burning rubber because brake hoses are composite like rubber			
Truck binding up going through a curve in a rail car		Not listening to different sounds while the train is moving Not paying attention to what you feel while the train is moving	A lot of derailments occur on curves. You can hear and feel a pop if the truck is binding up through a turn. You will feel it through the floorboard, which is an indication that something is wrong, but you will hear it too.			

Vehicle/Track Interaction

Critical Decision, Judgment or Action	**Why Difficult?**	**Common Errors**	**Cues and Factors**	**Strategies**	**Information Sources**	**Suggested Changes**
Vehicle/track interaction derailment investigation	Derailments are often caused by a combination of things There is a direct connection between the design and construction of the track and the vehicle– they must coexist in the physical space between them It can be difficult to determine the cause	A lot of people on opposite sides of the equation do not think about how the two components affect each other Most people immediately blame the track for rough rides Looking at the track or the vehicle in isolation	Wheels must be able to accommodate the bumps and dips on the track independently of each other The combination of profile (surface) and alignment (wiggles) can create an unsafe condition even though neither one exceeds individual safety standards	Look at vehicle design and how it functions related to track shape The design of the train affects the deterioration of the track, and the deterioration of the track severely affects the train Ensure the track can still provide service	49 CFR 213.345 Appendix D– Minimally Compliant Analytical Track (MCAT) – computer model helps determine whether it is safe to operate a vehicle or not without actually operating it over the physical track Derailment committees	

	of derailments because everything can measure to spec, so it seems like nothing is wrong There are often arguments over who or what caused a derailment– a lot of finger pointing and blaming across departments People are not trained in derailment investigations because most people think it is obvious to find the cause Some trains derail and engineers do not know it	The train can be nowhere near the point of derailment, so people might not search far enough for clues	Harmonic rockoff Vertical bounce Condition of the cars and the track Broken equipment Flange marks on the rail (means a wheel was touching the ties)		Photographs	
Determining at what point a wheel flange will climb over the rail and derail	Low speed derailments are caused by a combination of things that affect the suspension of the car and how the wheels equalize As the car negotiates the undulations on a piece of track, it has to twist and roll The wheel's weights change based on how the suspension is compressing and relaxing	If the L/V ratio of the wheel force exceeds the L/V ratio calculated by the Nadal ratio, the train will climb the rail and derail The gauge face angle should be no less than 30 degrees The wheel flange angle should be no less than 72 degrees Resurfacing car wheels increases friction– a freshly trued wheel has marks on it from the billing machine, so there are grips like snow ties Substandard conformal contact	The flange is parabolic because it needs to negotiate railroad operations– it has a rotational element that allows it to climb the rail As the friction goes down, the tendency of the wheel to climb the rail goes up As the weight on the wheel goes up and up and down, it has the same effect with the weight on the lateral force on the wheel	You always want the L/V ratio to be less than 1 As long as the L/V ratio of the actual wheel is less than the L/V ratio calculated by the elements of the gauge face angle and friction using the formula, the train does not derail Update wheel standards	The forces required for the wheel to climb the rail are lateral force and friction The elements that prevent the wheel from climbing the rail are vertical force and friction The Nadal formula produced a ratio of lateral to vertical force in combination with the friction on the rail– L/V formula	
Inspecting the track	Over time, the track can slowly deteriorate– if the same person looks at the same piece of track every week, they might not notice the issues because it happens so slowly One of the biggest arguments in the railroad industry revolves around the use of technology for	Not noticing the changes to the track because of parochialism Not using the available technology to identify and fix faulty track The CWR changed the way track deteriorated under train operations, but the standards did not	Microgeometry= track's internal shape Macrogeometry= how the track sits on the earth Cross-level elevation Bumps and wiggles on the track If the track's surface score goes up, it means the track is	Use track recording car measurements to determine the worst points on the track Algorithms allow people to plan and predict maintenance for capital projects– automate the process so it is constantly updated Have someone who understands the data	Dynamic simulations Radius measurement Track and acceleration measurements Track geometry cars ARMs system VPI system Inertial measuring	

	inspection Track inspection helps with maintenance and capital planning for rail replacement Until you can automate the data, humans have to do all the work Expensive technology	Not having a data warehouse to access important information about track conditions People not understanding that the technology does not work even if it is presenting that it is working– need someone who understands what the output should be	deteriorating at a rapid rate; if the surface score is stable, you can plan long range fices	output	units Spectral analysis Catenary geometry Ground penetrating radar Lidar Point Cloud Edge detection	
Measuring a track curve's radius	If there is a curve piece of track and you want to determine the macrogeometry, you need to know the radius The curve may have a radius measured in miles, so you need an internal way to determine the radius without drawing a string out across many miles		If you know the mid-chord offset, you know the radius of the curve If the distance between the two chords is 62 feet, the MCO measurement in inches is the same as the degree of curve of the track The degree of the curve of the track multiplied by 5927.65 tells you the radius in feet The FRA put limits on how big the mid-chord offset can be to provide safe riding conditions on the track The mid-chord offset for Class I's at 15 mph can be as much as 3 inches	Break the curve into equal arcs; draw a straight chord between each arc; get the midpoint of the segment Measure the mid-chord offset	Mid-chord offset measurement When you measure this by hand, you can eyeball and mark the maximum points to get the individual measurements	
Determining why a train rides poorly	Certain vehicles act differently– systems on cars react to different frequencies and wavelengths A piece of track could have a safety exception according to track standards, but the train can still ride well over it FRA track safety standards have almost no relationship with ride quality People are	Thinking ride quality is just about acceleration and vibration	People hate lateral acceleration on their body when they cannot see what the train is doing Good ride quality= sound insulation, bright lights Bad ride quality= rattling parts, poor lighting Ride quality is more perceptual and subjective than people can imagine– the elements of ride	Measure for ride quality with accelerometers Understand people's perception of what to expect– people have high expectations of a smooth ride; they do not want to feel any large accelerations Use the tilting car body to counterbalance the centrifugal acceleration	Accelerometer values for acceleration and vibration Larger values= worse ride quality If you are on a train and feel more than 1g lateral force on your body without any perceptual cues, you hate it Spectral analysis of the waveform of the geometry	

	subjective– they can think a train rides poorly even if the objective accelerometers' measurement says differently		quality have more to do with lighting, temperature, and noise than they do with actual vibrations, bumps, dips, jumps, and bangs			
Detecting and correcting harmonic frequency	When the same vehicles ride at the same speed at the same place over and over again, it creates a dip in the track, and the cars start to bounce Hysteresis causes a secondary reaction for the vehicle because it bounces down and rebounds a bunch of times, resulting in a wave motion The dents start relating to the natural frequencies of the vehicles	If the dip frequency and amplitude do not match FRA track safety standards, no one reports it as a defect, so no one fixes it	The railroad gets dents Dips are common because they are created by the downward pressure of the vehicle pushing on the surface of the track Impact load occurs when all the springs compress When a dip reaches a certain depth, it becomes dangerous	The ARMs system monitors harmonic frequency Fix the dips and dents in the track before it gets dangerous	The harmonic frequency of a railroad passenger car is 1 hertz	
Constructing and building track	Tracks have pockets of strength and weakness The track can take on various shapes Railroads twist, warp, and buckle Dips develop over the pockets of weakness because the materials go through phases of deformation Track structure depends on what the earth is made out of at any particular location— the underlying formation of the earth can cause the track to dent and create dips There is a sudden change in the geologic formation depending on location If you cannot	Putting track over areas saturated with water	The rails sit on the ties, which sit on crushed stone ballasts. Then, there is a sub-ballast layer, a subgrade layer, and the rest of the earth Elastic deformation= materials stretch like a rubber band and return back to their original shape, so nothing deteriorates Plastic deformation= materials stretch and almost return back to their original shape, but not quite; the small defect grows bigger and bigger over time, and the vehicle forms a dip Track has a life cycle that eventually expires	Place the layers with material, compaction, and thickness requirements so they can support heavy loads Make the track bed as uniform as possible– the horizontal plane of the top of the rails is supposed to be as straight as possible Determine what track shape the vehicle does not like Tamping machines surface track to put the rail back in a straight line Geocell, a recent invention, is a plastic framework that stabilizes the ballast, which particularly benefits track beds operating over soft soils	Track geometry Vehicle dynamic model	

	maintain a straight line, you lose your surface Every once in a while, you have to rip out the track and put it back					
Dealing with vehicle manufacturers	Vehicle manufacturers rarely pay attention to the track New FRA safety regulations mandate that cab cars must have crash energy management elements on the front of the truck, making the train longer Could get into a situation where an "irresistible force meets an immovable object"-- a large vehicle running into a strong track FRA has stipulations that everything organizations buy has to be made in the United States	Not paying attention to the symbiotic relationship between the track and the vehicles	Vehicle needs displacement in the suspension to cushion the ride Pay attention to the track environment– top of the rail, guardrails, point protectors, self guarding frogs	Track people and vehicle people have to talk to each other		
Tamping	Tamping is critical in the railroad industry because its' job is to create a solid and uniform foundation for the track The tamping machine never makes the track great– it can make it better but not perfect The middle buggy always lifts, so every time they tamp, the track gets higher, and they start losing bridge clearance	Some workers are mindless and do not pay enough attention Fluffing the stones around the ties	The track includes several structural elements, such as the rails, the ties, and the ballasts	Level the track by packing ballast stones around the ties Look for how much the base layer of earth gets dented over time Dynamic track stabilizer runs right behind the tamping system	Modern tamping machinery Computer system on the buggy that measures the track geometry and calculates anomalies automatically	
Setting curve speed limits	The FRA will shoot you down in a heartbeat if you try to increase the speed to 160 mph in a risky area	Focusing on high speed People want to spend a billion dollars to go 160 mph for five miles, but the difference between going 145 mph and 160 mph for five miles is only about 10 minutes– the benefits	Look for areas where you can increase the speed over longer stretches	Benefits accrue at lower speeds– if you can double the speed from 30 mph to 60 mph in particular locations, you can halve the running time through there Spend your money where there is more bang for your buck	Track speed Track curves FRA regulations	

		do not accrue		Stay away from mega projects that buy you seconds and focus on mega projects that buy you minutes Focus on average speed, not top speed		

Stories

The CTA interviews captured stories about expert's experiences that were particularly challenging. Expert stories are effective for training real-life problems. Students learn about complex cases directly from the expert, giving them a sense of the cognitive skills required to perform effectively in difficult situations.

The expert stories are the basis for the Decision Games; however, they can also augment existing training. Students are more likely to remember information when it is presented as a story and distributed throughout training sessions.

We organized the stories based on topics rather than experts. The stories have been scrubbed of names and identifying factors to keep the Subject Matter Experts (SMEs) confidential. An asterisk next to the heading (*) denotes that the content was reviewed by the SME.

Management

Main Yard Reconstruction Project*

Railroad Reconfiguration

In the Railroad's main yard, one of the routes comes in from two Class I railroads. Prior to a major reconfiguration, the Railroad had three arrival and departure tracks in the middle of the classification yard. The trains came into the classification yard, got switched around, put in order, and sent out to commercial customers.

However, there was only one way in and one way out. Any time the Railroad needed to land or depart a train, the whole yard shut down. The objective of the reconfiguration was to have continuous operations as trains were adjusted and moved. Today, the Railroad does all their switching from the east end and can depart and land trains at the same time.

Underlying Problem

The Railroad's main yard lacked efficiency. Before the reconfiguration, the Railroad typically switched industrial customers at night. During the day, the Railroad prepared for the customers. The crew had to stop and wait when they switched cars, so there were potential delays during the day.

Everything went into one switch on the west end of the yard, and that switch took the trains from the classification yards, which was on either side of the arrival and departure tracks or it took them to the main line. The main line was where the trains came in, so it was basically one intersection where all the trains went to do all the work on the west end.

The Railroad decided to move the arrival and departure tracks further to the north, which freed up the east end for switching. This change helped them from having to travel a couple of additional crossings when they were switching at the west end. It improved overall traffic flow.

The Port's Input

The reconfiguration ended up being a Port project, which further complicated the operation. The Port owned the ground under the tracks, so they initiated and funded the project through a separate grant. They had a heavy stake in the entire process. The Railroad had a smaller project starting, so the Railroad contributed some matching funds. Overall, the project cost about 15 million dollars.

The Port understood railroading at a high level, but they relied on the Railroad's expertise since the Railroad moved all of the cars on their tracks.

SME's Role

The SME helped design the entire reconfiguration. The Railroad drew the main yard on a piece of paper to show the existing problems and told the Port what they wanted to do. The Port wanted to hire a consultant to map out the operation and improve it. The Railroad went through months of interviews and meetings with consultants. The Railroad employees understood what the consultants were saying, but the Railroad workers felt that the consultants were unnecessary. It was frustrating for the SME because the Railroad was already telling the Port how to deal with the issues, but the Port kept spending millions of dollars for an outside group to tell them the same things.

The SME was the lead person for interacting with the consultants. He buried himself in the project so that he had less questions for operations and saved time by understanding everything himself. Eventually, the Port realized they spent a lot of money to hear what the Railroad was already telling them.

The Consulting Team

The Port wanted to confirm the SME's ideas. The consulting group conducted a lot of interviews with the Railroad to understand the operation and present their suggestions to the Port. The Railroad already knew what the consulting team was going to say because they were already sharing data with them. Although it took many meetings and cost the Port a lot of money, everyone eventually came to the same understanding.

Overall, the process with the consulting team worked out. The SME does not think any time is wasted when you talk with other people. If anything, the Port, the Railroad, and the consulting team built a relationship. The consulting team confirmed that the Railroad operated as efficiently as the Railroad said it did.

Tools

The Railroad gave the consultants all of their data and a model of the current operation. The consultants built a picture from those data points. They also used Google Earth overlay to map things out. The consultants walked around the tracks and used a technology to find the degree of curvature.

What to Think About During Reconfiguration

The Railroad is pretty good at giving everyone the tools, maps, and track distances to do their job in a challenging area.

The surrounding area has a lot of switches, making it a tough area to work. The Railroad typically leaves it up to the employees to determine the most efficient ways to work in the main yard. If the management sees something they did not like, they propose an alternative solution. The SME convinced the employees that a reconfiguration of the main yard would make their lives easier. If their work finished earlier, they could go home sooner.

This project primarily focused on the main yard, but the SME had to think of scenarios beyond that. In an operation as big as this one, the SME had to consider all the potential problems and potential solutions. He thought about tracks, switches, types of trains, schedules, crossing blocks, degree of curvature, and derailments.

He asked questions such as, "If something happens here, how do we recover from that? Are we creating a bigger problem for something that may never happen? Is this blocking a major arterial?" Furthermore, he had to think about the other projects they were doing that they could impact. Throughout the process, the SME pulled up Google Earth and put yellow lines down where the construction would be done to get a visual of the changes.

One train could completely block the surrounding area if there was a derailment. They also could landlock half of the port, so they had to have a backup plan if something happened.

Initially, the SME and his team missed the addition of a simple crossover in another area; however, they made the improvement a year after the project finished. Emergency management was important to make sure they were not creating bigger problems for themselves.

Design Team

The consultants created design ideations on their own and brought them back to the Railroad. Talking to the consultants helped the SME understand his own operation. He adjusted his mental model in the moment because he could see the effects of their design ideas.

Then, the Port hired a design team through a different contract. The design team was from a civil engineering firm. The Port gave the design team the information from the consulting team about where to put the tracks and how to improve the operational activities. The design team surveyed everything and made sure they got all of the engineering details correct. This included nailing down the storm and elevation aspects of the track.

The design team was great at what they did, but they did not fully understand railroad operations. The SME had to get them up to speed. They were a smart team, but they needed some education.

For example, the SME said they were a little over their head in the beginning when it came to a crossover. A crossover occurs when there are two parallel tracks and a switch crosses from one track to another. In the middle of the switches, the tracks have to be perfectly level because they share long ties. The SME had to make sure that the design team did not forget about details like this that can have major effects. He felt like he was responsible to make sure the design team did not miss specific nuances.

This partnership with the design team was a great opportunity to help them with their expertise. The Railroad still has a great relationship with them. They worked well together, and the design team wanted to do whatever they could to help. The SME said he would take a great working relationship over expertise any day. Their cohesiveness outweighed experience in a lot of aspects.

Looking back, the SME did not regret working with them. They were open to learning about rail, and they took the SME's guidance when he offered it. The Port did not give the design team much direction, so the SME helped point them in the right direction to make their job easier.

Technical Design Knowledge

The SME's railroad crew did not have the time to spend on such a detailed design. When it came to a major reconfiguration project, they preferred to use an outside consultant whose team was used to doing these projects. The Railroad knew the design firm and had faith in them to do a good job.

The SME sat down with the design team and went through the plans. He does not remember if there was a representative from the Port at the design meetings. The SME and the firm made sure they had all of the correct tools (i.e., points, frogs, etc.), and confirmed that they matched what they already had in the field and in stock.

The Port asked for certain things, but they did not fully understand what they had in stock. The SME helped them realize that what they were asking for was not what they actually wanted. The SME knew the operation and led the Port in the right direction. The Port's foreman felt comfortable coming to the SME, and the SME used his expertise to explain the implications of what they asked for.

People relied on the SME so much that they did not always check what he was doing. Although there was the chance for him to miss something, they trusted him with these big decisions.

The majority of the project was the Railroad's responsibility to maintain. The design team presented the phases of design to the SME, and he reviewed them. The SME involved the Railroad's operation team. He talked to workers and yard masters asking if they had any suggestions or tweaks. The SME put every phase in front of these workers to pick their brains or point things out. Although the workers might not have understood the plans, the SME gave them the option to provide their input. He spoke one-on-one with people asking them about the individual challenges they face and explaining why they designed the reconfiguration the way they did. Most of the time, people agreed that it made sense.

There were about 60-70 operational folks on the ground at this point. The workers who wanted to stay in the loop and who cared about the reconfiguration process were vocal about their ideas and opinions. About 10% of all of the workers really cared and shared their thoughts. These workers included switchmen, conductors, engineers, trainmasters, and yardmasters who were on the ground actually moving the trains. Their input was helpful to the SME and the design team.

30% Design

The SME and the design team started with a 30% design. They created an initial survey and map. They looked at layouts, distances, degree of curves, obstructions, storm water systems and drainage. They wanted to know all of the implications of moving big pieces.

The design required them to completely shift a storage yard with its own storage water system. The SME asked questions like, "Can we accommodate this curve in these switches? Do the crossings work? Can we tie it into the other stormwater stuff? How will this maintenance work? Can we store stuff? Since we can't turn around there anymore, what will the new access roads look like? Where can we place the crossings to keep them out of certain track components?" He did not want to bury any frogs or points.

The team also looked at the drainage system. The drainage had to fit around the track and walkways, and they had to make sure that the trains could go over it.

Furthermore, the Railroad could not shut the yard down for six months during construction, so they had to phase the process. The SME put every phase in front of the workers to pick their brains and ask them if they think it would work. He encouraged the employees to tell him the most efficient way to make everything work in a small area. The SME then went back to the design team and told them about any input from the employees.

The design team ran things by the SME, and he made suggestions. It was an interactive approach. They held weekly meetings and worked closely together. They constantly thought about how to continue the current operations with minimal disruptions.

Any time the west end of a major yard gets shut down, the design and the pieces leading up to it are challenging.

Double Diamonds

In a diamond crossing, two tracks cross without a switch. The Railroad never had a diamond crossing before, but they planned to have a double diamond at the end of their yard after reconstruction. If the double diamond did not work, nothing else would work. The only way to accomplish this layout was to have tracks that go across at the angle of the diamond. When it wears out, it can lead to issues in the future, so they had to buy an extra diamond crossing to have in stock in case there was a major emergency.

There was some apprehension about adding double diamonds in the main yard. People were concerned about accidents because of them. However, they overcame these fears because they trusted the SME. The SME helped the workers realize that the double diamonds would benefit them. The SME explained that adding the double diamonds was not simply to save money and keep operations moving. The addition would actually help the operators themselves.

Guidelines
The General Code of Operating Rules (GCOR) covers the double diamond operation. The GCOR contains rules adopted by the majority of railroads in the country. Whatever the design team decided to do for the reconfiguration, GCOR laid out the rules and regulations that control specific areas of rail.

The American Railway Engineering and Maintenance-of-Way Association (AREMA) also contains national standard guidelines for railroads. Railroads do not have to follow them, but AREMA provides guidelines for engineering.

Yard Air System
Before the reconfiguration, the Railroad had an air compressor off the side of the tracks with a hose running under the rail. Intermodal trains went to the terminal, the workers collected five tracks worth of a train, and built the train in the order it needed to go on the departure track.

The yard air helps with the challenge of getting locomotives on site. To prevent departure delays, the workers charge the train, test it, and leave it on air. Then, the train is good for four-six hours before the power comes in, and it is ready to go.

This was a major benefit to have the train ready to go without the power. To ensure that the yard air could still function, the SME made sure the vaults in between the tracks fit the new configuration.

60%, 90%, 100%
The next stages of design ironed out any kinks. The design team and the SME talked about the actual components to build the crossing.

There was an 11-foot culvert that they were adding five tracks across. This required the installation of a culvert in a wetland, so they had to consider environmental permitting rules.

Overall, the maintenance standards were pretty simple. There was a single page that laid out the type of switch they needed. They did not want anything smaller than a #7 and no longer than a #9. If they went longer than a #9, they would have to change their inventory.

They also considered transit clips versus jaw clips. If the SME had a crew changing out points, he wanted to make sure the points were the same as what they currently used. This same process went into the type of crossing, whether it was concrete versus panel.

If they were going to put a cache facing on one side, they did not want an asphalt crossing at the same level on the other side because when that tie goes bad, how would they change that?

Inventory was a key aspect of the project. The SME thought of his crew and their capabilities and how that would affect operations. It was critical to understand the granular level of day-to-day maintenance that can shut the track down. He worked with his crew daily to understand the struggles of something that seemed so small but could cost them two extra hours to get done. The SME focused on this stuff because

it could really help morale. If the SME did not talk to the people and he did not know the area he was designing, he would miss a lot of details beyond the survey.

Digging into these details that seem small can have major impacts for years afterwards. The engineers needed to think beyond infrastructure. Including the hourly workers in the design process builds confidence and improves overall efficiency.

Final Design
This project was a drastic reconstruction of their yard. Getting buy-in from everyone involved was challenging. The SME had to go with his gut and trust that he played out every possible scenario. He asked himself a lot of questions and talked to employees one-on-one. The SME got their input and explained why they designed it a certain way. Most people agreed that the design made sense, and they said they would see the outcome when it was actually built.

Inexperienced Civil Contractors*
The reconstruction project included civil contractors who were not entirely familiar with railroad rules. The rail industry has strict safety rules, and workers need to know where they are working. The civil contractors did not understand live tracks versus not live tracks, working limits, and job briefings.

There were some “dirt guys” who wanted to jump on a loader and start digging next to a live track. The SME wanted to know who they talked to, why the basic protection was not up, and who the employee in charge was. The workers did not even know that they were not following a track.

The SME’s train crew reported what they saw to him. The train crews were especially frustrated. In one instance, the train crew was coming around the bend, and there was one dirt guy on a loader leaning out over the tracks. The train crew stopped and waited until they moved.

The SME got in contact with the contractor. He expressed that he knew it was the Port’s project, but they could not have guys doing dangerous stuff. The SME made it known that anytime something like the situation between the train crew and the dirt guys happened, they would shut it down.

They eventually removed a couple people from the project because they were not doing their job safely or correctly. They were not qualified to do this type of work, and the railroad was not messing around.

The Railroad was committed to safety rules. They laid out the rules in the bid, so it was up to the contracting company to adhere to it.

Customer Service: Thinking Ahead*
The Railroad had to adapt throughout the construction process. For example, they pre-built a lot of switches. They took a switch, built it in a warehouse, tore it apart, and numbered it. This helped greatly because a typical three-day outage became a six-hour outage.

In one situation, the Railroad had to shut down the yard for three days. The Railroad made sure they were transparent and let their customers know. They sometimes asked if their customers could take advantage of this setback and potentially do their own business shutdown cleanups. The Railroad made it a priority to work closely with their customers and tell them how they would be impacted.

The Railroad would help the customers and give them demerge credits. When a car comes into the Railroad’s yard, they have a certain amount of time to get it to their facility. If they do not get it to their facility within 24 hours, the Railroad charges them by the day or by the hour depending on the car. During this project, they would help the customers save some money with these demerge credits.

The SME had to think about how to minimize the impacts of the construction shutdowns. Customer service worked directly with management to understand how long outages would take. They discussed the project schedule for and tried to plan about two weeks ahead.

After a couple of months of construction, they got into a groove. The Railroad figured out what was working and started building their confidence. Their flexibility improved, and they were watching the project come to fruition.

In a larger organization, it is unlikely that the SME would have been involved in all of this problem solving and forecasting. The SME knows he wears a lot more hats than a typical roadmaster. Railroads typically rely on their marketing team to interact with their customers. The SME made a point to have a strong relationship with his customers and build trust. He would have customers call him with questions and concerns. Because the Railroad is a small and local operation, they have great customer feedback.

Railroad Wye Construction*

Wye Example

A wye is a type of track where three lines form a "Y" shape, allowing trains to turn in the opposite direction. If you have three legs of a triangle with tracks that extend for headroom on all three legs, you can take a locomotive, go around one leg and throw a switch, go back around another leg and throw a switch, and end up facing a different direction.

Certain geographic locations can pinhole locomotives with no way out. In these situations, they want to be able to turn a locomotive around so that the trainman does not have to ride the back of the train holding onto a ladder for three miles to get where they want to go. It is key to use sidings or wyes to turn locomotives around and reposition the train to face the other direction. The SME uses wyes in strategic locations.

The Railroad had a specific location where locomotives had to go all the way to the north end to take headroom and then shove around to switch customers in the east. They added a wye further south, so they could shove the train to the east in a single move and avoid going to the north end. This could save 20 minutes in the overall operation. They also added another leg from the west that went right into the new wye leg.

This reconfiguration improved the yard's flexibility. Now, customers can do congruent moves without blocking a track just by adding a short piece of track.

Challenges

This reconstruction project came with some challenges. The Railroad did not own certain real estate. They could have blocked emergency access to the fire department by adding tracks. They could not move the transmission line for the city's power service. There were underground utilities and overhead power lines.

The only way they could get a curve in that spot was to make it 20 degrees and put a switch in the curve, which they did prefer to do. Therefore, they had to put out special instructions for certain cars over 90 ft. that cannot make that turn consistently. If someone misses a step, it could be a huge risk. If there is any lapse in train handling, like a hard joint or a strong pull that pops the wheel off the ground, the train could take out a major transmission line. When they built the new leg, the SME thought about how to prevent stuff like that from happening, so they put in guardrails to hold the train to the tracks and keep it away from the poles.

The SME also considered future projects that this reconfiguration could affect. The Railroad did not want to shoehorn themselves for the next 10-20 years. The SME had a relationship with the Port, the city, and the state, so he knew what their capital projects were moving forward, and he wanted to be a part of them.

They looked for any additional track features to mitigate risks. They put a switch on a crossing. Anytime you put a track across other tracks, you might block something. However, the wye allows them to make a through move into the yard and off the main line, which eliminates extra congestion.

The SME had to weigh the benefits versus the risks and talk to all the different agencies the reconfiguration would affect. He looked at pre-existing railroad standards, but the goal was maximum flexibility. They wanted to stay off the main roads and avoid major intersections. Fewer moves meant fewer risks.

Customer Spur Installation Example*

In the main yard, one customer was located in a horrible place behind another customer. The crew had to pull a customer car out to get the other customer's car in. It was a nightmare location. When the SME suggested relocating, operations immediately agreed to put a spur in there. They would take the headache of relocating the customer over the labor-intensive work at the previous location any day. They wanted to make the process easier for everyone involved.

As they got further into the process, operations knew all the important questions to ask and how much money they would make off of the cars each night. The SME talked to the customer and told them to get an engineering firm on board and to create a plan. He wanted to see the degree of curves, elevations, and crossings. The SME responded to their plan with even more questions. Then, they started putting in for permits and start planning for the specification. The SME was essentially a consultant to the company. Whenever a potential customer to be a part of their rail service, the SME tells them what he needs to ensure that everything will work on his side.

From an engineering perspective, the SME looked at the car's curve negotiability and their limits. He wanted to make work easier for his crews. For example, moving knuckles at an angle can be challenging. The SME made sure his crew can easily couple the cars in the new spur. Then, he talked to the engineer and told him what he found. He told them that they cannot go any sharper than a 20-degree curve because of the type of commodity they get. If their business model could fit the flat, they could build the spur as long as the customer knew what type of cars they were restricted to at that location.

Once the engineering firm completely built out the plans and the Railroad approved it, then the engineering firm contracted the construction. The Railroad had to approve it because the spur ties into their track, and they maintain everything outside of the fence. Many engineers do not understand how car types and current operations are correlated. If they built something without the railroad's approval, it might not work. If the SME relied on an engineering firm to put something in themselves, they might choose the cheap options. The engineering firm might miss something or put too sharp of a curve in there. The Railroad's train is serving their industry, so they must know it works for the operation, it is legal, and it is safe.

Anything they build on the Railroad's property must meet their standards. The Railroad can give suggestions for the inside of the customer's location, but the customer can build it as cheap as they want to. The Railroad sometimes offers customers second-hand track if they have it available.

The SME also acts as an insurance policy for the customers. The SME has had customers who wanted their car to make a tight turn, and the SME knew they could not safely get that car in there based on how the spur was built. The SME protects them while helping them meet their business needs.

The engineering firm nailed the plans pretty quickly, which was refreshing. There was still a bit of tweaking needed, but it looked pretty good. The SME is always cautiously optimistic. He has to see driveway elevations and how that interacts with everything else. The SME also has to think about neighbors that do not benefit from certain changes. He is a proxy for the Railroad's neighbors.

Angry Customer Call*

The SME had an issue with a customer who got upset that the Railroad was adding a crossing in the main yard. Leading up to the project, the SME described the customer as a "prickly pear." When the Railroad told the customer they needed to put the driveway down, the customer got really upset and said he was going to shut the Railroad down. He started yelled at the SME when the SME called him. The SME told the customer he was calling because he wanted to work with him and wanted to figure out what was wrong. The SME listened to all of the customer's other issues and let him know he wanted to help him with those too, but the SME kept the focus on the crossing. The SME gave the customer his phone number to call him about any other issues and ended the call on a good note. The SME makes sure to give the people he works with something in return, even if it is just a listening ear or his phone number.

Surprise Visit: Intimidation Example*

Trains are built so there are loads in the front and empties in the back. When you think about it from an operating standpoint, if you have lighter cars towards the front of the train and heavier cars towards the rear, any heavy braking application would cause the heavier cars to run into the lighter ones and derail.

Over the last five years, there have been several derailments in a particular location with the exact same type of train. The train crew has to shove into the yard because of the way the tracks are laid out. As the trains cross a segment of a sharp enough curve, they have a bunch of empty cars in the middle of the curve, and they put locomotives on the tail end. When the cars push against the empties, they keep derailing because the car has to go somewhere. They take out a power pole and go into the road. This exact situation has happened four times in the last four years, and regulators have gotten involved.

The last derailment occurred within the past six months, and the area was out of service for about three days. Since the Railroad is in an industrial area, the power never goes out; however, every derailment in that specific area leads to a power outage because the train takes out a poll and a feeder. During the third derailment, the SME was walking by the superintendent's office when the power went out, and he immediately knew another derailment occurred. A minute later, he got a phone call saying there was a derailment.

Two weeks later, the other railroad coincidentally showed up at the Railroad's yard. The SME got a weird call from a representative saying, "Hey, does your inspector have time to meet me out here to talk through this and look at the track?" The SME said, "No. Let me know what time, and I'll show up." They never called the SME back, so he showed up where the initial meeting was. The other railroad brought all kinds of people from operations and engineering to the Railroad's yard without telling the SME. It is a common procedure to let the Railroad know they are coming.

The SME showed up right when about a dozen railroad guys started looking at the track and surprised everyone. The SME said, "Are you planning on having a job briefing? Anytime you guys want to investigate something on our tracks, you should probably let us know. But I'm here now, so thanks for the invite." He caught them off guard.

Then, the SME said they should have a safety briefing about how to achieve the regulation since they were out on the tracks. The SME was the watchman, and they went through the safety steps. The SME established that he was in charge, and it was his railroad. He knew all the details of the track, so he knew what the railroad folks were saying was not accurate. The SME also had a crew on scene who watched the derailment occur and saw the locomotive engineer pushing hard on the engines. They were coincidentally standing off to the side, and a bystander from the nearby medical clinic happened to film the whole derailment. Someone searched for the video online and found it, so there was clear evidence.

The SME investigates a lot of derailments, so the railroad tried to get a lower-level inspector who might not be as comfortable pushing back to a Class I to meet them instead. The SME knew a couple of people from previous interactions, including the roadmaster, but the railroad brought one of their top operations guys. The SME could tell he was taking the lead for all the departments. He categorized the derailment as an engineering/track issue with the FRA. The SME told him there was nothing wrong with the tracks. He knew they were in great shape.

Operations vs. Engineering Dynamic

The forceful hand from operations tried to intimidate the engineering department, saying he would report the derailment as an engineering issue. The SME told him, “If you’re going to do that, there’s going to be an issue.”

The railroad’s operations guys tried to point out things like the frogs or the tight curve, but the SME pulled out the facts. It was a 17-degree curve and a number 9 switch. The entire yard consists of number 9 frogs and the same degree of curvature, so their argument did not hold. The SME knew it was a typical 10 mph switch. The railroad was just throwing out scenarios to see if anything would stick.

The SME talked to the railroad’s engineering guys, and they said their own operations representative did not know what he was talking about. These guys were part of one of the top engineering groups in the Northwest, so they were all on the same page and knew the track. However, they had to be diplomatic because they were dealing with the top guy in their organization.

The SME stepped off to the side with the engineers and said he would not be intimidated by operations. He told them they would have a problem if the railroad submitted an inaccurate FRA code, but the SME knew the engineers knew what actually happened. The railroad’s boss looked at one of the engineers and said, “You would speak up and tell me if I was wrong, wouldn’t you?” The engineer responded, “Oh, yeah,” and the SME just looked down, shook his head, and smiled. It was an awkward moment. The SME did not want anything to be contentious, but he gave them his expert opinion and told them he would not take a hit for something that clearly was not their fault.

This example shows how having a relationship with the major railroads helped with credibility and understanding between departments. The SME did not put the railroad in its own silo. He did not think the railroad was bad or that they were out to get the Railroad. There was just a particular person in the operations department that caused the issue. The SME had a great relationship with other people in the organization in his discipline.

The SME went to the Railroad’s operations department, and they agreed with the SME that the track was not the issue. The SME talked to his counterpart at the railroad who was just below the top operations guy. The railroad counterpart said the top operations guy was way out of line. This solidified that the Railroad has a good relationship with the majority of people at these organizations.

FRA Involvement

The Railroad is still in the paperwork stage of this situation. The Railroad waited for the other railroad to submit their report. The Railroad knew how they wanted to report it, but they wanted to see how much information the railroad would provide to them. When the other railroad reported their own code, the Railroad disagreed and provided a different cause code. The three previous derailments were all reported as train make up codes.

The FRA came back and said there was a discrepancy between the owner railroad and the operating railroad codes. The SME's report cited the train makeup code, saying the way the train came in was not conducive to the normal operation. The Railroad asked the other railroad for the downloads, which tells you speed, horsepower, and throttle position, but the railroad has yet to share that information with the Railroad. The Railroad could not pinpoint train handling as the cause, so they reported the train makeup code. The SME knows how every train is built when it comes into the yard. The Railroad's investigation folder has all the evidence from the investigation, and they have a written report for the FRA with a code. The FRA can investigate if they want to and ask for records.

To prevent derailments from happening again, the Railroad talked to the railroad and created an operational instruction, saying no matter how long the train is that comes in, they will cut the train, so the locomotive does not go past the curve. They will not even put the train in the curve for this specific type of train. The railroad incorporated it into their operating instructions. The railroad did not have an option because the Railroad controls how the trains come in. Neither party wanted a derailment, so the Railroad gave the other railroad a logical way to avoid that from happening. There was cross communication between engineering and operations to figure out how to prevent future issues, and the SME gave them track measurements and instructions. For now, the Railroad does not even cross that road with any long trains because they cannot risk something happening in that area again.

This is an example where a lot of issues are coming to head at the same time.

Challenging Relationships*

Emotional Employee

One of the SME's employees does not talk to him for weeks at a time. This particular person is tough to develop a relationship with. According to the SME, he is emotional, but he is great at his job. When the SME questions him on anything, he often comes back a week or so later and says he thought about what the SME said.

The last time this situation happened was a growing opportunity for the SME and his employee. The SME would not let the conversation end until they both understood each other. The SME wanted to get to the root cause of the problem.

This employee is a union inspector. When he writes up defects on the track, the crew often complains about what he says. The inspector's feelings get hurt when they question his authority and his expertise, which is hard for his ego. The crew thinks it is ridiculous because a lot of defects are subjective. Both the inspector and the crew report to the SME, so this has been an ongoing issue with him in the middle.

The SME eventually put his foot down and tried to understand why both sides were upset. The SME said, "Talk to me about it, and I will help you. We're not going to agree all the time, but let's talk through the regulation. I would appreciate that." The SME was empathetic to his needs, no matter how ridiculous they were because it was the employee's feelings. If the SME just sat there and disagreed with him, they would not get anywhere. On the employee satisfaction surveys, the inspector has said the SME is a great boss.

Empathy is huge for the SME with his employees and contractors. He will take the time to understand what they deal with day to day and how he fits into that. They do not have to agree, but they need to be able to disagree and still have a relationship. The SME listens, empathizes, and understands.

The SME watches for triggers with different individuals. When they are upset, he does not get upset with them or go into defensive mode saying they should not feel a certain way. Most of the time, people are not even looking for a response, they want to tell the SME how they feel. The SME lets them know he is there to talk, and they can always come to him.

Blowing Up at the Boss*

One of the SME's employees went to the top boss's office to talk about a situation. The SME told his employee to park a car somewhere, and it was broken into. The employee had to park the car there because there were no other options, and no one knew the car would have been broken into. The boss assigned the blame on the SME right in front of his employee. The boss undermined the SME's authority without having all of the information. The SME encourages the boss to question and council him as much as he wants, but not with an employee right there. The SME did not mind the employee going to the boss, but he did not appreciate the boss making assumptions without knowing any of the facts. The situation was not major, so the fact that he was even questioning the SME was frustrating for him.

The SME was frustrated and rushed. He reacted in the moment and said, "Why don't the two of you f*cking figure it out," and he walked out of the door. Both the top boss and the employee knew the SME did not usually respond to situations like that.

In retrospect, the situation had more of a positive effect than a negative one. The boss knew the SME rarely got that worked up, so it showed the boss he crossed a boundary. Later on, the boss told the SME he had never cussed at him before. The SME apologized and said that was a weak moment for him, and they laughed about it afterwards. The SME is comfortable enough in his role that he will speak his truth. The company has a good culture, and people can respectfully tell each other how they feel. The boss praises the SME in private and public, so the SME appreciates him and has a good relationship with him.

Read the Room

When the SME gets frustrated, he usually takes a moment away from people to recenter himself. He uses the restroom or gets a drink of water when he is heated. There is a chance he will say something he regrets, so he finds a reason to step away and take a mental break.

If the SME gets upset in front of a group of people, he intentionally makes eye contact with everyone so he can read the room. It is easy to have tunnel vision and get into an argument with one person. By taking a moment to look around the room, the SME knows if the debate is individual or if it includes everyone. Most of the time, everyone does not feel the same way. The SME is mindful of people who might not want to be involved in a particular situation, and he does not want to put anyone in an uncomfortable situation. The SME can ask whoever is upset to talk in private later.

Building Teams in a Small Town*

The Story

In 2010, there was a new short line railroad in the Northeast U.S. Coming into town, the railroad shared a portion of its track with a freight line. When operating a passenger train on a freight line with hazardous materials, everything must be Part 238 compliant (Passenger Equipment Safety Standards). Therefore, there were a lot of changes that had to be made to the historic and antiquated equipment for it to be Part 238 compliant.

The Subject Matter Expert (SME) volunteered and asked for the opportunity to help start the railroad. He had the intention of getting the equipment in compliance and training locals on the equipment, including how to start the generator and how to do the inspections. He worked closely with the FRA to complete a checklist that was required to start the railroad, including equipment compliance, track compliance, and Part 239 emergency evacuation plans. The SME worked with consultants to write the plans for Part 239. When the company needed new management, they hired the SME. He successfully built a team to help run the railroad for about four years.

Journey to the Town
The SME finished working on a locomotive in the central U.S. that was going to be used in the Northeast. One of his friends there who was a conductor and engineer was also going to the Northeast to help with the operation of the railroad, so they both traveled together with the locomotive to the Northeast.

The SME arrived in the Northeast with the intention of helping with the start-up and training locals on the equipment. He was working to test the cars and get them ready for service. There was a checklist they had to complete, including equipment and track compliance and emergency evacuation plans. The team structure included a General Manager, a locomotive engineer who was hired locally, and a consulting firm.

The company hired a mechanical superintendent; however, he lasted about a week before the General Manager fired him.

The General Manager knew the SME and recommended the SME as the mechanical superintendent. The company saw that the SME was bright and offered him the position. The company convinced the home office to let the SME be the mechanical superintendent of the railroad. The SME took the position and worked there for five years.

Building the Team
This was the first time the SME had been in a supervisory position. The SME was expected to build the rest of the team. The company said there were five FTEs allocated for mechanical. They put the SME in touch with HR through a phone conversation. HR sent the SME the job description file by email, and he reviewed it. They scheduled a conversation to see if he had any questions. They also discussed where it was going to get posted.

The SME talked to HR about the job description because they did not include all of the duties assigned. He believes it is important to put all duties assigned in the job description, especially for a small operation, specifically because the workers might have to do all kinds of different tasks. The SME wanted to give applicants the sense that they would be doing multiple things.

HR posted the job on online forums such as Indeed and internal postings on rail websites. They also posted the job in the local newspapers through “Help Wanted” advertisements and the SME did on-the-ground recruiting when he was in the local bakery, restaurants, and bars.

The Team
During interviews, the SME noted that a lot of people can say they know stuff, but when you ask them to tell you what they did, it says a lot about their work. The SME highlighted the importance of asking them to give examples. The SME also needed to know the technical side of railroading so he could tell if the interviewees actually knew what they were talking about.

Because it was the SME’s first time in a supervisor position, he came up with the interview questions on his own. The SME did not go to college. He went to technical school, so most of his learning is found on

the Internet. He found real-world examples and good interview questions for mechanics on Google, and he took information that he had been asked during his own previous interviews.

The SME knew that he wanted composite technicians who had general mechanical aptitude. However, there were not any Class I railroads nearby, and the SME knew he probably would not find many skilled workers in the area.

The SME also knew he needed to have some workers who had high-strength skills in certain areas. He tried to find someone who was strong in electrical and someone with experience in plumbing or piping.

When looking at resumes, the SME asked himself, “Will this guy be good all around?” and “Do I also have special guys for specific situations?”

Because it was such a small town, the SME only found three “good” guys and two other young guys with no experience. However, he looked at the positives. The SME knew hiring was not only about skills. He also wanted to make sure that the candidates were a good fit for the team. If the SME thought they would not work well with others, he did not want them on his team.

The two younger applicants had great ambition, morals, and personality, which the SME knew could be beneficial. The SME noted that bad habits can also come from experience. He could mentor and train the younger workers. One of the younger men had a family issue and had to move to a nearby state, so the SME only had him for a couple of months.

A young locomotive mechanic from a different railroad down South was the back-fill for the worker who left. He heard about the job posting online through the Railroad Retirement Board. He applied through the site and sent his resume to the SME. During a phone interview, the SME could tell that he knew locomotives well, and his technical answers were spot on. He was looking for a change after a breakup with his girlfriend, so he had been applying for other jobs and was willing to move to the Northeast. The idea of an internal hire sat better with the SME because they probably already went through initial company training, so he would only have to do site-specific training. The SME decided to hire him, and he asked his General Manager to call the applicant's General Manager as a courtesy. This hire was the only person that the SME was slightly concerned about. The General Manager responded that he was a great mechanic, but he could be a hot-head sometimes. The SME saw this behavior a few times throughout the years and could see the escalation of his reactions.

The SME tried to work on it with him and manage him. In one incident, there was an electrical problem with a locomotive. Electrical problems can be hard to trace, especially if they are intermittent. He was getting frustrated while he was working underneath the locomotive. The SME was in the shop, and he heard a cuss word and a wrench flying from underneath the locomotive across the shop. The SME asked him to step away and take a walk. The SME told him it was okay to get frustrated, but it was not okay to cuss and throw things. The SME said if he felt himself escalating to walk away, take a breath, and go sit by the river. He was understanding and took the constructive criticism.

The other young man the SME hired was a local 19-year-old nicknamed “Junior.” He just got out of a technical school for auto and diesel mechanics, so he had limited experience. He also had some non-work history in mechanics. The SME recognized his drive, attitude, and motivation. The SME believes in mentoring and looks to pass that on because he learned a lot throughout his experience through mentors and coaching. The SME wanted to give “Junior” an opportunity because he had a good head on his shoulders and motivation. During his in-person interview, the SME could tell he had some good examples of working well with others, working with his dad, and having morals and integrity.

The SME hired another man from down South, who found the job posting internally from the company. The SME reached out to him and had a phone conversation with him. The SME was blown away by his experience, which included railroad and airbrake skills. The applicant addressed the SME as "Sir," and the SME thought he was kind and respectful in his mannerisms. Impressed by the applicant, the SME asked his General Manager to talk to him. The SME also called the applicant's company for a reference and to let them know that he would likely leave to join the SME's team. In the railroad industry, most people openly understand that people move around.

The SME found another team member through word-of-mouth at a local restaurant. He was talking about the job posting with his server, and she said she knew someone in town who might be interested. The SME told the server to tell him to go on Indeed to see the job posting. When the man applied for the job online, they scheduled an in-person interview, and the applicant came to the shop. The SME said he had a great work history, and he seemed genuine, honest, and fun-spirited. The applicant had experience as a general automotive, and he used to work for the school system on buses. He knew airbrakes, pneumatic air, diesel, and had handyman experience. He was a well-rounded mechanic. The SME mentioned that he thought this worker would bring a lot to the team with his energy and mood, so the SME wanted him on the team. The applicant did not try to be somebody he was not in the interview. He did not get dressed up or get nervous, and he was laughing, all of which stuck out in the SME's mind.

The SME discovered his next hire in a local family-owned shop. When the SME was in the shop one day, the wife said that her husband might be interested in the job. The SME went to talk to the man a few days later. The man used to work on recreational equipment at a resort and had a strong electrical background. When they had a conversation about the start-up, the SME explained that the railroad equipment was similar to the recreational equipment. The SME knew that if he had mechanical aptitude and the basics, he could apply what he knew to this new product. The SME tried to sell the job, telling him about his own experience, railroad retirement benefits, and how fun it is. The SME also told him he could really use him and convinced him to try it. The SME mentioned that he could tell this man had good morals, honesty, integrity, and kindness. The man was honest about the problems in his last job.

After the SME hired his workers, he held a meeting with all of the new team members. He instructed everyone to talk about where they came from and what they did so everyone could identify each other's strengths and weaknesses.

The SME did not have any concerns about the hires getting along because he thought about the team dynamic during the interviews. Everyone hit it off right away. The SME described the team culture as a very family-like environment, and he said that smaller teams tend to be like that. There was even a family feel with the train and engine crew.

It took about 7 weeks to start the railroad operation because training was long. The SME built a timeline for when they had to have a certain number of people in place and when they had to complete the training. Each team member needed certifications under Part 238– Passenger Equipment Safety Standards. All employees went into training at the same time and went through qualifications in early July.

Overall, it took the SME a couple of months from getting his supervisory role in May to hiring his five-person team. The first month of operations began in mid-August, and he had his entire team in place by then. His team remained the same group of men for about four years.

It was hard for the SME to leave his team. His mother passed away and his father was still home, so he moved back to the central U.S. He was proud of the team that he created and how well they worked together. The SME mentioned that he has always led with the mentality of "leading with love." As a

supervisor, he has loyalty to his company, but he also has a responsibility to serve and provide for his team members. He makes sure that his employees feel loved, supported, and like they have what they need to do their job. The SME takes time to invest in his employees and genuinely wants to know about their lives. He asks about their home life and tries to remember it and come back to it. His empathy and friendship (with authority) has proven to be successful in his career.

Building Teams for a New Operation*

The Story

After returning to the central U.S., the SME worked for a new Railroad. He was the 23rd employee for the new operation. The maintenance department only included one consultant and one mechanical manager at the time. The company hoped to find someone with more experience, and the consultant recommended they give the SME a chance.

The Railroad hired the SME under the consultant as the Deputy Chief Mechanical Officer to help write the plans and finish setting everything up. They planned to reevaluate his position down the road.

Early Relationships

The mechanical manager was an older man who ran the shop and had considerable experience, but the SME's job title put him above the mechanical manager. The SME recalls some deep-rooted friction between the two of them. The SME said he took offense to the SME coming in as a younger guy and now having to answer to him. Even though the mechanical manager had a mechanical background, the SME was coming from an operation standpoint and knew Part 238 because of his experience in the Northeast. The Railroad's commuter operation was going to be running under 238 standards.

The SME was a little worried and anxious about how the tension would affect setting up the whole operation, including conducting interviews and creating maintenance plans together. About six months later, the SME remembers the mechanical manager being honest with him, saying he did not like the SME when he came in, but he respected the SME because he knew what he was doing. The mechanical manager finally accepted him because he was holding his weight.

About seven months after the SME was hired and before they started hiring for supervisors and technicians, the SME was promoted from Deputy Chief to full Chief.

The SME and the maintenance manager set up the shop and wrote plans during the first year. They had a timeline set and worked backwards. They knew the opening date for the first rail line, so the SME and the maintenance manager had about a year to hire everyone and train everyone.

Preparing to Hire

The SME and the managing director had to hire seven supervisors and 33 technicians for their first team. The number of employees was predetermined by the Board and the financial structure of the company. This was a much larger team than the SME previously managed.

The first revenue train was set to open in April. They hired the supervisors the previous July. It was standard practice to hire supervisors before technical folks when building a team from scratch. They wanted to build the team from the top down and get the structure in place. They then hired the technicians by October, so they would have about three months of training. It took about 10 months from hiring the team to opening up the rail line in April.

The consultant was in town Monday-Friday. He was pretty engaged for a while. After they opened the first line, he started to pull back. By a year later, the SME only leaned on him when he needed him.

Before they started hiring, the consultant, the mechanical manager, and the SME made the operating schedules. They built a shift schedule that would ensure they covered all the train inspections 24/7. They created three shifts. They wanted two supervisors per shift, and three for the third shift because that was the bulk of the business. When the trains came back at night, they needed a lot of oversight. They also wanted to space out the technicians. There would be 20% on the first shift, 20% on the second shift, and 60% on the third shift because they would need more help. When the employees came in, they would bid for their shift.

The consultant, the mechanical manager, and the SME met to create the job descriptions for the supervisors and discuss what they were looking for. The consultant already had previous job descriptions from other projects, so they just tailored them to their needs. They identified past supervisor or lead experience, preferably rail experience, expertise in different areas of the car, electrical experience, communications experience, and general mechanic experience. Electrical experience was critical because the trains ran on electricity, not diesel. They also needed expertise in Network Communications in these newer, high-tech cars, which the SME did not have in his previous passenger cars. They also wanted to space out the expertise, so they didn't want all supervisors that were electricians because they could not help with communications and what not. The consultant, the mechanical manager, and the SME made sure that all duties assigned were included in the job description.

They gave the job description to HR for posting. There was no internal posting. They posted on Indeed and local newspapers and advertisements. They also posted on the Railroad Retirement job site. Because it is a larger urban city, they posted far and wide on job sites. According to the SME, word-of-mouth would not do much in a large city.

The Hiring Process: Supervisors

It took about two to three months to get the supervisors hired. They only hired one local. Quite a few guys from the SME's previous light rail company applied for positions. Two people came from a Southwest light rail system. A supervisor from the east coast applied, who was an obvious hire because he helped build the equipment and knew it like the back of his hand.

The Railroad flew the applicants in for interviews after an initial phone interview.

One skillset they were looking for was working with sheet metal because the outside of the car was all stainless steel. The local from Railroad previously worked in the airline industry. He did a lot of sheet metal work in the airline industry, so they knew he could pass on training to the technicians.

One of the men from the Southwest was a lead technician, and he did not have any previous supervisor experience. They were on the fence about hiring him, and they did a lot of checking and references. They took a chance on him because he was the strongest out of the other candidates. The other man from the Southwest was a supervisor. He told the SME that he knew the other man from the Southwest. He said he was a good technician, but it was sometimes hard to get him moving and light a fire under him.

The SME said that first impressions make a big difference. He remembers the lead technician from his interview because he was dressed in a suit. After he got back home, he sent a card thanking them for the interview and for flying him in. The SME was okay taking the chance on him because his interview and the card let him know more about his character. Although they had to put a lot into him, he is still working there and doing fine. He is currently a first shift supervisor.

They did not find a supervisor who was really strong in communications. The supervisor from the east coast had the most experience with it because he installed it, but no one had done a lot of troubleshooting.

Communications includes announcements, the PA system, and wireless and ethernet systems. They made sure some of the technicians they hired were heavier on communications.

The supervisors were all hired by August, and they all started on the same day. Because they started together, they based bidding for their schedules off of the last four numbers of their social security number. They had to make it random because they all had the same start date. The supervisors thought it was fair and they understood the process.

The newly hired supervisors did not play a role in the hiring interviews. They helped commission the shop, and they started commissioning the trains when they started coming in little by little. The SME said they started the supervisors on tasks pretty quickly.

The Hiring Process: Technicians

HR and the hiring team used the same internet platforms to post the job listings. The job descriptions were similar to the supervisors other than supervisor experience. The consultant, the mechanical manager, and the SME looked for three lead technicians, one for each shift.

However, in the contract the Railroad had, most of the money came from the Federal Transit Administration (FTA). When you receive money from the FTA, there is usually a requirement to use a portion of the money towards diversified business enterprises and small business enterprises. The Railroad had a contractual obligation to have 12% of all annual spending go towards small businesses, which can be a large number to reach. To hit the percentage, the consultant had the idea of contracting the technicians through a small business. They would still have oversight over the technicians, but it would be like a rail staffing agency. The consultant knew about a company from New England. The Railroad put out a bid and got into a contract with them to supply technicians. In the contract, the Railroad would interview them and make the hiring decisions. The Railroad basically did everything other than payroll and benefits. This arrangement made the hiring process unique because the company from New England posted the positions. The company had locations throughout the country, so they posted internally. The company also did job fairs and recruitments at tech centers, and they held career fairs at colleges in different areas to find graduates just leaving school. They recruited the applicants and sent the Railroad candidates. All 33 technicians came through the arrangement. Using that contractor and payment, the Railroad reached 14% spending on small businesses and surpassed their goal. They paid more for the arrangement, but they would have been penalized if they did not hit the 12% obligation.

The company screened about 150 total applicants. The Railroad interviewed about 75 applicants to reach their 33 final employees. The SME and the mechanical manager did most of the interviews together.

The SME and the mechanical manager kept a spreadsheet for each of the interviewees. They created columns with a rating 1-5. The different columns included length of work history, attitude and personality perceived during the interview, safety, and specialized skills. They gave the interviewees an overall rating 1-10 to help determine whether or not they would hire them. After each interview, they would fill out the spreadsheet and then compare to see if they matched up on numbers and strengths. The SME and the mechanical manager would talk about any major differences they found.

The SME realized he could be fooled easily during an interview, and it was good that he had someone to pick up on something he might have missed. The mechanical manager had a lot more interview experience than the SME. He had better follow-up questions to see if the interviewee was fooling them. He asked more specific technical questions and personality questions. For example, he would ask, “What is your opinion about safety in the workplace and what leadership do you take in regard to safety in the workplace?” Most people would answer that safety was their number one priority. The mechanical manager would then ask them to give specific examples of how they implemented or supported safety

measures. When interviewees said something very general, he would ask them a deeper question to see if they could come up with something. He would also put them on the spot with technical questions, and he could tell when someone lied to him about technical stuff. Both the SME and the mechanical manager had the deep technical knowledge to know the intricacies of the technical aspects of the interviews.

In the SME's eyes, technical and personality skills were weighted the same. However, if he had to say which one was more important it would be personality. You can teach someone skills if they have the aptitude. It is harder to teach someone morals and integrity, and it is harder to change a person than to teach them technical skills. A person could be very skilled and qualified, but they could bring down the entire team if they are not a great person. The SME said you have to have thoughtfulness about the team culture because it spreads. Prior to the interviews, the consultant told the SME that he had to make sure he gets a good feel for their attitude and their personality.

The Railroad had a lot of turnover in technicians throughout the years. The SME recalls interviewing over 300 applicants within six years.

There was one applicant who was respectful, but the mechanical manager thought something about him did not feel right. It turned out that the worker got in trouble with the law three months after he was hired. Something in the mechanical manager's gut told him that they should not hire them, but the SME does not know where that gut feeling came from.

On the other hand, another technician came in with no experience directly out of a tech school. He was from a different country, and he had a thick accent that was hard for the SME to understand. They were concerned about communication between everyone; however, they hired him, and he was humble and thankful for the job. He kept his head down and worked hard. The SME said he was a great success story, and he is now a supervisor.

Once they hired the 33 technicians, the SME scheduled a meeting with all of the new employees. They went around the room and introduced themselves, including their name, where they were from, and their background and work history.

Married Pair Cracks & Dealing with the FRA*

The Story

When the SME worked as the Chief Mechanical Officer, he made a decision that could have cost him his job. When his crew started finding cracks on critical suspension components on their trains, the SME and the Mechanical Manager curated a proactive plan and decided to inform the FRA about the situation. The FRA could have grounded the entire fleet and put them out of service, but the SME knew the potential dangers of hiding the information from the FRA, and he believed in truth and honesty.

Discovering the Cracks

Two cars are put together with a draw bar, and they form what's called a married pair. One night during the third shift inspection, someone found a crack on the equalizer beam on one of the trucks within the married pair.

The mechanical manager worked the morning shift, so he was there for supervisor turnover. He found out about the crack from a conversation with the third shift supervisor.

When the SME came into work at 7:00am, the mechanical manager told him, "We are in trouble."

The SME knew what he was talking about because they talked about another company experiencing a similar defect. Their trains and the other company's trains had a very similar model. The other company had this same defect about two years prior, so the SME had already been sensitive to a potential issue.

Devising the Plan
The SME immediately got his PPE and inspected the train. It was easy for him to see that it was cracked pretty good. The SME started talking through the situation and decided they needed to tell the General Manager as soon as possible.

For about 45 minutes the crew inspected the other eight married pairs that were currently in the shop. They found a hairline crack on another married pair. They were running about 14-18 married pairs throughout the fleet. The married pairs were inspected every night, and they went through a cycle of inspecting the whole fleet every four to five days.

The crew continued inspections. The SME tried to look at the married pair under the car with a flashlight, but he could only see one side. He struggled to see the backside of the equalizer, so the mechanical manager said they needed a borescope. The SME called another worker who went online to Grainger, found a borescope in stock, and ordered it.

Meeting with the General Manager
At 8:00am, the workers had a round table meeting with the General Manager. The SME briefed the General Manager on the situation. The General Manager asked what they would do. She mainly asked questions about availability. She wanted to know if they could still meet service requirements and meet obligations. The General Manager told them to let them know when they got all of their information together.

The second line that was scheduled to open was significantly delayed on opening, so they had extra cars in the shop, which gave them a cushion if they had to take some cars out of service.

Continuing the Plan
They inspected about five more married pairs that were in the shop. They found another hairline crack, but that was it. The mechanical manager and the SME put together a plan before they met with the General Manager again in the afternoon.

The mechanical manager had expertise in manufacturing. He said it wasn't as bad as it seemed, but they should put a plan together and inspect it daily until they got a solid plan in place with the manufacturer.

The SME called the manufacturer (with whom they were under warranty) to come look at the cracks the next week because it was already the end of the week. The manufacturer said they would send two engineers the next week to look at it. Until the engineers came, the Railroad would just keep inspecting each crack.

In their plan, if they found anything that looked like a defect, they did non-destructive testing (dye penetrant inspection). They sprayed a chemical on the train, wiped it down, and sprayed another chemical. If there was a crack, one chemical will concentrate on the crack and the other chemical will illuminate where the crack is.

Since the mechanical manager had done it before (he's a welder by trade), he put together a quick SOP on how to do the process and disseminated that to others.

Big Meeting

At 1:00pm, the SME had another meeting with the General Manager.

The SME told the General Manager about their plan, which included frequent and detailed inspections, dedicating a technician on night shift to be the specific inspector for the cracks, speaking with the manufacturer, and voluntarily removing cars from service if they found any cracks.

The SME was very anxious to make the decision to tell the FRA, especially because he was in opposition to the General Manager.

The SME told the General Manager that he thought they should notify the FRA immediately. She didn't think it was a good idea because they could ground the whole fleet, but the General Manager understood the safety component. In a worst-case scenario, the train could derail and harm the riders.

The General Manager said, "If they find it, we should tell them, but I don't think we should tell them." The SME pushed back. Even though he recalls being a little scared because he was putting himself out there, he took the chance and said, "No, we need to tell them." The SME thinks he probably would have lost his job if the FRA came and decided to ground the entire operation until it was fixed.

The SME told the General Manager about his previous experience in the Northeast and how he never lied to the FRA. The SME had a friendly relationship with the guys at FRA who worked with them. He said, "The FRA guys were very levelheaded and reasonable to work with. They weren't jerks, even though there was still a possibility that they ground the whole fleet."

The General Manager said, "Okay" and told the SME to go ahead and call the FRA.

Engagement with the FRA
The SME called the FRA and said, "Hey, do you have time to come down tomorrow? We'd like to show you something that we found on the train."

The SME and the mechanical manager created a job safety briefing with pictures and diagrams of where to look for the cracks.

Inspections continued throughout the night.

The FRA came to their site around 9:00am the next morning. The SME sat them down in the office and told them about the situation at the other company with similar train defects. He went into details about their cracks and walked them through the timeline.

The SME showed the FRA pictures and SOPs they gave to their technicians and how they were tracking the cracks.

The FRA went to the floor and looked at both cracks. The SME showed them how to do the chemical testing and how to identify the cracks.

They all came back to the office and the SME asked, "Where do we go from here?"

Next Steps
The SME detailed the safety plan to the FRA, and the FRA was good with the plan. They also said when the SME gets more information from the manufacturer to let them know what's going on and notify them immediately.

Conclusion
The SME said, “The roll of the dice paid off, and they worked with us on it, and it was a learning opportunity for me to prove that being honest and upfront is better. Having a plan of action and presenting it to them rather than hiding it.” The SME heard of situations from other people in the industry who lied or tried to cover something up from the FRA. He said, "If the FRA finds you have not been honest with them, you will lose their trust and you will be on their radar for frequent inspections and follow ups.”

The SME said, “I’ve always led with that mentality: don’t hide anything from them because they’re gonna eventually find out and when you’re truthful and honest with them they stay out of your business.”

They eventually found two more hairline cracks throughout the entire fleet, but nothing started to separate. It didn’t turn out to be a major problem. Rather, they had a proactive process from the first day until the last married pair got a replacement of equalizers (about two and a half years later).

Moving Equipment Rule Change*
As the Director of Safety and Training, the Subject Matter Expert (SME) spent a lot of time with the crews when he first got his new railroad and rode on the trains with them. He had to learn the territory, and he wanted to get to know the people working there. While riding the trains and talking with the crews, the SME noticed there was inconsistency between the rules and what the workers did. For example, the rulebook stated that they could not get on and off moving equipment, yet the SME saw people getting on and off moving equipment all the time. When the SME asked, “Why are you guys getting on and off the equipment when your rule says you can’t?” They responded, “We’ve been doing it for years. We don’t follow that rule.”

The SME went to the managers and asked them the same question. They said they changed that rule years ago, but they never updated it with documentation. Being a smaller railroad, a lot of practices were learned through word of mouth. If new hires saw everyone getting on and off of equipment, they figured that it was okay for them to do it, too.

Hand brake securement was another inconsistent rule at the railroad. In 2013, a fatal and destructive incident occurred. The train had an archaic hand brake rule based on the grade of the track and how heavy the train was, so the crew had to do the math to figure out how many hand brakes were needed. Since the incident, most railroads the SME worked with had done away with that process and were specific on hand brake rules. However, when the SME talked to his crews, their responses were inconsistent. When the SME asked them, “How many hand brakes do you need to buy?” he received different answers based on the same area.

A lot of little things added up that made the SME realize he needed to go through the entire rules structure and redo it.

General Codes
The SME put out a general order to change the rule about getting on or off moving equipment. This general order canceled the previous rule. The new rule stated that workers could get on and off moving equipment when it was moving slower than 4 mph if they were properly trained. The rule was very specific about when you can and cannot get on and off moving equipment and what to look out for. The SME told the new hires they could get on and off moving equipment when they felt comfortable doing it and when the SME said they were ready.

Some people struggled to get on and off equipment, so the SME put the trainees in the field and evaluated how they moved. He got the trainmasters and the locomotive engineers involved to have their perspectives. Some people immediately excelled, and others needed more help. The SME used that

information to tailor training for each particular new-hire class based on who he was working with. He understood people's strengths and let the more experienced people help teach the class. The SME also paired the weaker employees with someone who was a little stronger to help them improve their skills.

The SME used his experience from other railroads to know what rule structures were in place at different railroads and where they allowed workers to get on or off moving equipment. The SME also called up people in the industry and asked them about their rules regarding moving equipment, and almost all of them had the same specific parameters. Then, the SME decided what made sense for this railroad as far as particular details.

The SME spoke with the Vice President of Operations about the general order. The SME knew where he wanted to take the rules structure of the railroad, and the Vice President gave the SME free reign to push his vision forward. He supported the SME wherever he wanted to go with it. Then, the SME talked to the trainmaster and the crews that the general order directly affected. They thought it was a sensible approach, so the SME did not receive much pushback.

The SME also implemented a general order for the hand brake rule. He wanted to ensure that what people were actually doing was in compliance with his expectations. The SME posted the general orders on duty stations, the daily operating bulletin, and through an email. He also conducted safety briefings before the rules were initiated and the new hires went into the field. The SME showed the workers how to get on and off of moving equipment in the classroom, told them where to mount and dismount, and what to look for. Some people got it right away while others never could really do it.

The SME was still new in his role, so the general orders took about a month to go into effect. Other minor orders included PPE color and wearing metallic rings. Some of the general orders affected more than just the transportation department. He did not receive any pushback, and he gave everyone information upfront. There were no surprises.

Identifying Peer Trainers*

In his first couple of months, the SME spent a lot of time in the field where the activity was. He wanted to show the employees who he was rather than sitting in his office and dictating all of the rules from afar. He took every opportunity to get to know people by shadowing crews, riding trains, and sitting in the backseat with the buggies while they did their jobs. During this time, the workers showed the SME who they were without really knowing it.

When the SME started at the railroad, there were eight conductors. Personality was the first thing the SME considered for peer trainers. He picked their brains to get a sense of their knowledge of the rules and territory and if they operated well. The SME did not want someone who kept to themselves and did not talk to anyone.

One person who the SME wanted as a trainer complained all the time. No one really liked him because he was hard to work with. He had an attitude. He came off as very abrasive and to the point, but the SME loved that part of his personality. There was no guessing where he was coming from. He did not really care that no one liked him. The SME realized that he cared about his coworkers, he was just upfront because he wanted everyone to know how he felt. He got in people's faces when they messed up, and he was not very good at saying "Good job." The SME told him that, with a little bit of coaching, he would be great at training people, specifically engineers, because he was a great operator. He accepted the training responsibility and told the SME no one had ever approached him like that before. He ended up touching a lot of engineers and was a good teacher.

Another engineer had worked extensively with the company, and he was a trainmaster back in the day. He knew the railroad inside and out, and he was respected by his teammates. He could tell you how many trees were in a particular area, where the dips were on the track, and anything else you never wanted to know about the railroad. He helped the SME develop a program for other subdivisions. He wrote pages of information for each customer, and the SME worked with him to turn it into bullet points to fit into a booklet.

There were also two guys who worked the morning shift. One of them fast-tracked through training because he previously worked for both Class I and smaller railroads. He was competent and confident. These two guys were the SME's go-tos because he knew they could handle four new hires with them. They had their own agenda and how they wanted to do things. They got to know personalities and tailored their approach based on who they worked with, but they pushed everyone in the same direction.

The SME got experienced folks to talk about their expertise for training purposes. It had been 20 years since the SME operated a locomotive, so he was rusty on some of the rules. He could fiddle his way around a locomotive to get it to work, but he knew he needed help from people within the company. The SME invited the three guys to come into the classroom to help with training. The SME told the classes that these areas were not in his ballpark, but he had experts with him. He jumped in when he could and facilitated the discussion.

Difficult Trainers

There was another safety guy on the engineering side who came in. His approach was different from the SME's, which was fine, but he contradicted a lot of what the SME taught in his classes and in the field when the SME was not there.

For example, Part 214 says you need to have 3 points of contact while riding Maintenance of Way equipment, but the SME's rule specifically said do not ride a piece of equipment unless you have a designated seat and a seatbelt. The safety engineering guy pointed to the Part 214 rule to show the SME he only needed three points of contact, but the SME told him they were more restrictive.

Another issue arose with hand tools. Spike mauls are used for spiking; however, some people used sledgehammers to do the same thing. The safety engineering guy said they could not do that. It was not as easy, but if somebody was proficient at it, there was not a problem. It was just a preference. The SME had to tell him that they could use a sledgehammer if they wanted to.

He also would sit in class and interrupt and contradict what the SME presented to the class, and the other guys had trouble focusing. The SME was the senior guy in title and time, so he told him that he was telling people the wrong things and it was confusing the students. He said, "That's what I've always done, and that's the way it is." The SME had to tell him, "No, it's not," and put his foot down. That side of him did not come out too often, so people knew he was serious. The SME removed him from the training program and had another manager take over.

The SME had another difficult relationship with a trainmaster. The SME tried to get him involved with the training process and told him he was going to do the majority of training. The trainmaster said, "That's not my job. You're the director of safety and training." The SME said, "Yes, I am, and I'm directing you to assist with the training." The trainmaster did not like that.

Disruptive Student on a Zoom Call*

During a virtual training session, the SME noticed there was one student in the class who was in their car on the phone. The SME saw the highway going by and that the student was having a conversation with other people in the car. The SME stopped class because it was too distracting. He told the individual he

needed to get off of the call, and the SME gave him his phone number to call him. The student was very argumentative. He dropped off the call and never called the SME. The student's supervisor called the SME to ask what was going on. The SME explained the situation, and the supervisor parted ways with the student.

Other issues occurred when people did not take the SME's training classes seriously. People came into class hungover, slept in class, and played on their phones during presentations. If someone distracted others, the SME did not tolerate it. He pulled them out of class and asked what was going on. Then, he told them they could not be in class if they acted like that. The SME stepped into the role of being a "bad guy" if he had to.

Exaggerated Emergency Response

The Story

In a large city on the east coast, a tank car containing liquid petroleum gas went off the track, flew in the air, and hit a pile of gravel. Although the incident was not considered an emergency, the rail workers were required to call 9-1-1. The responders dramatically overreacted, sending over 100 individuals, multiple trucks, and several helicopters to the scene. The incident even caused an evacuation of the nearby neighborhood. There was major publicity surrounding the event, and the Railroad's reputation was on the line.

While working in the Safety and Compliance department at the Railroad, the SME was at the center of coordinating the various city departments, providing emergency responder training, and dealing with political and public backlash. The Railroad's contract with another railroad likely would have been terminated if the SME and his team did not handle the remediation well.

Background

A railroad in the city decided it would be a good idea to have a company that specializes in freight to operate their track. The railroad company has been running the freight line for over 20 years, which is unusual for one company to keep it that long.

This large city is one of the most difficult places in the United States to operate a railroad. Passenger trains run at 79 mph along many tracks and crossovers, and it gets very busy during rush hour times. The operation is quite complex.

Liquid petroleum gas (LPG) was the only hazmat item that the Railroad hauled on that particular piece of track.

There is a lot of concern regarding LPG. People perceive LPG as a "big bomb" because there is gas inside of a tank car in a highly populated area. Long before the SME worked at the Railroad, there was an incident where an LPG rail car went off of a track, and they signed an agreement with the fire department that they would dial 9-1-1 if they ever had a derailment involving an LPG car.

The Incident

This agreement created issues for the Railroad. Shortly after the SME began working there, they had a similar incident. One evening, a rail car went off the end of a track into a pile of gravel. The engineer lost control of the cut as he was shoving, and the rail car went up in the air in the middle of the yard. Because the Railroad had to dial 9-1-1, the crash resulted in an unnecessary amount of emergency responders, the evacuation of the neighborhood area, and the closing of nearby businesses.

Emergency and Public Response

After the 9-1-1 call, the incident became a major public relations issue, a community issue, a costly liability, and resulted in reputational damage for the Railroad.

About 100 people from the fire department, police department, and Office of Emergency Management arrived at the scene, along with multiple trucks, equipment, and one to three helicopters overhead at any given time.

The police department controlled the scene until they declared that it was not a terrorist attack. Ever since the events of September 11, 2001, emergency responders are concerned about potential terrorist activity in large cities. The police were not trained to assess the hazmat situation, and it could have put them at risk.

The Railroad's head of mechanical, the hazmat contractor, and the FRA were responsible for assessing the damage. It took the FRA approximately 5-6 hours to arrive and give their assessment. They operated under the assumption that this was an extremely dangerous accident. After inspecting the scene, the FRA told the emergency responders that it was not a major incident.

The FRA inspector said it was not a catastrophic or emergency situation because the tank car has an outer jacket, an inner shell, and insulation between the inner shell. Only the outer 8-inch seal was skimmed. The inner shell was not touched during the accident, so they just had to get the rail car back on the track.

It took the hazmat contractor approximately 10-12 hours to get there. The contractor was a "wrecking" company that had front end loaders and caterpillar tractors. A police escort brought in the contractor from the next state over through the city to the incident site. The contractor agreed with the FRA folks that the incident was not a big deal. The contractor lifted the rail car and put it back on the track.

This situation was a different ball game because it occurred in such a large city and there were several different stakeholders. The fire chief became the authority when they got to the scene. Having a relationship with them ahead of time was extremely important. According to the SME, the Railroad did not have a strong relationship with these local departments because it had not been a priority. At the time, the Railroad had not done aggressive outreach to the fire department and other local emergency responders. About 20 years ago, some Class I railroads did outreach, but short line railroads rarely did.

In most areas of the country, no one would hear about a car going off of a track into a gravel pile. The SME was frustrated that the responders did not understand this was not a severe emergency or how much damage it did to the Railroad's reputation. However, the SME realized that they did not know what they did not know.

SME's Response

The SME was fairly new to the Railroad. He was the first Head of Safety that the Railroad had ever had, and he had never worked in this large city before.

The SME was 1,500 miles away at the time of the incident. He received a call detailing the incident and the emergency response outcome. The SME knew it was an LPG car, but he did not know the extent to which the car was damaged because they were still investigating at the scene. He first wanted to know if anyone was hurt and if the fire department had been notified. Then, the SME went through his checklist of who needed to be notified.

When the FRA agreed with the mechanical workers and the contractors about the severity of the derailment, all the SME could do was get the hazmat response contractors to the site as soon as possible to get the rail car back on track.

The SME coordinated with his contacts at the Association of American Railroads (AAR) to begin the Railroad's hazmat plan, which was a document describing how to handle the situation. The SME's internal team worked through the plan.

The SME also called the Railroad's legal team and got in touch with the claims folks regarding the local businesses. He worked to get the claims folks to the City the next day to speak with all of the businesses who were impacted to minimize the impact.

The SME called one of the owners of the Railroad who lived in the City and understood the politics of the area. He knew how the media would respond, so he was doing everything he could to keep the situation under control. He recognized how monumental and impactful this type of incident could be. The SME reached out to the railroad's senior leadership team because they knew how the public would respond, and the SME knew they could be criticized for hiring the SME's railroad company. Both the SME and the owner understood the importance of making sure they were more prepared in the future.

This was a fairly frantic time for the SME because he had not had something like this happen before, and he knew there would be reputational damage to the company. The whole incident was cleaned up after about 12-14 hours, and the scene got smaller as things got under control.

Public Apologies

Because of the political pressure, the SME sent apologies to the public. The Railroad did not have a media team for costly situations like this one, but now they do. The SME and one of the owners decided they needed to do critical incident planning so that presidents have training on media engagement, including what to say and what not to say. They created an emergency response communication plan, contracted an outfit from the Midwest, and brought the presidents and owners in for training. After the training, the Railroad put a book together that made their entire railroad much stronger to respond to these types of situations. The SME also engaged in various PR-related efforts to make sure people knew the Railroad's stance.

Town Hall Disaster

The SME, the president, and the owner of the Railroad went to a neighborhood meeting at the local school. The school was located about .5 miles away from the tracks, and the tracks ran adjacent to the school. People were upset because they were evacuated, and they believed the railroad was dangerous for bringing hazardous chemicals into their community. The locals were upset about the incident, and they did not like the noise from the railroad in general. According to the SME, the town hall was "not a pleasant experience." The locals asked difficult questions, and they were emotional.

The SME and his coworkers were brought in to respond to the anger of the community. He had an idea that they would be upset, but he did not know it would be so uncomfortable.

Building Relationships and Trust

The SME initiated a year-long process to build trust with emergency response teams, customize training, and work with stakeholders to eliminate unnecessary responses. He made an effort to engage with his Class I counterparts in the AAR to see what could be done. He brought in a safety train, which is a train made up of different types of tank cars and a classroom car, for training purposes. He got instructors from the Bureau of Explosives (BOE), who inspect tank cars around the United States at manufacturing facilities. The SME also reached out to the head of a Class I railroad to send over their hazmat guy.

The hazmat guy and the SME started the training plan. While this was happening, there was another minor derailment on a wide track at a slow speed. Although no one had to evacuate, the emergency responders brought in the fire department, the police department, and the Office of Emergency

Management with their trailers. This incident occurred shortly after September 11, 2001, so the local departments received money from the federal government and the state for new equipment that they wanted to use; however, the response was another major disruption.

The SME did not understand this at the time, but there were "turf wars" between the fire department, the police department, and the Office of Emergency Management (OEM). At the time, the City mayor said that the OEM was in charge; however, when he left office, there was limited direction and communication between the three entities. The SME met with the OEM and the fire department to eliminate the 9-1-1 agreement because it triggered a tremendous response, including headlines all over the local newspapers.

Training Programs

The SME wanted to build trusting relationships with the various stakeholders and educate them after the incident. The SME also expanded training beyond the city limits. He set up training in various locations, and they were extremely appreciative.

Preparation prior to an incident minimizes the repercussions, especially in volatile places like large cities. The SME and the owner of the Railroad wanted to be prepared for the future. The owner told the SME they needed to do training with first responders, and he wanted the SME to set that up. The owner directed the SME to come to the city every three weeks for a six-month time period because they wanted to stop the bleeding.

The SME was in charge of safety at the Railroad, but now he was developing training for people outside of his organization. After working with Class I railroads, the SME knew how to get things done. He knew who to call and contact and who could give him advice.

Fire Department

The SME first reached out to the fire chief. He got to know him, shared his thoughts about the incident with him, and told him that the Railroad had training ideas in mind. He told the fire chief that the Railroad would like to have the fire department come to the railroad for damage assessment training.

The fire chief was receptive to the suggestions. He said the fire department had not dealt with tank cars, and most of them did not have any training on it. They were competent hazmat responders but not in the railroad context.

The relationship between the Railroad and the fire department budded. The Railroad welcomed the fire department to use their tunnels for subway rescue training, and they have had contracts with them for several years. In addition, the Railroad led them through basic training and simulated exercises, so they had hands-on training. This relationship was a two-way training opportunity for everyone involved.

Tank Cars

The Bureau of Explosives (BOE) already provided training around the country, mostly with the Class I railroads. The BOE built the training, so the SME and the Railroad just adjusted the training to what they were doing. The BOE conducted a 101 Class on tank cars, including how they are constructed and designed, what happens if they are impacted, what happens if they are set on fire, mechanisms to avoid tank explosions, and damage assessment.

The SME participated and learned a lot from the training. He wanted to be more knowledgeable about these situations from a fire department's perspective. He felt like it was the right thing to do as a professional. Then, the SME customized and tailored pre-existing training to local organizations.

The first round of training was conducted in two surrounding areas of the city. The Railroad continued to conduct training every other year afterwards because the fire departments get new people on a regular basis, including leadership positions. The SME recognized that everyone involved was getting smarter because of this exchange of ideas. Growing relationships, finding opportunities to work together, and familiarizing everyone benefited both organizations. The SME brought the safety trains to their other properties that handled hazmat materials across other states, such as Kentucky, Indiana, Illinois, and California.

The Short Line Safety Institute provided some of the hazmat training, but the Railroad paid for most of it with their resources. The SME said it was a good investment because of where they operate. They conduct tabletop training exercises and simulation training across the country. Spending all of this time and effort to train people outside of the organization makes situations much easier to deal with when they occur.

Pushback

As a privately held company, the Railroad had two owners. They got frustrated when presidents did not spend money to reduce the risk of future incidents occurring. One property did not want to bring in the safety training because they did not want to spend the money. The owners trusted the SME's word and listened to him. The SME told the owners, "This is what we do on our properties to minimize the risk." When the president of the property called the owners of the Railroad, the owners relayed the SME's message and told the president that they had to do the training because that is what they do at the Railroad for overall safety.

What is Different Now?

The SME prioritizes his relationships with the emergency response community. Proactive communication is critical. The SME understands the importance of reaching out to politicians, holding community related activities, and building credibility. Educating citizens who are against railroads has improved how the community perceives the Railroad and the railroad industry.

It is important to bring locals to the railroad so they can meet the Railroad's people and build trust. The SME invited the media to training events, and there have been some articles written about it in local newspapers. Politicians and business leaders have also been invited to the track to experience riding a train. The SME also worked a lot with attorneys on different policies and programs for crisis situations.

The SME strongly encourages other players in the short line industry to do training and outreach between firefighters and railroad employees. His emergency response program is utilized across the country. The SME has shared copies of tabletop exercise slides with other railroad entities and invited them to their training. Many of the companies want to implement the training at their properties.

Response Preparation

There is a new fire chief in the city. The SME does not have a deep relationship with him yet. The fire department leadership is a big deal. The previous chief completely trusted the SME, so it will take a bit more time to earn the new chief's trust. The subway rescue training on the railroad helps with their credibility, and they invite the fire department to ride their trains whenever they want. The SME still knows folks at the fire department, and the SME has been to their training center in the city to see how they train their workers.

The SME also mentioned the uncertainty when it comes to politicians, particularly during political seasons. Politicians love to springboard off of incidents that involve companies and different entities to show their authority. They do not always understand what they are regulating, and that can be very damaging to railroad companies.

SME's Leadership Skills
The SME has so many relationships in the industry because of his ability to connect with people. He attributes this to paying attention to people and talking with them. Because of his reputation, people know they can trust him.

For example, the SME sent someone a book on leadership. He is not afraid to talk to people. He is an extrovert, and he is very engaging. He believes in saying "please" and "thank you," and acknowledging people. He tries to get people who do not want to speak to speak.

The reputation of the SME's railroad is strong. His company is one of the top premier railroad companies. He compliments his owners who are ethical people, and they hire other ethical people.

Rail Shoe Dispute

Third Rail Train Shoes
A railroad's equipment had rail shoes that stuck out to the side and tucked onto the third rail to get its power. The car's shoes stuck out too far and hit other things on the rail. The clearance itself was fine, but the Department of Transportation (DOT) did not think about the rail shoes. The railroad had a design where shoes folded up and out of the way, but the Railroad said they were not going to do that. Therefore, the locomotives hit and damaged parts of the rail, including a bridge. The SME told the Railroad they could not run the trains if they did not take the shoes off.

The SME went to the location to look at the rail constraints himself. The surveyors could not be there because they were so busy, and no one else was qualified to do the tests and get the measurements they needed. The SME's crew included a conductor engineer, two supervisors, observers, and two railroad mechanics in case of equipment issues. They used lidar drawings and maps to identify potential hotspots and found 12 locations.

They drove a test train to every location to see if the train fit with the shoes. The appending bridge was the only location with an issue. They could not get by the bridge on one piece of track, so they went down a different track and got by with an inch or two to spare, which was not good enough for operations. The SME could walk the train by slowly, but on a regular basis, the equipment would hit the side. Everyone took pictures of the area because they knew the problem was real. The SME told the DOT and the Railroad they had to do something about it.

The SME gave the DOT three options: 1) Take the shoes off; 2) Put the mechanism on the trains to lift the shoes up; 3) Do not run. Not running was not an option, and the mechanism would take years and millions of dollars to develop. As a result, the DOT and the Railroad worked on a deal and temporarily agreed to take the shoes off. However, if they operated without the shoes, they could not take the train into the city.

The railroad agreed to fix the bridge if the DOT reimbursed them. A contractor looked at a plan to change the appending bridge. They could not use the bridge anyway because of ride quality and speed issues, so they are working on it now.

Dealing with External Utilities

Last week, the SME dealt with another project that does not have anything to do with the FRA. The Railroad had some strategic planning consultants work on a project to make improvements for one of their services, but they have not done anything in the last 6 years to make any difference. The SME got involved in a recent meeting and asked the planners what they were doing now to make improvements.

The consultants kept talking about all of the big future questions, whereas the SME wanted to fix the immediate issues. He knew there were basic things they could get done to make progress until they got to the bigger stuff. The consultants did not even know how to change the small things first.

The SME told them they were missing opportunities to improve services today. He did not discount what they were doing, but his focus was different. He asked, "What do we need to do to make this happen now?" They did not have a basic plan to fix potholes, for example, which could be done quickly without huge maintenance requirements, capital investment, or loss of track time.

Although the SME is straightforward, he tries to be self-aware of his weaknesses.

Asking the Right Questions and Knowing the Right People

The SME can quickly look across all departments to understand different situations. The organization leans on the SME because he can see the broad implications. He can come up with the top 10 things they need to do. For example, he was assigned to a project with a rail equipment vendor that may be available. He has to figure out if the organization should purchase the equipment or not. The SME spent two hours with the vendor going through questions and answers to determine what would and would not work. Then, he is going to provide a synopsis of the meeting to the executive leadership team and give them his recommendations. Because there are still some things they do not know, the SME suggests further investigation. So far, he has not found any showstoppers, but he definitely has some other questions that need to be addressed. The SME knows the right questions to ask to figure out the best steps moving forward. For example, he wants to know if the purchase makes sense short term, medium term, and long term. What is the budget? Is it worth it? What is the ROI?

In his email to the executive team, he will include the issues they discussed, the issues they still need to discuss, and the next steps. The SME plans on getting other folks involved to do a deep dive into additional areas for investigation. The SME can gauge the right people to bring into situations, so he does not have to drag everyone in. He knows the best person for each role because he has experience working with individuals across the different departments. In some instances, the SME may not know the exact person to contact, but he knows who to call to figure it out.

At a recent consulting meeting, there were 65 stakeholders on the call. The meeting took forever when it should have been pretty quick. The SME took a picture of the screen because there was so much "fluff." He was frustrated because the meeting sucked up everyone's time.

People are often stove piped at the organization. There are very few people who can cross disciplines, but railroading is a team sport. For instance, track people generally do not think about other crafts or the customers. When people do not understand what their team members do, it takes longer to work things out, and projects get delayed.

Knowing What's Going On in the Industry

Information Sources

Every engineer in the organization has a tablet where they can access the rulebooks and register any issues into the system. The system fills out generic information, including the engineer's name, the train number, and the date. Then, the engineers check different boxes and describe their issues in a free form text section. Depending on the situation, there are different distribution groups, and the forms go into a queue at a PTC help desk.

The SME still has access to some queues, so he flips through them to see what is going on across the organization. He gets queues for locomotive issues, inventory for trains, crew issues, and alert and update messages. The forms look like a PDF, which can be seen on a cell phone, tablet, or computer. The reports go into a 90-day basket and then they go away.

The SME likes to stay up to date on any issues that pop up. He watches all the operations even though he could probably let it go. The SME can still give a high-level synopsis of most things happening at the organization. For example, there is a recurring issue in Louisiana that the SME has been following. A railroad rolled out a new PTC system, and it does not match up with the other railroads. Every time the train goes across the boundary, the PTC screen turns blue and stops working. When the train gets past the boundary, it syncs back up. The SME has not done anything about it, but he is aware of the issue.

Unless the SME notices something extraordinary, other people take action. If there is a major issue, the SME looks into it and asks more questions.

The organization is trying to move away from books, so the tablets have electronic rulebooks. The SME likes books, but he appreciates the tablet because he can carry one thing instead of 50 heavy books. The SME keeps track of a lot of information to give him a bigger picture of the organization. He encourages other people to monitor certain forums so they can also see the broader view.

New Hire Cab Car Learning Experience

The most important quality for diagnosing locomotive issues is having an electrical background. If someone has a good understanding of the electrical system, then they can figure out problems much more efficiently. The organization has a system to bring good people into the workforce. Most of the people coming in have solid electrical backgrounds. The problem is the organization's short handedness. Since the organization does not have enough employees, the less experienced folks do not get to stay in-house and see the troubleshooting with their own eyes. They rarely get to see SME's working on the hard problems and get to ask him questions. The new hires need to understand the basics, but they also need to be willing to learn more.

New people move around a lot. They like working with the SME because he explains everything to them. They might not understand what he is doing, but the SME tells them what they are there to do. When the SME has time, he walks them through the locomotive. Sometimes there is too much information for the new people to comprehend, and the SME might never see some of them again, so he is purposeful with what he tells people.

The SME prints out different materials and puts the information on a thumb drive for them to read. These materials include general operations about the locomotives and training guides. If the new hires do not read the materials, they will not have any questions to ask.

In one situation, a new hire came back with questions for the SME, and it made the SME very happy. The new hire asked about running a cab signal test. The SME took him to a locomotive and told him to run the test the way he understood it. Then, the SME walked through the process with him. He got pretty close to doing it correctly, but he did not understand bringing the speed back down from 125 mph. The materials should explain this process, but it is completely different when people actually put their hands on the equipment.

It makes the SME's job easier if people ask questions and know what is going on. During the qualification process, new hires attend classes, take a test, and do the training. If they want to become a technician, they have to do more training to understand the system. There are only seven technicians, including the

SME. The SME is not the most experienced technician because some other guys have been in the locomotive department longer than him.

A younger employee is qualified to become a technician, so the SME is hoping a job will open up for him soon. The biggest problem is getting people to stay in-house.

Rollout

OSA Screening Program

The Story

Obstructive sleep apnea (OSA) was not adequately addressed in the railroad industry for years. Many railroads did not recognize the danger of obstructive sleep apnea or the need for a solution.

The SME worked as the corporate safety person for training and development at the Railroad. As he became aware of the need to combat obstructive sleep apnea related incidents, he engaged with various committees and experts to create and implement a program. The owners of the Railroad also recognized the necessity of putting a program in place. Despite pushback, the SME's work resulted in successful obstructive sleep apnea training, testing, and treatment.

Background

The SME first became aware of the need for an OSA program in the mid 1990s. There were no regulations in the railroad industry for OSA at this point, but It was clear to the SME that OSA was a significant risk to the railroad industry. The SME engaged with the AAR and worked on various committees with experts on sleep, rest, and fatigue. This group of individuals recognized the importance of having a more alert workforce. Multi-million-dollar trains can be deadly if people are not alert on the job.

Representatives like the SME from Class I railroads met periodically to discuss the situation and the countermeasures. With time, the FRA and unions gained interest in OSA and the associated risks. Union members were especially concerned about their quality of life. They wanted to know when they had to come to work so they could plan around their schedule and get adequate rest.

A series of collisions related to people falling asleep on the job occurred, and there was constant pounding from the unions about their quality of life. These incidents and the increased union advocacy drove more awareness for an OSA program.

Voluntary Approach

The SME and others interested in reducing these issues in the railroad industry began searching for countermeasures without introducing regulatory requirements. Because they took a voluntary approach, they could focus on a singular issue and be effective without the downsides of a "sledgehammer" approach.

Having medical professionals support the process was critical. The SME worked closely with doctors researching and writing reports on an annual basis about sleep-related topics.

For example, researchers began looking at watches that registered wrist movement. As people get more fatigued, their wrist moves less. They also researched napping strategies where they let train crews nap on the train. This method strayed from the norm in the railroad industry because people never slept on the job. Furthermore, they created rest facilities for employees with La-Z-Boy recliners at different locations.

Overall, there was a surge in educational research revolving around sleep and fatigue.

Bringing Information Back to Organizations
The SME relayed all of this information back to the Railroad. He provided briefings at meetings and eventually created training programs for employees. Before he left the Railroad, he assigned a person full-time to focus on fatigue and alertness because it was so important.

When the SME moved to a different railroad in 1998, no one had been in his role for about a year. He was part of an entirely new safety action plan, so he promoted education for the leadership team and engagement with the employees. His first step was to assist communication from the AAR committee to his senior leadership. The SME wanted to give them the basic information about where they needed to go.

He brought in an expert from a Class I railroad to give presentations on OSA to his senior leadership team for credibility. This got their attention by showing that a big Class I railroad was taking action. The SME understood the value of having a representative who was making an impact at a Class I railroad with 40,000 employees versus a 3,000-person railroad.

Although some individuals pushed back, the SME discussed his plans with them individually and in groups. When other Class I railroads are doing something, the rest tend to follow their lead. By letting people know what was happening across the industry, the SME could show them his safety program was being implemented elsewhere.

Working with the Harvard Medical School
Pointing to academic resources proved a strong strategy for implementing the OSA program. The Harvard Medical School Division of Sleep Science created a website, funded by the FRA, that focused on sleep and alertness, including sleep apnea. This website was a great information source and provided more credibility for the SME's efforts. The FRA and the entire railroad industry played a role in the website's creation. Employees who wanted to learn more about getting quality rest had a simple and convenient source to use.

The Need for Urgency
The SME wanted his organization and the entire industry to make changes as quickly as possible. His program intended to change people's preconceived notions and help them understand the situation through training and access to resources.

Some folks blame the people who experience fatigue instead of other explanations for sleep-related incidents. Although workers have the responsibility to be rested when they come to work, it can be difficult because life can get in the way. Railroaders' quality of life often suffers because of their hours. It is hard for anyone to sleep from 6 am until noon because of their biological clock. Therefore, it is critical for people to know when they have work so they can plan in advance.

Developing Training
The SME's training strategies included briefing guides, information sharing, postings and links to websites. He had training delivered for transportation, mechanical, and maintenance of way because they did not previously talk about OSA in depth.

These training sessions highlighted wise use of caffeine, the importance of rest before work, and healthy foods.

The SME used his network to spread his message and communicate with organizations. He conveyed what he learned about sleep and fatigue to the folks he trained, trying to create a norm in the industry.

Industry Changes
Sleep-related issues were ever-present with the unions. An updated hours of service regulation came into place in 2008. This regulation enforced mandatory rest times and ensured that workers could not be contacted during certain periods. They could work up to 272 hours per month.

The SME made sure everyone knew the new rule and complied with the regulation. He believed the hours of service regulation contributed to reducing the risk of sleep related incidents, although there was not one solution that could solve fatigue and alertness issues.

The Organization
When he switched organizations and started working at a new railroad, industry wide data continued to show collisions and incidents occurring. Employees working for Class I railroads were particularly concerned because their schedules were less predictable than short lines. The SME constantly checked data from The National Transportation Safety Board (NTSB) reports and spoke with AAR committees. The FRA also had concerns regarding these sleep-related incidents.

The SME engaged in some studies for the AAR with a doctor researching which countermeasures were most effective. The SME had been in contact with this doctor since the early 1990s, and they had a long relationship revolving around efforts to combat these issues.

When the SME got to the new organization, he was surprised at how they managed people getting hurt. They would see a local doctor, and management would cooperate with the doctor to determine when the individual could return to work. Most doctors have no railroad background and do not understand the demands of the job. Therefore, employees would not get the best care.

The SME and one of the organization's owners believed they needed to make a change regarding medical professionals. The owner asked the SME to find a corporate medical doctor. The SME got in contact with a doctor who previously worked at a railroad and understood the industry. He had a bariatric specialty and had worked in the trucking industry, so he dealt with sleep issues there. He was also a former medical search doctor in the military, and he had a great personality. The organization hired him to be the Chief Medical Officer.

The SME said the two of them had a "natural mind meld" about sleep apnea. They decided they needed to implement a program that included training, testing, and treatment. They approached the owners about their idea.

Source of Interest
The SME cares deeply about people, and he did not want these tragic sleep-related incidents to keep happening. It can be hard to prove that an incident occurred solely because of sleep apnea. There are almost always multiple causes; however, fatigue is present in many different circumstances. He interacted with his employees and understood their reality with fatigue and sleep apnea. He was also frustrated with the industry not wanting to recognize the issue as much as the SME thought they should.

The SME knew that research and tracking data could help show the root cause of some of these incidents. Furthermore, he spoke with hourly folks describing their experience that was not reflected in the data. They found that there were likely people who had sleep disorders or sleep apnea who did not even know it. The biggest issue was that people did not have sufficient education on the topic, including the effect of caffeine and exercise.

Although some efforts were made to manage risk, the consequences for these types of accidents were severe.

Focusing on OSA
There was some activity on Class I railroads when it came to combating sleep apnea. With more incidents occurring, the FRA pressured Class I railroads to make changes. Furthermore, the Canadian railroads were more aggressive than the United States to implement programs and regulations.

The SME envisioned taking the lead on sleep apnea issues in the short line industry because they ran passenger lines. The SME's Railroad was already required to have programs in place because they ran in some of the most complex metropolitan areas in the United States. The chances of people getting hurt in these environments were significant. The SME learned how to manage those risks. The Railroad had a highly capable President, Vice President, and trainmasters. They were careful who they hired and paid attention to risk areas, like sleep apnea. The SME highlighted the necessity to have strong rules enforcement, good training, discipline, and effective management to run trains in these places.

With the Chief Medical Officer and the SME on the same page about sleep apnea, they began implementing a program.

Meeting with Another Railroad
The SME built a strong relationship with another, larger railroad's Head of Safety. They met two times per year because the SME's railroad ran on their track, and engagement was important. The larger railroad had passenger trains, and the smaller organization's freight trains ran on the same lines. If there was an incident between the two, it would not be a good situation. Furthermore, relationships are particularly important in a metropolitan city climate with politicians and community groups. These groups ultimately determine whether or not the freight railroad can operate on the tracks. Because the SME was good at building trust and relationships, he felt comfortable engaging with the larger railroad. They made it a priority to meet periodically.

The larger railroad already mandated sleep-related training. The SME and his railroad's Chief Medical Officer were interested in how the larger railroad implemented OSA training. They wanted to gather more information and make sure they understood everything. They were considering if this was something they could realistically accomplish on a short line because no short line had done that before.

The SME requested a meeting with the railroad because he thought it was in everyone's best interest to see how a larger railroad had successfully implemented a sleep-related program. The SME also believed that a meeting like this one would help get his railroad owner on board.

The larger railroad gladly took the opportunity to convene the right parties together. The SME and his railroad's Chief Medical Officer met with several groups of people for a briefing. There were 15 people included in the meeting. The representatives discussed labor relations. Medical professionals discussed their engagement and the complexity of a large railroad. HR offered their perspective, since they were in charge of medical and health plans. The SME did not know most people at the meeting, but they were sincere and passionate. They knew that a program like this was the right thing to do, even with pushback.

It was not apparent at this meeting that a short line could implement a program like the larger one, but after some more exploration, they made progress. After the meeting, it took the SME about 9 months to develop an entire sleep apnea program.

Pilot Program
After the meeting with the larger railroad, the Chief Medical Officer contacted another railroad and collaborated with them to conduct a pilot program in the city. They discovered that a general chairman

had sleep apnea, and he was a huge proponent for the training program at the larger railroad. The general chairman was very helpful and pushed for a program beyond fatigue and alertness.

Strategic Implementation
The SME put together a contractual document that was carefully written. In developing the contract, the Railroad had a lot of engagement with expert medical attorneys. The Railroad made sure they were covered legally before moving forward with the program.

At the behest of the Railroad, the SME required his employees to take a sleep test outside of work hours. The SME went to the FRA's Chief Safety Officer because he was concerned about hours of service. The FRA representative said that was not a problem. Getting assurance from the FRA was a big deal for the SME.

The SME strategically planned which properties he would visit and when he rolled-out the program. He started in their commuter line cities, then went to their Midwest and west coast cities. The Midwest cities tended to be less adversarial. The SME anticipated pushback on the West Coast. He figured if he successfully implemented screening and training programs at the other properties, he could be successful there too.

The SME and the Chief Medical Officer both spent time at the railroad properties. They spoke with the labor leaders and employees, and they educated the management team. People have respect for medical doctors given their training, so bringing the Chief Medical Officer helped with credibility. It also said a lot about the Railroad as a company that they were willing to spend money to bring the doctor to the properties and interact with people. Although the Chief Medical officer was not present at every property, the SME was always there. He knew the importance of face-to-face interactions.

The SME felt like he had to be present to make sure everything happened the right way and to answer any questions. He was extremely knowledgeable because of his experience.

He brought a sample CPAP device, brochures, video clips, and PowerPoint presentations to the properties.

Challenges
Sleep-related training was not a regulatory requirement, and the SME did not have the FRA behind him. Without the support of a federal organization, it was less likely that railroaders would cooperate.

There was difficulty with unions on the West Coast, and the unions even contemplated litigation. The unions resisted OSA screening because they knew they would find people with sleep apnea. The unions felt that screening invaded their members' medical privacy, and the West Coast labor groups feared that they would be fired if they had sleep apnea. Furthermore, railroaders would be required to do things that were never required before, such as wearing a CPAP machine while they slept. Wearing a CPAP device is not pleasant for everyone who wears them, so it would be a lifestyle change for people. The SME called the General Chairman that had sleep apnea, and asked him to use his influence to speak with the local chairman. The General Chairman trusted the SME and the Chief Medical Officer and knew it was the right thing to do. He was passionate and committed to the program because it improved his own life and health greatly.

Another problem with testing for sleep apnea was that people normally had to spend the night in a lab while they were monitored with connections all over their body. This meant they were less likely to get tested in the first place. However, the SME found a firm that could perform at-home sleep studies.

Treatment

The Railroad took away excuses for people not to accept the program. They initially used a soft approach, giving people a lot of grace because it was a new requirement. As they went forward with the program, they needed people to know that there were consequences if they did not comply, and employees would be taken out of service.

The Railroad screened people for sleep apnea based on collar size, throat size, snoring tendencies, and subjective surveys. Then, they would go through testing to identify what level of sleep apnea people had if they did have it.

The Railroad paid for treatment, including a CPAP machine for everyone. The CPAP machine took away the issue of requiring employees to take a thumb drive from a CPAP machine and bring it to their medical doctor on a periodic basis and have to pay for the doctor. The CPAP machine sent information to a third-party firm to monitor whether the person was using the device or not.

A third-party company provided counseling for everyone involved in the program. They educated the employees on different approaches for wearing the CPAP machine and different styles that could improve comfort. The CPAP device was sent directly to homes, so it was confidential. Local management did not know which individuals were involved in the program unless they refused to comply.

By making it easier for employees to participate in the program and use the CPAP machines, people were more likely to comply with the program. The Railroad also made sure that they understood why the program was important and made resources easily accessible if anyone had any questions.

Positive Effects of Treatment

Getting treatment for sleep apnea can dramatically change someone's life because they feel less fatigued in their daily life. People often lose weight, feel healthier, and tend to be happier. Overall, treatment can be very impactful.

Personal Story

An individual at one of the SME's properties initially opposed the program. The 60-year-old man eventually got tested and discovered he had severe sleep apnea. The Railroad bought him a CPAP device, but he refused to use it, so they medically disqualified him. He threatened litigation. The Railroad leadership team told him, "This is what we are doing. If you comply with the requirements, you can come back to work."

He asked to see a professional sleep apnea expert to confirm the diagnosis, and The Railroad agreed to pay for it. He did not want to go because the appointment was 30 miles away, and he did not show up the first time; however, he showed up the second time.

After talking to the expert, he started using the CPAP device, started to exercise, and lost a lot of weight. He became a much more positive individual. He still does not like to wear the CPAP device, but he became a success story.

Advocates

Because of the education and information that the SME disseminated, three of the SME's senior executives asked to get screened, tested, and treated for sleep apnea. All three of them had severe sleep apnea, and they all wore the CPAP machine voluntarily. The Railroad took care of the costs for them, and they received supplies annually. Their life, health, and ability to perform improved. They became advocates for the program and openly talked about their sleep apnea diagnosis.

Sleep Apnea Prevalence

The Railroad does not treat people with mild sleep apnea; however, there are currently 32 people with moderate to severe sleep apnea, which is about 10.1% of the company.

The Railroad has witnessed a number of people start exercise routines, see their health improve, and drop out of the program because they live healthier lives. Even if they leave the program, they can keep the equipment provided by the Railroad. The Railroad will pay for them to be retested.

Safety Action Plan Development

The SME intended to use Safety Action Plans (SAP) to achieve safety excellence. Through communication processes and videos on leadership, the SME hoped that increased training would revamp the Railroad's risk management. Those who were not on board when it came to making safety their highest priority lost their job. They either left the company or were fired.

The SME did not have a budget for the first two years at the Railroad. They were desperate. His job was to reduce the number of people who were hurt. The claims department had been writing numerous checks, and litigation was expensive. The Railroad hired the SME to find the root of the problems and reduce the ratio of injured people.

The SME's approach at the Railroad was system wide. When it came to the safety department and the railroad, the leadership had to improve. Within 3-5 years after the SAPs, the Railroad's injury ratio got down to a 2.5 ratio and eventually to 1 ratio.

SAPs addressed about 19 different areas in the industry. These included communication, operational testing, facility safety, security assessments, safety rules and health, safety contacts with employees, evaluating safety performance, new hires, mentor programs, recognition, public safety action systems, and accident injury reporting. The goal was to target upstream activities to drive the downstream results.

The SME issued requirements to develop safety action plans to each of his railroads. He provided sample safety action plans, gave them a format to follow and instructions, and he conducted conference calls. Each location had ownership over their plans. The SME said developing these individual safety action plans was like federalism. His properties needed the same basic programs in place, but they were able to design them to meet the needs of particular locations. The SME wanted buy-in from the Presidents and Vice Presidents, and they let the hourly employees weigh in on the final safety action plans. The employees could review them and tell management if they did not like something in there. The leaders listened to them, changed it if necessary, and tried to stay transparent with all employees.

The Vice President of each property is responsible for ensuring that the SAPs are in place and up to date. They basically run the operation. Each year, the SME and one of the co-owners provided the Vice Presidents a marked-up document that showed exactly what changes they made to the plans.

The SME also introduced requirements when it came to bonuses. Each railroad was evaluated in 3 areas when it came to safety. 1) They did operation testing at the frequency and quality that was required within the safety action plan. 2) How many reportable derailments to the FRA occurred on that property (there's a scale that identified how many points they got for different levels of performance). 3) How they dealt with safety and security assessments: were they performed? What was the quality? Is the documentation done?

There were expectations and goals. The SME measured these expectations and rewarded railroads with bonuses. The SME evaluated all 3 areas and provided his assessments to the Board of Directors for each location to determine what the bonus level would be on the safety side. Depending on the job, it resulted in 25% to 35% on their bonus as far as the impact.

Over time, the Railroad established electronic communication boards to communicate new rules, policy changes, and general notices. Most information sources are transitioning to electronic approaches and will likely be on tablets for employees, including the rulebooks.

The SME also introduced the Actively Caring Employees (ACE) aspect of training. This area discussed personal responsibility and the need to approach each other if they saw someone doing something unsafe.

PTC Rollout

The Story

The SME recently dealt with the rollout of M8 electric railcars, which was stalled for over 14 years. Once the SME got involved, it took about 36 months to get everything up and running.

The Railroad has operated and maintained track as a commuter service with diesel equipment since 1990. 10 years later, the Railroad put electric wires over the train lines while still operating diesel equipment. In the mid-2000s, the DOT bought new equipment for their service to go into New York City in conjunction with another railroad. The plan was to buy enough equipment to also electrify the equipment that the Railroad operated.

The M8 equipment arrived around 2008; however, there were a multitude of technical issues that had to be fixed in order to operate the new equipment on the Railroad's territory. In addition, the Railroad required every train to be equipped with a PTC system in 2008, which was eight years before federal legislation requirements. The DOT electric trains did not have PTC, so they could not operate in that area until they did.

There were some other technical issues with the power on the Railroad's lines. They had to conduct a whole bunch of studies to make sure the power infrastructure could handle the extra commuter trains. They bumped along with the studies, but no one was focused on getting it done. Meanwhile, the DOT really wanted to get the trains running.

Fast forward to 2020, there was a major federal deadline to implement PTC on all trains. The DOT and the Railroad got the PTC systems working on their equipment. The equipment became available to operate, but they still had to do additional testing on the Railroad's territory. The SME went to the location with the electrical power department to determine any restrictions and technical issues. He got the right folks together and figured out what everyone had to do in order to create an acceptable plan and continue to the next round of testing.

Overall, it took 14 years to get all the M8 equipment running. Over the final two years, the SME had the knowledge of who to talk to, what to do, and how to get everyone together. He came up with both short-term alternatives and long-term plans. PTC touches all departments and multiple departments within these organizations. The SME's cross-departmental network and knowledge helped speed up the process.

SME'S Involvement

About 30 years ago, the SME worked as a construction train master in the area, so he was familiar with that particular piece of track. He did a lot of infrastructure upgrades as a railroad employee. There were not as many regulations when he worked as a train master. The FRA had some oversight, but there were not a lot of extra hoops to go through.

In 2020, the SME was in charge of the PTC deadline, so the rollout issues in the area naturally came to his attention. Folks gave him updates, and he asked about the progress. He knew no one in the area could find a path forward, and the PTC implementation was stagnant. That was when the SME got involved.

The equipment was not cleared or authorized for the Railroad, so the SME had to go and test everything. The overall goal was to get the electrical trains up to PTC standard.

After 2020, the DOT and the SME had the time to focus on getting the trains to standard, and the SME took charge in the Spring of 2021.

Different Equipment
The SME was first exposed to the PTC system in 1993. The Railroad implemented PTC on diesel trains before the federal regulations. The PTC system had been used for 20 years on the Railroad's trains, but it had never been used on this new electric equipment.

After the Railroad installed the M8 equipment in the mid-2000s, the DOT did not want any more diesel equipment on the line. The DOT paid the Railroad to maintain and operate their equipment under the state. It was very good equipment, but it was difficult to integrate with the physical layout of the tracks.

Since the state has start-stop commuter trains, their equipment was better suited for constantly starting and stopping. The Railroad's equipment was good for efficient, sustained running over a longer period of time. The Railroad trains could not go into the city station, so the DOT had to buy something that worked there as well.

Overall, the wires were designed differently in the area because there was no electric contemplation when they were built. When the DOT purchased the M8 equipment, they assumed it was designed to work in their wire system.

The Railroad operates at 150 mph, so they built the railroad to have better maintenance and more reliability at the higher speeds. Some of the components the other railroad put in their wires to operate the equipment only works for the slower speeds. The DOT did not think about these differences when they bought the M8 equipment. The Railroad did not want to put those components into their wires because of increased maintenance cost, risk of failure, and equipment damage.

Wire and Power
The SME mainly talked to the Railroad folks throughout this process, especially the wire and power people. There were restrictions regarding the power supply and physical layout of the wires. People could blow up the whole system if they did not do things the right way. The SME talked through a bunch of options with the other railroad. He told them they were not going to rely on a GPS signal unless they signed off for liability. The SME found a way to mitigate the risk out of the system so there were no machine or human failures that could cause everything to blow up.

SME's Plan
When the Railroad told the SME they had a problem with the M8 equipment, the SME figured out what the DOT could and could not do, and he gave them options. He came up with a temporary condition to let them start service, but it did not solve the long-range plan.

The SME was going to hire a consultant, but the DOT had their own consultant do a track redesign to see if they could make it work.

Big Issues
When the SME started working on this project, no one in the organization took charge to make everything work. The DOT kept saying they had to get it done, but no one owned the project. When the equipment arrived in 2008, any extra equipment they had was consumed by ridership going through the roof on the

other lines, so the equipment was not sitting idle. They used the equipment elsewhere on the main service. The SME knew the equipment worked, so he felt good about it. All the bugs had been shaken out of that equipment.

When you bring a new piece of train into service, it is about safety first and reliability second. The first question is: does the car physically fit? If the equipment is too big, it is a non-starter. If it fits, you have to check compatibility with the signal system, power system, door system, train platforms, etc. You must check all the different components of the train to see how it works, what you have to do for training, and who maintains it. In this case, the Railroad did not have to maintain the equipment because the other railroad was maintaining 350 cars.

Regulatory Hurdles

According to the SME, the FRA is always in conflict with itself regarding safety and service. The equipment had already been operating for 10 years and was proven safe. However, because it was operating on a new piece of track, they were constantly being roadblocked by regulation. For example, the FRA would not let the trains run because they had to test for noise exposure on the new track, but the SME did not see why the engineer would have a different noise exposure on a railroad that was 20 miles away from the other railroad. The FRA told the SME he had to test the hearing data, or they would not let them run the equipment, and they asked it to be done in 90 days. The Railroad found the same results as the other railroad. The FRA did not have to approve the noise data because the cars had been operating for so long, but they still had to retest.

Furthermore, the FRA asked the Railroad to run more training to operate the trains on the track. It was the same commute with the same railroad principles. It did not make sense to the SME that they had to run all of these tests again. All of the testing was to check a box for the FRA to say they did something, not necessarily because it was safer. The SME pushed back and told the FRA it was stupid, but the Railroad still did the testing.

The Railroad felt they met the training standards because they were not running a new service. All of the locomotive engineers went through classroom training and simulator training, but the FRA kept throwing requirements on them. The SME was not necessarily required to submit all of this information, but the FRA has the authority to inspect the Railroad and make sure they are in compliance with all of the rules whenever they want. The FRA also wanted permanent station sign markers, but the SME just had temporary spray-painted markers. The SME agreed that made for a cleaner operation, so the Railroad eventually installed permanent ones.

The SME got through all the regulatory hurdles by knowing who to talk to and what to do about it. He never said he would not do the training but told the FRA that the consequence would be delays. The SME tries to work with FRA representatives logically and patiently. If this approach does not work, it can escalate. Sometimes, the SME realizes it is not worth it to push back.

At a new service extension, the Railroad trained people for four months. During this time, the freight railroad did some work on the track infrastructure. The FRA came back and said they had to do the training runs all over again with a different speed set. The SME pushed back and said engineers operate at different speed sets every day, so it was pointless to have to redo all of the training. This is an example of the SME pushing back and working with the FRA to reach a common understanding.

Power System

The power system was complex. The Railroad did some studies around interference, withdrawal, and contingency situations. If certain substations were offline, a single point of failure could take the whole

network down. The Railroad hired a power consultant to do the studies. The Railroad told them what they needed, and the consultant did the math.

The SME had to confirm the risks. Operating with a big train was out of the question because they would blow out the power grid. It would blow up a bunch of stuff if they ran certain sized trains. There is a certain combination of cars that would cause a dead shortage in the wire.

The issue was figuring out how to keep the electric sections isolated. They could shorten the train and run four cars without a problem, or they could use a GPS; however, the SME wanted to keep human failure out of the picture. He did not trust the GPS because all the trains could come to a screeching halt for a month or two and burn up the electric system. He did not want to rely on software or gadgets. The SME decided to run four-car trains, which was more than enough for the load that the DOT needed. In the meantime, they hired contractors to redesign the system to be more compatible and remove the physical hazard in the wire for the future. This is an ongoing study to allow longer trains to run across the entire system.

Starting Service
M8 equipment service began in 2022. The shoes are off, and the trains are running. The Railroad has about 16 cars set aside with the shoes removed because it is a pain to take them off and put them back on. The trains look the same except for the number, so they have a procedure to prevent the cars from getting mixed up. Because the Railroad's fleet is so big, carving out 16 cars is not a big deal. The larger the fleet, the less of a spare margin is needed because the equipment is compatible and there is more flexibility.

The DOT has other procedures in effect to ensure the crews know when the shoes are off and that the Railroad knows when the shoes are applied, so they can go into the city. The SME did not want to have the crew sticking their heads out to see if the shoe was on or off. They have paperwork that tells them the equipment they are riding. There are certain things that the crew has to check anyway, so the SME leveraged some of the other inspection processes and added an extra step.

Incidents

Whistle Timing Incident

Incident Example
In his training classes, the SME tells a story of one of the best engineers at the Railroad who worked there for 30 years. The engineer ended up hitting a vehicle and killing a family. The accident bothered the engineer deeply. The SME was the first responder at the scene. 2 years later, the SME was asked to go to the court case. After the SME spoke, he sat in the back of the room. The SME will never forget when the engineer got up to talk about the accident.

The lawyer asked the engineer how long he blew his whistle. Like a robot, the engineer said he needed to blow my whistle for 15 to 20 seconds, starting at the crossing board. The lawyer asked the engineer if he knew how many seconds he actually blew his whistle before the accident. The engineer said he assumed he did it for 15 to 20 seconds, starting at the crossing board. The lawyer pulled up the tape, and the engineer blew the whistle for 14.9 seconds.

The lawyer asked, "Do you think if you had blown it for that .1 second that my clients would still be alive?" They put all of the blame on the engineer because of a millisecond. The engineer started crying and apologizing. The railroad lost the case, and it cost about $6 million.

The engineer knew the rule and assumed that he followed the rule, but he never knew how to tell. He thought if he started blowing the whistle at the X where they put the sign he would be in compliance, but

the sign was wrong. When he started blowing the whistle, it had already been under 15 seconds. Now, the SME tells this story to every class and explains why they need to blow their whistle for 15 to 20 seconds.

Locomotive Repair

P32 Diesel Recovery Time

The Issue

Brake penalties are applied if a train exceeds the track speed limit or does not acknowledge a signal, and the brakes are automatically thrown into emergency. Penalties are called the "dead man feature." Whenever P32s get a penalty, they are supposed to recover within 30-40 seconds. The locomotive cannot do anything until it comes out of the penalty.

There was a P32 Diesel at an outlying point that moved track equipment. During 24-hour inspections, inspectors do brake tests to make sure the penalty brakes work. The inspectors realized this particular unit recovered after a penalty, but it took almost exactly three minutes every time.

Previous Attempts

The mechanics moved the handle to suppress the penalty, but it kept taking three minutes to recover. They tried replacing the P2A valves, which control the penalty to get the brake application, but it did not fix the recovery time.

The mechanics did their best to correct the brakes, but they did not have the ability, time, facility, or availability of parts that the Subject Matter Expert (SME) had in his shop location. The P32 was out of service for a while before they eventually sent the P32 to the SME's location to figure out the problem. They attached the locomotive to a train going near there.

SME's Fix

The SME got a heads up about the P32 Diesel a day or two before it arrived. He went into the computer and read the notes from the work order to see what the mechanics had already done to the equipment before he got to it. Notes included in the work order help facilities understand the history of the equipment.

The locomotive arrived dead to the SME's location. There was a Map 9 defect on the P32, which explained the penalty brake issue, that went to the foreman in charge. Then, the foreman put the Map 9 defect on the turnover sheet so the SME could access it. People told the SME the locomotive was not coming out of penalty until after three minutes. The SME has seen situations where locomotives never get a penalty or they never come out of a penalty, but this one just took too long.

The SME ran it through the 24-hour inspection himself to verify the problem. When he got to the penalty test, he tried to recover half a dozen times. The SME let the locomotive sit in penalty until the light went out to signify it met the criteria to release and recover from the penalty. If he tried rushing the recovery by going to release and putting it back in suppression, the time would start over.

After the inspection, the SME replaced the P2A valve and the H5 relay that could have caused the penalty brake issue. Sometimes you just have to throw parts at the equipment. Once he exhausted that solution, the SME got out his schematics and checked all the piping in the P2A system. In his office, he looked at his laminated diagrams, traced all the lines, and wrote notes. The organization's manual for the P32 provides a drawing of the locomotive and the valves and their functions. Since the P2A valve replacement did not solve the problem, the SME knew something abnormal was wrong.

Then, the SME located all the airlines on the equipment itself. The SME put his eyes on the parts to trace the system. He taped the lines in red electrical tape, so he knew which ones were part of the penalty system. Using the process of elimination, the SME removed every line and worked his way through all the valves. For every valve, there was another one attached to it, and there were so many pipes that intersected underneath.

During this process, the SME listened for air leaks. He also took soap and water and sprayed the surface, looking for bumps. If there was an air leak, it would start bubbling like crazy. That little trick has fixed hundreds of problems for the SME because minute air loss is often a problem. Then, he checked the pressure relays and the pressure switch to make sure they operated correctly. A lot of times, there is an electrical side to the air system, especially in newer equipment. The SME did not find anything, so he was stumped for a while. He examined 20 feet of piping.

Every valve bolted to a manifold. There were four or five different manifolds throughout the air system. The SME checked every manifold. He pulled off the piping in between the manifolds to ensure there was not any rot, rust, or debris inhibiting air flow. Then, the SME removed every choke and checked them by holding it up to a light and blowing through it. The chokes' diameter was less than ⅛ of an inch.

The SME found a choke plugged with cotton, and he could not see through it. He immediately knew that was the issue. Over the years, the cotton filter deteriorated and blocked the orifice. The SME cleaned the choke with his torch tip cleaner and poked out the cotton. He reassembled the locomotive and ran the brake test a dozen more times to make sure the problem was solved. The SME sent the P32 back to its home terminal without any issues. Throughout the entire process, the SME took notes and relayed information to the foreman to put into the work orders.

Overall, it took the SME two weeks to pinpoint the issue. However, he probably could have figured it out within a few hours if he had more time to solely focus on this particular problem.

P42 Diesel Gas Fumes

The Issue

A P42 locomotive came into the pit for a 24-hour inspection, and the locomotive engineer's notes stated that there was a strong smell of diesel fuel. Eventually, people discovered there were locomotives with the same issue at other locations. Every morning, managers and superintendents from different locations joined a call to discuss any issues and faulty equipment, and they realized this problem was widespread.

People should never smell fuel on a locomotive. The cab should be a completely sealed system. If there is a note saying there are gas fumes in the cab, it should immediately be taken out of service and taken to the shop.

This issue occurred in the middle of the summer, so people noticed the smell whenever they walked near the cab. When the windows were shut and the air conditioning was running, the fumes could have caused incapacitation. In the winter, the air is heavier, so it keeps a lot of smells down.

These locomotives had been in service for years. All of a sudden, they started having issues with the diesel fuel smell at the same time. This issue was unforeseen when they built the locomotives, but they had traveled millions of miles over multiple decades, so it was an aging problem.

Previous Attempts

People at other facilities had their own locomotives to work on. Most facilities looked for leaks, but they could not see anything.

A back shop in the Midwest smelled the diesel fuel during their overhauls. When they fueled the equipment, they discovered the overflow got a little bit of fuel into the frame, and it built up over time. The back shop does total overhauls, so they took the trains apart. They could not see the leak without tearing the locomotive down. When they located the problem, they started to replace the steel tubes.

No one did anything wrong, it was just an unfortunate design problem.

SME's Fix
At first, the SME was not aware that other locations were working on the same issue. Initially, the SME located the fuel pump and looked at the pressure lines and return lines. He put gauges on different areas to check fuel pressure because there was a specific fuel pressure to maintain. He did not see any drop in fuel pressure, and he did not see any physical leaks. However, the SME knew there could not be a smell without a leak.

The fuel pump sat over the fuel tank, so the SME started tracing the lines. The SME referred back to the manuals to trace and track the entire fuel system because he did not have everything memorized. Then, he found a small trickle of fuel on the underside of the locomotive. The trickle location did not necessarily suggest a particular source because it was nowhere near where the refueling occurred. The SME put an air nozzle onto the return line with a regulator, and he fed air into it to see if he could hear a leak. When he put air through the return line, he heard it throughout the body. That was how he determined the line was eroded somewhere. The crossover line deteriorated over the years and allowed the fuel to enter the framing of the equipment, which gave off the gas fumes.

Because of his automotive background, he made sure there were no fuel tank leaks, fuel pipe leaks, injector leaks, or high-pressure pumps. The only leaking that would have occurred was during fueling, otherwise, the line was empty.

After the SME found the source of the smell, he called different facilities. They told the SME to drill certain areas of the line to allow the fuel to escape and sent him diagrams of where to drill the holes. They had to get rid of the existing fuel that was trapped in the lines.

The SME's location shipped the locomotives to the overhaul shop in the Midwest. They had to remove the diesel engine to repair it, which takes a lot of time. Since the back shop did diesel engine repairs every day, they had the experience.

Yard Engine Application and Release Function

The Issue
One of the yard switchers, built in the early 1950s, kept having an issue with application and release of the yard engine. The railroad still ran older locomotives to move equipment around for training. It would not apply all the way or release all the way. Whenever they made an application, they got a brake application; however, the release took a long time. It still did its job, but it took a while.

Previous Attempts
Most people thought the issue was the service portion valve (which controls application and release) or the automatic brake control lever. 80-90% of the time, changing these parts fixed the problem. In this case, however, the mechanics could not fix the issue. The switcher came to the SME's location for the SME to check out.

SME's Fix

The mechanics told the SME they had issues applying and releasing on the locomotive. They reported problems with the brakes under low pressure. The SME looked up the work order and saw that they changed the control portion, the automatic brake control portion, and the CDW valve.

Even though the previous mechanics swapped out the components, the SME changed them again to ensure they did not just have bad ones. Then, he conducted his normal routine to find what was in the system and what piping connected that system. He traced the airflow, and he cracked the lines that went from the automatic brake control lever to the service portion. The last place air pressure went was the brake cylinder. There were specific numbered lines for specific jobs, and they do not all go to the same valve. It was simpler to see the layout on paper, but the SME had to track it all down on the locomotive. The SME also knew this locomotive did not have an air dryer because of his experience and knowledge of the equipment.

When he cracked line 16, water poured out like a garden hose. The SME did not expect it to have that much water. Then, he cracked every single line, 40 total, and removed them to ensure that there was not more water elsewhere. Before taking the lines apart, there was no way to tell there was water in there. Sometimes, breaking things apart can open up a hornet's nest, and you have to fix everything you touch.

Over time, drops of moisture built up. The piping was almost like a trap in your sink, where there is always water in the trap so the gasses from the sewage do not creep up into your house. The piping had a little trap of fluid. Whenever the air came in, it moved the fluid to the valve and would not allow it to do its job, so the fluid moved backwards.

A lot of times, the valves have a spring that the air pressure has to overcome, or the spring pressure has to overcome the air pressure. In this situation, the spring could not overcome the liquid, so it stalled. You cannot compress liquid. You should never see moisture, which is why they have the air dryer systems.

Most modern equipment includes air dryers, but the older switchers did not have them. In the past, mechanics drained the main tanks whenever they did a 24-hour inspection. As technology advanced, they started installing air dryers to improve the system. In some instances, the air dryers can fail, but the locomotive will still apply and release the brakes. The air just is not clean or dry. Now, they have test ports where you can put in a gauge that tells you how much air pressure there should be, making the process a lot quicker. You do not have to crack all the lines and remove them.

After the water stopped, the SME reconnected everything. He had to replace a few lines because they were so deteriorated when he tried to break them apart.

Trains can run without the air dryer system. If they had drained the main res every day, the problem would not have occurred. As long as they do maintenance, the locomotives are fine to operate.

Steps to Locomotive Repair

1. Test & inspect
2. Verify the issue
3. Trace the system
4. Locate the problem
5. Repair accordingly

Manufacture Modification
Thinking Ahead

The organization bought 70 ACS locomotives that were each worth $5 million built specifically for them. They told the manufacturer what they wanted, and the manufacturer built them. The SME was not involved in the design and building process, but he had information that could have saved them from a lot of modifications, some of which they are implementing now.

For example, the manufacturer built the windows with a hollow aluminum frame and a handle on the side. Because the handle was right next to the engineers, they grabbed it to lift them out of their seat like a grab bar. The threaded inserts were not strong enough to support them. It was not designed to support that, but with the SME's machining background, he told them to replace the inserts with the same ones that the SME used to repair engine blocks. The Siemens team came over, and the SME showed them what they were using and what he suggested they should use. His inserts did not have any failures. As a result, they replaced the inserts with the SME's suggestion.

A lot of these modifications were common failures that put a delay on operations. The manufacturers did not think far enough in advance about how people might use things.

Detecting Discoloration: Excessive Heat

Discoloration Signs

The SME has discussed failures with a representative who goes to the manufacturer to make them aware of the issues. On one locomotive fleet, the gear cases had a labyrinth seal. The seal held in the gear case oil. Over time, it wore through the bolts that held the seal onto the wheel. The bolts could not hold it, and the seal came off the wheel, resulting in total failure of the wheel set.

The issue was brought to the SME's attention after a 24-hour inspection in the pit. The SME saw a discoloration and knew it was from excessive heat. He jotted down notes about what he saw. The paint on the seal was gone, but it looked like a rainbow because of the heat on the metal. The SME knew it should never get that hot. Heat comes from a lack of lubrication or metal touching metal, so it was an early indicator that something was wrong.

The SME saw discolorations across the fleet, and he showed people his notes. Eventually, he saw total failures. They sent out a work order, saying the wheels had to be changed out if there was a discoloration. They had to change out every wheel in the 70 locomotive fleet to prevent a catastrophic failure. The Siemens engineers came over and the SME showed them his notes, pictures, and the total failures. They corrected the problem on the wheel sets.

"– – " Speed Sensor Failure

Speed Sensors

The Subject Matter Expert (SME) recently dealt with a speed sensor failure on a computer-based locomotive. The sensor monitors the locomotive's speed to calculate how far the locomotive is moving. The locomotive engineer saw a problem with the speed sensor on his screen. The screen showed a "-- --" instead of showing the speed. He wrote the issue on the map 100 and notified the train controller to call mechanical to create a work order. The locomotive engineer knew a speed sensor failed, but he did not know which one. The screen sometimes tells the engineer which speed sensor failed, but they have to look into the problem either way. The only way to really tell is to pull the entire log from that particular trip. Once the engineer reported the failure, they took the locomotive out of service until they fixed it.

The locomotive had 11 speed sensors. There were four axles, and each axle had two speed sensors. Another speed sensor was attached to the #3 axle in the form of a generator, which monitored the ATC and ACSES PTC systems. The other speed sensor was for the event recorder. The sensors monitor the pulses and send information to the computer. If the vehicle is slacking or over speeding, the computer

uses that information to put the locomotive into failure. If one speed sensor fails, the system reports a problem, but the locomotive will still get to the final destination.

Map 100 and Work Orders

When the locomotive arrived at the mechanical shop, they asked the SME to look at it. He saw the locomotive about three hours after it arrived. The SME first checked what the engineer wrote on the map 100. In some cases, the information can change a little bit from the map 100 to the work order, so the SME makes sure he looks at the engineers' initial notes on the map 100. This information helped the SME when he looked through the log.

Engineers do not always write the most detailed information on the map 100. It is really helpful when they write the time of the failure, but they do not always include it. The railroad uses a TCD system that monitors the movement of the train, so it shows what time the train is in a particular location, which helps pinpoint issues.

In this particular case, the work order reported "excessive every 10 to 20 miles," which was not very specific. When the SME saw the map, he knew exactly what the engineer was talking about. The map 100 said, "excessive ((– –)) every 10 to 20 miles from NYP to Magnolia," which meant the engineer was not seeing the track limit on the display unit.

The engineer described what he saw on the map 100, and it was up to the SME to understand what he meant. The map 100 condition reports vary a lot from engineer to engineer. Sometimes they do not put any details, which adds more time to the diagnosis and repair process. The most helpful information the engineer can write down is the time, the location, and any additional details. This engineer included enough information that the SME knew what he experienced. The SME took a picture of the map 100 on his phone so he could carry it around with him. Anytime the SME works with new people, he tells them the map 100 is very helpful in addition to the work order.

The engineer communicates with the conductor, who is in charge of the train. The conductor passes the information to the back office. In most situations, the foreman creates the work order because they receive the calls. Work orders are made whenever there is a problem, and they can come in at any time of the day. Someone has to address each work order and close them out. Whenever a locomotive is involved in an accident, they have to fill out an X15 form to make sure everything is working. They include the cost, what they did to correct the default, and eventually release the locomotive.

The operations center sends out emails about incidents and failures, so the SME knows when something happens. The SME does not know the impact right away, so he still has to inspect the incident. He receives the email, downloads the logs, and inspects the locomotive to make sure everything is fine. They need a technician with a laptop to do the downloading, but a machinist can do the inspection. The SME is exclusively the bad order guy.

The SME does not speak to the engineers. The only time he talks to them is when they are running a lot of trains and the SME has the opportunity to ride with them, especially around the holidays. He would like to talk to them more often, but it is not a part of the process. The engineers could give him more specific information.

Computer System

Since he was dealing with a computer-based locomotive, the SME used the computer software to analyze the data. When he logged into the system and typed in the train number, he saw the work order. The operations center received all the logs, and the train control system (TCS) gave the SME remote access to diagnostic information on the locomotives. The SME could go to the TCS and look up the downloads, but

that information would not be sufficient. The TCS gives him information about what to expect when the locomotive comes in.

The ((– –)) on the display could be caused by several things, and the SME knew there was a missing component. 1) If the system failed to read the transponder on the track. 2) If the radio communication is failing. 3) If there is an intermittent loose connection. 4) If the transponders had corrupt information. These are all wire systems. The SME looked at all of these possibilities in the data.

The first thing the SME checked for was the grounds. If they had leaking grounds in the system, it could cause signal failures. There should not be a continuity between the windings to the grounds. Then, the SME checks the ATC and ACSES components are free from grounds. Once the SME cleared the grounds, he read the sensors to make sure the values were correct. Next, he checked the connections on the display unit.

The SME downloaded the log to check each axle and figure out which one failed. Each speed sensor produces its own data stream, and the log shows the speed of each axle. The data usually goes back about three to four days. The information gave the SME an idea as to what was going on before the incident happened, so he basically relived the train's experience. The software showed the track limit and if the speed sensor failed. If the speed sensors were red, the SME knew there was an issue with the speed sensor. The download provided a lot of information to let the SME know what was going on. He could rewatch the entire trip from the log data. It can take a long time to watch the screen for cues, so the SME searched for the ((– –)) in the software. The timestamps are really helpful to find when the issue occurred. One axle's speed was off, so the SME knew that was the one that failed.

People cannot access any of this data without a computer and the skills to do so. Only seven other technicians have access to this software information. The SME still looked at the physical locomotive in the pit because the ACSES antenna sits outside of the locomotive. The antenna has a CTV that sends the signal to read the information and code it. The SME inspected the antenna in case a storm hit the wires or there was water damage. However, if the locomotive is in the pit and people do not have access to go underneath it, it is difficult to see any visual signs of damage. Damage can be external or internal, so they may not see anything until they open the locomotive. The SME pulls the logs regardless of obvious physical damage.

What Happened?

The organization had been having a lot of ACSES issues in the past six months. Siemens believed all their cables were conducting in a way that affected the operation of the system, so they introduced new gold tip cables. The SME noticed that this particular locomotive had not received the new cables yet. The organization let the locomotives run until the cables failed and replaced them.

When they brought the locomotive in, they replaced the old cables with the gold tip cables. Now, everything is fixed and the locomotive is back in service. After a couple trips, they will look at the data again to see if the new cables made a difference.

The SME does a complete system check when a unit is in the shop to make sure everything is fine. When he has his name on something, he does not want it to go back into service with any issues. The SME typically sends a general email to all the technicians, engineers, and foremen so they are aware of the locomotive's condition and repairs.

There is no particular plan for dealing with these issues. The SME solves problems as he receives them, and he knows the basic things to check. When he looks through the computer software system, he can rule out everything that is not failing. Since the SME is so busy, he looks into the data and recommends

changes for other people to work on because he has other things to do. In this case, the SME suggested the cables caused the intermittent issue. The SME has confidence in other people to fix the problems, and he always touches base with them to follow up. The SME has access to the log after the locomotive makes it to its destination, so he can go through the data to make sure everything is working. He usually tracks all of the locomotives he works on because he wants to see the information for himself.

Offline Locomotive

Locomotive Going Offline

A 656 locomotive came into the shop because the number four thrashing model went offline. One of the technicians determined that the cooling blower was faulty. He came to the conclusion that the whole blower needed to be replaced. Siemens got them a new blower to replace it. The locomotive worked for about a month, but it came back with the same problem.

They did an overhaul before they found this issue, and it was running. This time, the technician did a thorough inspection of the wiring from plug to plug. He got to a point where the low-speed contacts were, and it was mis-wired. That was difficult to determine because that should have caused overheating in the breaker, but that was not happening.

Eventually, they realized the issue, but they had to go through a thorough inspection all over again. Because his shop is a bigger maintenance facility, they see a lot of different issues. Sometimes other locations cannot fix locomotives for months because they cannot figure out what is wrong, so they bring it to their shop to fix.

Dead Battery System

Battery System

A locomotive's battery died. The crew used another locomotive to send power to the dead locomotive and charge the battery; however, the charger was not working. They called the SME to look at it. The SME told them to shop the locomotive and bring it to his facility because they have access to more things for inspection.

The SME checked the batteries and the cells. Everything looked fine, but it still was not charging. He charged the locomotive for two hours. Then, the SME played with the powers coming in and out. When he touched one of the plugs, it started working then went off again. The SME found a loose connection in the plug. When he opened the plug, one of the pins was pushed back. As soon as he fixed the pin, the battery worked again.

The locomotive supplies power to the cars. The battery is the backup system, but it also controls the power system. Batteries are really important because locomotives cannot do anything when the battery is dead. People rely on battery chargers to restart the locomotive during emergencies.

Cells

The battery system is huge. There is so much wiring and so many pins. When there is an issue with the batteries, the SME checks the batteries and all the cells. If the cells are bad, it will not hold the charge. A couple of bad cells will take the whole battery down, so they have to replace the entire battery because they do not want to take any chances.

There are two boxes. Both boxes should produce 32 volts. If one is reading 25 volts, the cells are not holding charge. The least amount of volts the cell should have is 30 volts. If you charge it for a little bit, it will work. If the cell is below 30 volts, you have to check each individual cell. If the charger over charges, water will boil and the cell will lose water and start to bend. The SME looks for cells that are dry because all of them should be filled with a certain amount of water.

Then, the SME checks the charger. The charger works when there is a good battery.

Battery inspection is part of the standard maintenance procedures. They have a periodic system of service for locomotives to come and clean the cells to make sure everything is done correctly before it is back in service.

Most tracks do not have anything to protect the train. Anything can hit the locomotive. One time, a big stone hit one of the terminals and hit through it. Another time, the train hit a deer, and it caused a lot of damage to the train. Stuff can affect the battery at any time. They usually have a backup path to get them to the final destination.

The SME does not have much visibility into things that happen outside of the shop. He mostly deals with whatever issues are in front of him. The general foreman decides if the SME needs to come see an electric issue. They are in constant communication with the engineer. The first contact is the road foreman. By the time it gets to the SME it is certain that it is an electrical issue.

Brake Hose Failure*

The Story

When the SME was working as an Onboard Mechanic Technician, the train suddenly stopped. He could hear the brakes go into emergency. The SME radioed the head, and they told him they lost the brake pressure.

SME's Response

The SME got off the train and started looking at the brakes. He noticed that one of the brake hoses got caught when they switched tracks, and it ripped off. The rubber hose was pulled out of the cramp, and they lost their brakes.

When the braking system is open in any way, the train stops.

The SME went back to the generator car where they stored spare parts. They had some extra airbrake hoses, but the one that broke was longer. The SME knew he needed an F gladhand to connect the valves.

The key questions he asked were "Where are we?" and "What resources are nearby?" The SME had to know where they were on the tracks and to communicate with the head and the crew. He knew they stored cars in a nearby siding a quarter mile up the tracks because he remembered his timetable. Every mechanic goes through timetable training and takes a test on it. The timetable tells you your sidings, length between sidings, and track structure. If you train on your timetables and know your mileposts, you can figure out where you are. The SME knew his timetable, and he knew they stored cars in almost every siding.

He requested permission from the dispatchers to see if he could find an air brake hose from the siding. The SME looked at the freight cars, found a longer hose from a freight car, and took it back to the train. He installed the new hose and got the brakes going again.

The SME made sure to put in a work order task on the equipment he took from the freight car so other people wouldn't be surprised in the future.

Generator Wire Failure*

Generator Wire

As an onboard mechanic, a lot of problems include the generator. The train on which the SME worked had an older generator. To increase revolutions per minute (RPM), the SME would pull on a cable and that cable would pull on a lever to open up more fuel for the engine to produce the power it needed.

Midway through one of the SME's trips, the cable snapped. The SME always had mechanics wire anywhere he went on a railroad. He held the lever at the full open position with mechanics wire.

He had to undo the wire to stop the engine and get the fuel back to zero. When they needed to bring it back, they would just pull on the wire and tie it tight.

The diagnosis was not difficult, and the fix was straightforward, but the SME's solution lasted the rest of the trip and about a month afterwards. On passenger rail, performance is everything. It's all about keeping to the schedule, so sometimes they have to do whatever they can to keep it going until they get to the destination. That's the job of the onboard mechanic.

Appendix B.
Facilitator's Guide for Creating and Executing Decision Games

Expertise Management for Safety Leadership Positions in the U.S. Railroad Industry – Appendix B

Facilitator's Guide for Creating and Executing Decision Games

Prepared by TrueSafety Evaluation, LLC, and Perigean Technologies

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Introduction to Decision Games

Decision games are an experiential learning activity in which learners (players) are placed in a particular role and into an emerging situation and required to make decisions that reflects how they might proceed. Generally, the purpose of decision games is to provide the player with the experience of thinking about high-level decisions and the consequences they may encounter in a given role. Decision games are domain specific, and typically developed from the stories encountered by experienced practitioners. The stories provide both the context of the situation that learners are placed in, and the specific challenges the practitioner faced.

There are many options for deploying decision games. They can be provided as a self-run activity or facilitated as an in-person or online training event. To optimize the learning potential of decision games, they must be facilitated effectively. A facilitator helps participants reflect deeply on their decisions. With some practice, a facilitator will also be able to draw upon the knowledge of the rest of the class, making the session highly interactive and, thus, increasing the individual's and the group's learning.

Purpose of this Guide

This facilitation guide has two major purposes. The first purpose is to explain the components of the game with a step-by-step description of all of the processes necessary for creating and operating decision games.

The second purpose is to guide an inexperienced facilitator through the task of facilitating the discussion sessions during the game. The guide uses an exemplar decision game developed for the railroad industry. The guidance includes list of possible questions for the facilitator to get feedback discussions started and keep the players involved and interested throughout the discussion.

This facilitation guide is primarily for targeted for facilitated decision game sessions, but we will include information about unfacilitated, self-run options as well.

Authoring Decision Games, and Their Structure

Effective decision games provide learners with scenarios marked by uncertainty and decision challenges at critical moments. The authoring process must keep these features at the forefront. The following provides guidance for authoring effective decision games.

Stage 1: Capture detailed stories

Decision games are derived from experts' real-life stories. These stories are captured using the Critical Decision Method (CDM), a story eliciting technique, with experts who have significant experience in their domain. CDM provides an interview structure and probing questions that enable elicitors to help experts articulate their cognitive experience in the context of a lived incident in which their cognitive performance had an effect on the outcome of the incident.

CDM is structured around four phases:

1. Incident identification and selection
2. Timeline verification and decision point identification
3. Deepening and probing
4. What If queries

The result of a successful CDM interview is a rich incident description of the experts' cognitive performance and its contexts. These incidents provide the content for decision games, which turn the stories into a learning experience by putting the learner 'in the shoes of the expert' and having them think about what they would do in that situation.

Stage 2: Identify decision points

After capturing a comprehensive incident in the CDM interview, transcribe and organize the story into a single document. Then, find decision points in the story – i.e., critical moments in the story where someone had to do something – and create a Decision Requirements Table (DRT) for each decision point. DRTs make explicit the critical decisions and judgments, contexts, and other attendant cognitive elements, that a person must perform to carry out a task. DRTs can be used to structure the results of the CDM interview. They provide categories of cognitive performance under which specific examples from a CDM interview can be placed. You may not have information for every cell, but organizing and synthesizing the decision points helps identify the critical *cognitive performance requirements* for that particular role and task. With this information, you can pose challenges that allow the learner to make decisions in the context of a real-life scenario. The DRT categories and their descriptions are provided in Table 1.

Critical Decision, Judgment or Action	**Why Difficult?**	**Common Errors**	**Factors**	**Cues**	**Strategies**	**Information Sources**	**Suggested Changes**
	Reasons the decision is challenging, including barriers.	Errors inexperienced people tend to make when addressing the decision.	Information known prior to the event that are used to make the decision.	Information from the environment that are used to make the decision.	How people say they make the decision.	Where the information used to make the decision comes from.	How changes to the organization, training, and/or technology could better support the decision.

Table 1: Decision Requirements Table

Stage 3: Set up the Format and Content

You should create the decision game against the *whole story*, but you will be dividing the story into sections following a standard format: Scenario → Challenge → Feedback. This format may be repeated for as many decision points as you identify in the DRT, or you may choose to stress certain decision points. You will repeat the format for as many cycles as it takes to complete the whole story.

Scenario. The stories from the CDM interviews provide the content for each decision game scenario. Your scenario segments should include as much detail as you need to set up the Challenge. You will also want to create some uncertainty – preferably the same sorts of uncertainty that your expert faced at that moment. Be judicious in providing information. You can create uncertainty in decision games by omitting certain details or presenting *just enough* information to challenge the learner. For some scenarios, you may want to provide a lot of details; for others, less. You'll need to decide if a detail is required, may give away too much, or is just not needed to advance the game.

Challenge. The learner should face the same major decision points as the expert from start to finish, and the story should progress through the decision game as it did in real life. When the scenario reaches a decision point that you want to stress, pose a challenge to the learner. Each challenge question or prompt should be as specific as possible. For example, you should not simply ask "What are your thoughts?" This type of question fails to make the learner think about what they would *do* in the situation, and it does not reveal the learner's cognitive process for responding to the challenge. Instead, ask specific questions and require the learner to include their rationale for each answer to get at the *why* behind their response – i.e., "What is your recommendation for next steps? Provide your rationale and list any concerns you want the team to watch out for." If your Scenario introduces significant uncertainty, questions such as, "What other pieces of information do you want to know and why?" can help reinforce the search for information. This type of question forces the learner to think about how they might approach uncertainty and gather more information to help them manage to the situation. Vary the types of challenges throughout the decision game. Variety keeps the learners engaged and targets different skills. Based on the scenario, you can ask the learner to state multiple responses, create products, prioritize or rank recommendations, and measure their confidence.

Feedback. After the learner shares their response to a challenge, the decision game should, at the very least, describes what the expert(s) did in real-life. There are no correct or incorrect answers in decision games; however, the opportunity to see what an expert did in a particular situation provides valuable feedback. It is important to note that what the expect did might not necessarily be the optimal course of action, but was workable for the situation. Feedback may also be provided through facilitated discussion, guidance for which is provided below.

(Optional) Stage 4: Modularize games

Once you have a collection of stories, you might want to mix and match sections from each story to create a robust decision game. The stories can come from multiple CDM interviews with different experts. This may require some reworking to create a coherent experience, but it provides more content to create a valuable learning experience. To ensure the game flows well, you can change details, such as roles and locations, as long as it makes sense in the context of the game and your training purposes.

Facilitating the Railroad Decision Games

The remainder of this facilitation guide shows how to facilitate decision games that have *already been authored* based on stories from experienced railroaders.

Two modes of play

The games are implemented in Google Form to enable two modes of play: facilitated and non-facilitated. Table 2 describes the differences in features between modes.

Features	**Facilitated**	**Non-facilitated**
People	Require one facilitator and several players (at least 3, but not more than 12)	Requires only 1 player
Time	Varies depending on number of cycles; includes facilitated discussion time, which is managed by the facilitator	Varies depending on number of cycles; does not include facilitated discussion time; Generally briefer
Logistics	Requires either in-person or virtual meeting space; if in-person, projection capability is desired	Requires only internet browser
Responses	Typically verbalized	Recorded as required Form responses
Feedback	Provided by facilitator and other players	Provided only through expert tips; Additional feedback may be provided through review and discussion of recorded responses

Table 2: Differences in features between modes

Brief Description of the Exemplar Game

The guidance below uses an exemplar, previously authored decision game titled "New to Management." The goal of this game was to provide an interactive learning experience to professionals in the railroad industry who were already in or seeking to take on a management role. Participants are provided opportunities to make decisions for the entire operation while building and managing their team.

Stage 1. Preparing for the Game

This section provides instructions for setting up the game.

Facilitator Preparation and Logon

The Week Before the Session

Decision games can be facilitated in-person and/or online. All participants should be informed ahead of time what the arrangement will be and provided with the appropriate information.

For facilitated games conducted in-person, determine where the game will take place and how many players will be participating. The physical space should comfortably fit the participants and, ideally, allow everyone to see each other. Find out if the space has the technology to project the decision game on a larger screen, and, if so, make sure you have the proper equipment for projection (i.e., computer, cords, adapters). If projection is not possible, you can ask the participants to bring their own computers, so they can see the game on their individual screens. Contact the participants and let them know the date, time, location, and necessary materials to bring (i.e., computers and/or a pen and paper).

For facilitated games conducted in virtual meetings, let the participants know the date, time, online location (e.g., Zoom, Microsoft Teams), and protocol for logging into the game via the Internet. Participants will need access to a web browser. Make sure you have the correct software to share your screen with the participants during the call, so they can follow the decision game throughout the session.

Minutes Before the Session

If the session facilitated in-person, arrive onsite early to prepare the space and materials. If possible, set up a computer and project the "Railroad Decision Games" dashboard onto a larger screen, so it's ready to go when the participants arrive. Confirm that the Internet works smoothly. Have the facilitation guide and a pen ready to jot notes as the game progresses.

If the session is facilitated online, log on to the session at least 10 minutes prior to game's start time. The "Railroad Decision Games" dashboard should be loaded and ready on your screen when participants enter the conference call; however, wait to share your screen until everyone has introduced themselves and understands the purpose of the session. Have the facilitation guide and a pen ready to jot notes as the game progresses.

To set up the decision game dashboard, go to: https://perigeantechnologies.com/fra-dashboard. You will see the "Railroad Decision Games" dashboard (see Figure 1 on next page). There are six games to choose from, including "Rollout," "New to Management," "A Day in the Life," "Mechanical Repair," "Electrical Repair" and "Derailment."

Participant Pre-Game Instructions

Once all participants are in the room or have joined the call, it is helpful to provide the participants with some instructions and guidelines as to what they should expect during the game. Welcome the participants and make sure everybody can hear each other well and see the same display on the projector or their computer screens—i.e., the "Railroad Decision Games" dashboard.

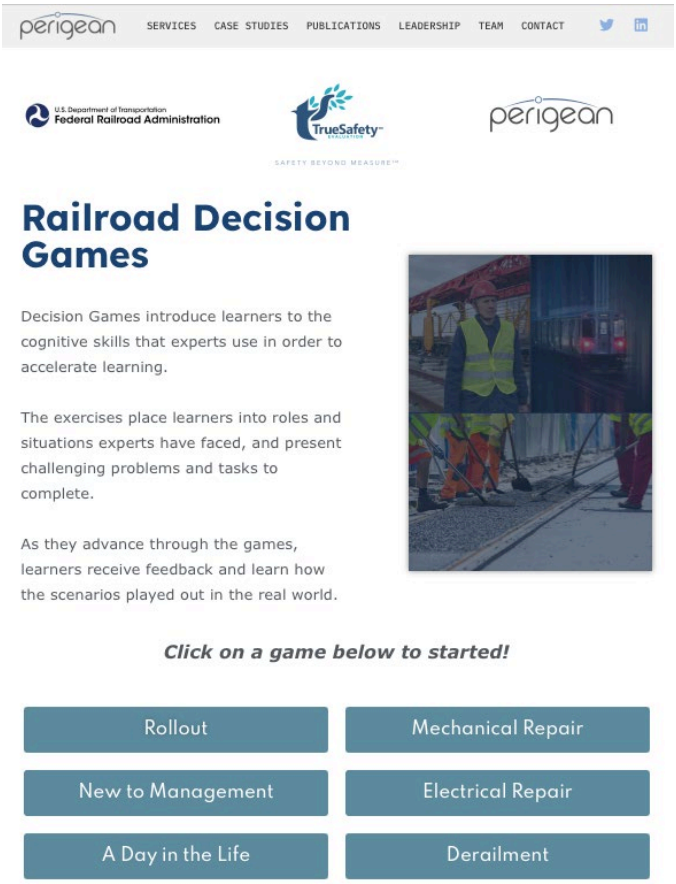


Figure 1: Railroad Decision Games dashboard

Introduction to the Game

> Offer an introduction similar to this example: *"Good morning. Today we will be playing a decision-making game. It will begin by describing your role as a manager at a new railroad operation. You should imagine that your own organization is being described. Then, I will present you with a series of additional scenarios, followed by a requirement for action. You will have a few minutes to develop your answers. We will then discuss everyone's responses. You are highly encouraged to draw on your own experience and interact with your fellow participants. Are there any questions?"*

Non-facilitated game

If a player is playing a non-facilitated game, let the learner know that decision games are an experiential learning activity in which they will be placed in a particular role and into an emerging situation and required to make decisions that reflects how they might proceed. Send the player the decision game dashboard directly and instruct them to click on the New to Management Decision game. The Google Form is self-explanatory about how to progress through the game. Each page of the form includes information to read and a Next button to progress, or *required* prompts to respond to and a Next button to proceed. Players proceed through all cycles at their own page, then Submit on the final page.

Stage 2. Facilitating the Game

The following sections provide instruction in how to facilitate decision games, either in-person or in virtual meeting spaces. The sections follow the course of the game. Below is an example of the New to Management decision game, but each game follows the same structure: Scenario → Challenge → Feedback (expert tips).

If the session facilitated in-person, the facilitator will typically click through the game on his or her computer screen that is being projected for everyone to see. If there is not a projector and the participants have individual computers, instruct them to follow along on their screens and only move forward when you tell them to.

If the session is facilitated online, make sure the participants can see the "Railroad Decision Games" dashboard that you are sharing on their screen. When you are ready to begin, click on the "New to Management" decision game.

Non-facilitated game

The dashboard link will bring learners to a Google Form for them to complete. The Google Form requires participants to enter their emails, so you know who wrote each response (see Figure 2). Tell each participant to input their preferred email to be included with their responses.

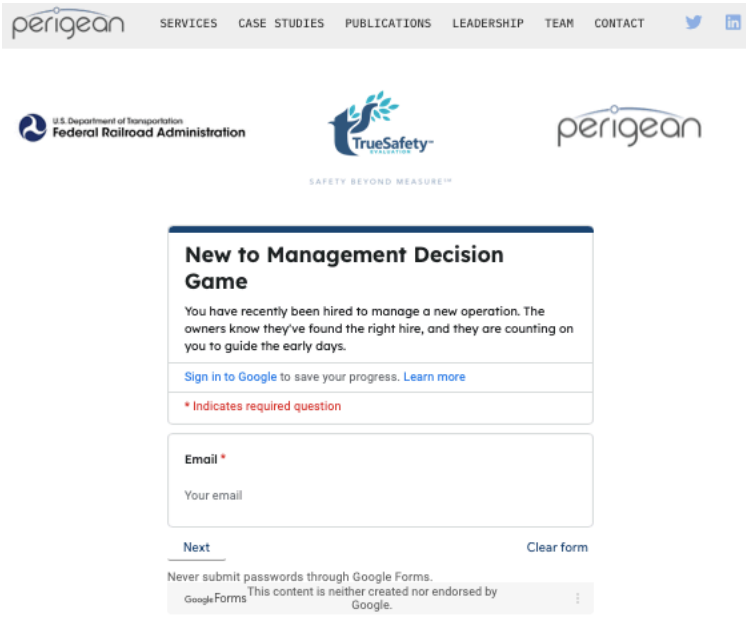


Figure 2: Learner logon

The "New to Management" decision game consists of 38 sections, each following the standard format of Scenario → Challenge → Feedback. The sections, in order, are as follows:

1. Introduction
2. Hiring Employees
3. Finding Candidates
4. Interviewing Applicants
6. Initial Team Meeting
8. Dealing with a Hot-Headed Employee
10. Ignoring the Rules
12. Employee Disagreements
14. Finding Cracks
16. Talking to the General Manager
18. Continuing Inspections
19. Notifying the FRA
20. Pushing Back
22. FRA Visit
23. Emergency Response
25. Responders
26. Building Relationships
27. Main Yard Reconfiguration Project
29. Dealing with Outside Utilities
31. Customer Service: Thinking Ahead
33. Surprise Visit
35. Code Disagreements
36. FRA Involvement
37. Operational Instruction Plan
38. Lessons Learned

Background and Role

The first section is the "New to Management Decision Game" slide. Read the scenario slowly and clearly to the participants.

After you have read the entire scenario to the participants, *ask if anyone has any questions that need to be clarified before you go on to the next requirement.* If participants ask questions pertaining to specific characteristics of the organization (e.g., size, organizational structure, their immediate supervisors, or union presence), refer them back to their own organization's characteristics. The goal is to get people to consider the described issues in the game as if they were facing them in their usual working context based on the characteristics of their own railroad property.

First Requirement: Hiring Employees

After all questions about the scenario have been answered, advance to the "Hiring Employees" section. Read it out loud clearly to the participants.

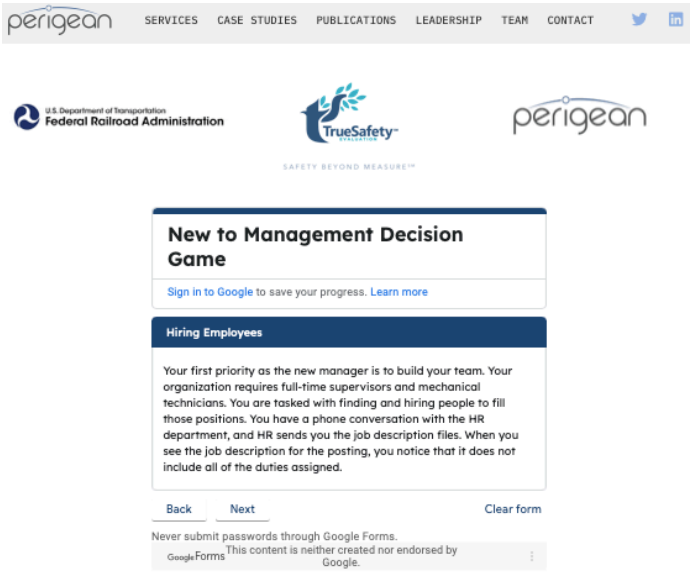


Figure 3: Hiring Employees Section

After reading the scenario aloud and allowing the participants to process the information, move to the Challenge section by clicking on the "Next" button.

The participants will be required to respond to certain challenge questions based on the scenario that was just read. Inform the participants to read through the instructions carefully.

Tell the participants to write their answers down on a piece of paper and be prepared to discuss it. If the participants are following the game on their own computers, tell them that they should enter their answers to the required questions where it says, "*Your answer,"* using their keyboard (Figure 4).

> **Caution**: Tell the participants to write their answers but NOT to click "Next" until you have discussed everyone's answers.

Do not advance the Google Form to the next slide until you have discussed everyone's answers; otherwise, the Feedback (expert tips) will appear prematurely before they have completed their answers.

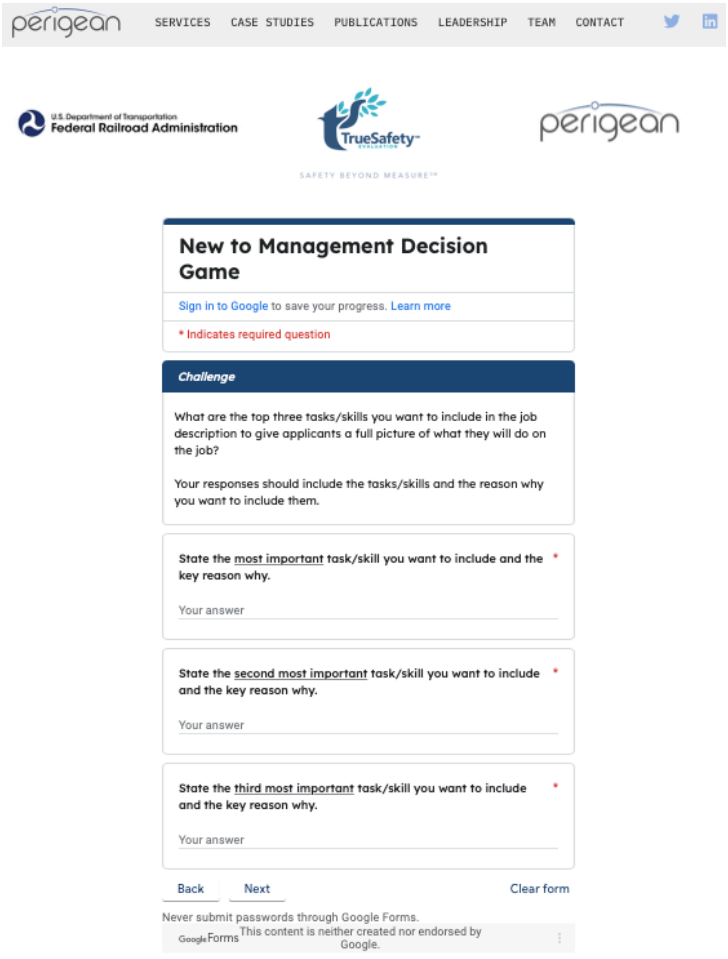


Figure 4: Challenge Section

Ask the participants if they have any questions about the requirement or how to submit their answers if they are on their computers. Then, tell the players the amount of time they have to respond (typically one to three minutes). Make a time announcement when they have 30 seconds to one minute remaining.

Feedback and Discussion

After all the participants have written their responses on paper or in the Google Form, initiate a discussion by addressing each individual player's answers. The facilitator ensures every participant states their answer to the challenge(s) and their rationale. This may lead to discussions and stories from other participants. If the conversation gets off topic, steer the group back to the challenge questions.

Allow everyone the opportunity to provide at least one response. As you go around the (virtual or physical) room, there will typically be some overlap in answers. Make sure you start with a different participant each round so the order differs.

The discussion is most effective when everybody is involved and stays engaged. The goal is to understand what experiences the participants used to generate their responses and facilitate a discussion among the different players that allows them to share their experiences, which might be quite different based on their background. As the facilitator, make sure every player has a chance to present his or her answer(s) and get reactions from others. Learners should not just observe the game; everyone is involved.

The list of questions below are meant to help uncover some of the assumptions, thinking processes, and experiences players bring to the game that allow them to generate their answers. Each question can be asked of any participant, but specific participants might be called upon if their participation level is low.

The discussion should take about 5 minutes.

Possible questions for the Hiring Employees section

Tell the participants to take a moment to review the answers. Then discuss and clarify the answers:

- Does anyone have questions about any of the tasks/skills?
- Was it difficult to generate and prioritize the tasks/skills?
- What made it difficult?
- What were you considering when generating the tasks/skills?
- What strategies did you use to prioritize the tasks/skills?
- What would have made it easier for you to come up with the tasks/skills?
- What information was most helpful to you to make the tasks/skills?
- Where would you get that information?
- What one piece of information that you did not have would have helped you to make that decision more easily?
- How would that information have made your decision easier to make?
- Are there any other sources that aren't usually considered but might be helpful?
- What assumptions did you make in order to come up with these tasks/skills?

Explore what participants think of the other answers and how they relate to the requirement:

- What are the main differences among the tasks/skills?
- Are these differences important? Why?
- What do you agree with and why?
- How do these help you choose employees?
- Why is that important to know?

Following the discussion, you might begin to summarize by using the following questions:

- After this discussion, what feels like the highest priority? Why? Does anyone have a different priority?
- What is the one question that you have seen over-looked the most when people are interviewing?

Wrapping up the discussion and moving on to the next section

When the discussion has advanced to the point of saturation of the topic, begin to wrap it up. You might segue with a comment similar to this: "*This was a very good discussion, and I would like to lead us now into the second requirement if there are no further comments on this requirement*."

Or, in case the discussion seems to have gotten into unrelated issues and the time is getting short, you could use a comment similar to this: "*This was a very interesting discussion and I apologize for interrupting here, but in light of our limited timeframe, I would like to move on to the next requirement*."

Once you wrap up the discussion, click "Next" to move onto the next section.

Second Requirement: Expert Tips

After almost every Challenge that requires a response from the participants, there will be feedback. In this decision game, feedback is in the form of Expert Tips (see Figure 5). The Expert Tips reflect what an expert did or said about the situation from their point of view.

Read out all the tips to the participants.

Ask the participants if they have any questions about the Expert Tips. There is a multiple-choice question after the Expert Tips asking if the participants understand them or not. As the facilitator, you can click any option to move forward.

Click "Next" to move to the next section. Continue facilitating the decision game following the same format.

Feedback from a Non-facilitated game

If a participant is going through the game online and/or individually, they are required to answer whether or not they understand the Expert Tips (see Figure 5). One of the advantages of having the game in Google Forms is that the trainer can see if anyone wants more help on a particular section. The trainer can go back later to discuss the Expert Tips with any participants who put "Yes, I understand, but I'm interested in learning more," or "No, I don't understand and feel like I need help with this part."

As the facilitator, you will be able to see the participants' responses after they complete the entire game under the "Responses" tab (Figure 6) in the Google Form.

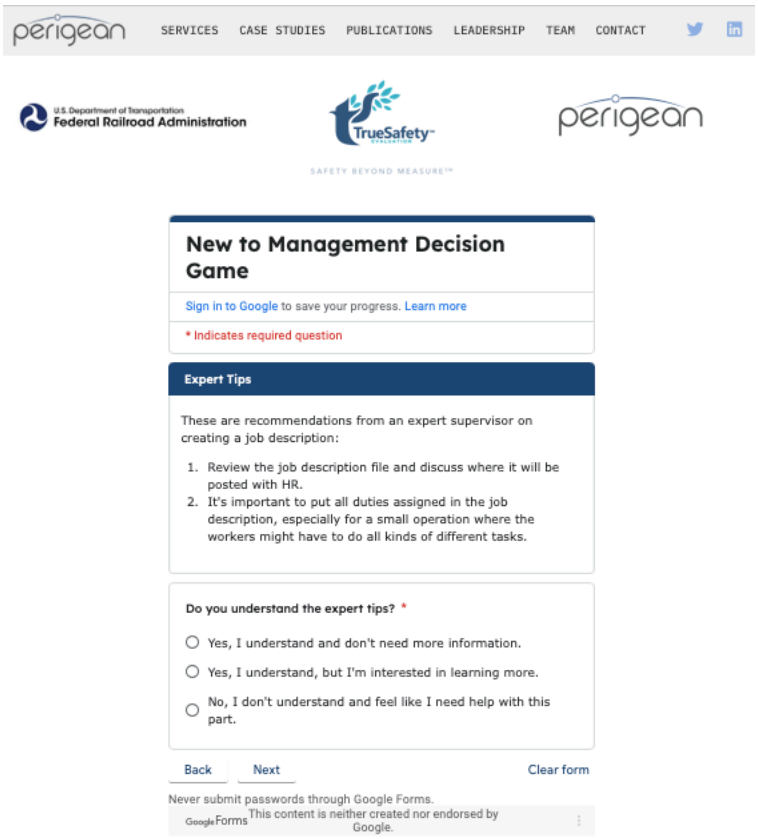


Figure 5: Expert Tips

Responses

As the facilitator, you will be able to see the self-run or online participants' responses after they complete the entire game under the "Responses" tab (Figure 6) in the Google Form.

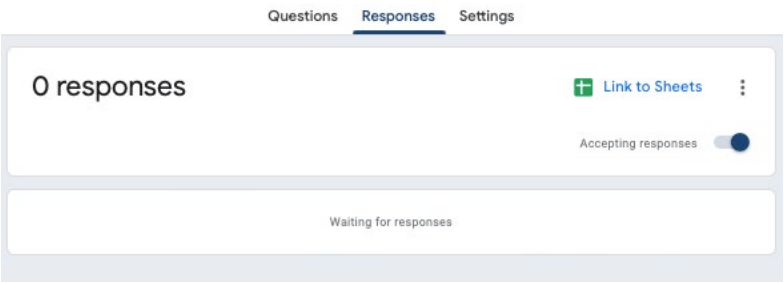


Figure 6: Responses Tab

Additional Discussion Question Examples

Additional discussion questions to consider throughout the decision game include the following:

- Was it difficult to come up with your answer?
- What made it difficult?
- What were you considering when answering the question?
- What assumptions about your own property did you make when coming up with this point?
- What could you do to prevent this problem?
- What piece of information do you wish you had?
- Where would you get that information?
- Who could you involve to minimize the chances of this problem occurring?
- What would have made it easier?
- Are there any other sources that aren't usually considered but might be helpful?
- What assumptions did you make?
- Do you have any questions?
- As a group, I'd like you to take three minutes and try to come up with the three problems most likely to occur.

Following discussion along these lines, you might begin to summarize using these questions:

- Given our discussion, have you thought of additional show-stoppers that have not made it onto our lists yet?
- After this discussion, do you feel like you could prevent any of these problems? Why or why not?
- What one problem do you believe is most often overlooked and why?

Additional Tips to Consider

Additional things to consider while facilitating the decision game include the following:

- Include breaks throughout the game, at least every hour, to keep the participants engaged and alert
- If you are short on time, you can skip ahead to the sections you want to cover for specific training purposes
- It may be beneficial for a Subject Matter Expert (SME) to participate in the game; SMEs can provide additional knowledge and stories that are valuable to the learning experience for more junior learners during discussions
- Avoid having one player monopolize the conversation; encourage every participant to share their thoughts and responses

Conclusion

Now that you have some background on how decision games are authored and their structure, how to facilitate each section, and some additional discussion questions to consider, use this facilitation guide to set-up and run your decision games!

Appendix C.
The Expertise Management Framework

Expertise Management for Safety Leadership Positions in the U.S. Railroad Industry – Appendix C

The Expertise Management Framework

Prepared by TrueSafety Evaluation, LLC, and Perigean Technologies

Executive Summary

The rail industry is a highly complex system of systems, comprising equipment and technology, formal and informal processes, and most importantly, expertise in its crafts from front-line operators to senior leadership. It is also becoming ever more dynamic. While the speed of technological transition receives significant attention, trends in expertise stand to have even more significant effects on the industry going forward.

Like most, the railroad industry is facing a significant loss of expertise in the coming years. This trend has been a long time in the making, and has perhaps been postponed following the COVID-19 pandemic. Regardless of when the losses come, the sheer volume of seniority in the railroad workforce suggests that neither succession planning nor workforce promotion programs alone will adequately mitigate the challenges of knowledge loss accompanying an aging employee population. The industry will also need to retain the most critical knowledge before it heads out the door.

Recognizing the risk, in 2022, FRA's Office of Research, Development, and Technology's Human Factors Division sponsored TrueSafety Evaluation to demonstrate an innovative Expertise Management (EM) Framework to demonstrate how to identify, capture, and transfer critical areas of expertise for safety leadership positions in the U.S. railroad industry. An overview of the program has been published in an FRA Research Results Report: Expertise Management: A Promising Approach For Succession Planning.

The EM Framework is a set of processes and methods for managing expertise–from identifying where expertise is centered, to methods for helping experts articulate what they know, to approaches for engaging other professionals in that expertise, with the goal of accelerating their own achievement of proficient performance. Notably, the EM Framework builds on the use of Cognitive Task Analysis for eliciting expertise, for which previous FRA-sponsored initiatives have also demonstrated value.

This Expertise Management Framework provides an overview of the EM process and methods, and guidelines for implementing EM. It also includes WatchOuts identified during the FRA-sponsored effort to introduce EM in the railroad industry.

Users of the EM Framework may include knowledge managers; training; learning and workforce development professionals; and anyone concerned about the loss of expertise in the rail industry.

Table of Contents

Introduction

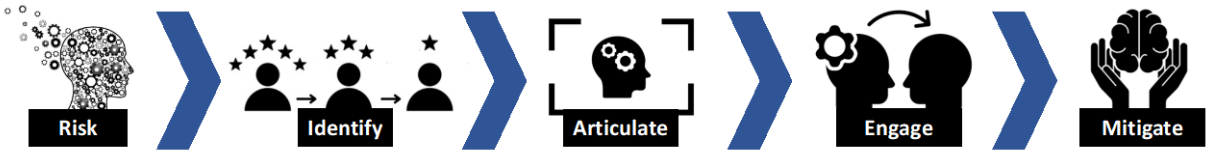
Expertise Management (EM) is a knowledge management approach that targets the most valuable knowledge in an organization—expertise. The approach builds upon the basic goals of knowledge management – i.e., identifying, capturing, evaluating, retrieving, and sharing all of an enterprise's information assets. Unfortunately, much of what is promoted under the knowledge management umbrella misses the mark when it comes to expertise. What cognitive scientist Gary Klein noted three decades ago remains true today in many organizations, including those in the rail industy:

> *Few organizations have any methods for preserving or expanding their experience, or even taking stock of their current expertise…When staff members retire, the organization does little to preserve their expertise (Klein, 1992).*

EM offers a structured process for managing the risk of lost knowledge. EM comprises processes for ***identifying*** critical, at-risk knowledge; techniques for helping experts ***articulate*** what they know; and methods for enabling organizations to ***engage*** with their expertise. When fully executed, EM helps to ensure that expert knowledge is transferred to others, to accelerate the development of their expertise and mitigate the overall risk to the organization.

The EM Framework is organized along just these three elements:

- *Identify* refers to approaches for identifying expertise on which to focus the subsequent activities.
- *Articulate* focuses on knowledge capture activities, especially Cognitive Task Analysis (CTA) as conducted by a experienced knowledge elicitors working one-on-one with identified experts.
- *Engage* covers activities that are intended to facilitate the acceleration of expertise in others, to include sharing the articulated expertise through representations and learning exercises.



Beyond just methods and processes, this EM Framework also incorporates experience in the application of each of these elements. For example, Moon et al. (2015) has offered guidance for – and discussed challenges to – implementing Expertise Management, drawing on collective experience with capturing and transferring expertise in scores of organizations. In this document, this additive guidance can be found in WatchOuts.

Applying the EM Framework to the domain of rail operations can help strengthen highly skilled areas of technical expertise and foundational non-technical skills, abilities, and competencies, such as emotional intelligence, team-building, listening, communicating, and conflict resolution, that are essential for building strong organizational impacts.

The EM Framework is best viewed as *a guide for getting serious about managing expertise*. Full implementation of an EM program will always require the use of other organizational development tools, such as change management, and most importantly, the development of professionals who are responsible for the overall EM program and its integration into the organization. Hence, the Framework is addressed to these "Expertise Managers."

Framework

The three phases of Expertise Management are: *Identify, Articulate,* and *Engage*. Each comprise both a focus of activities and a suite of tools that have been demonstrated to be effective and efficient for their implementation.

Generally speaking, the three phases will be executed in the listed order, particularly during initial rollout. As EM takes hold in the organization, the three phases will become more parallelized. For the purposes of the Framework, the phases are further subdivided into stages. Here again, the expectation should be that the stages will become parallelized over time.

Phase 1: Identify

Expertise Identification is the systematic process of identifying and prioritizing at-risk categories of expertise that are critical to operations but "reside" only in the minds of proficient performers.

The core goals of Phase 1 are:

- Identify key *stakeholders* to coordinate buy-in for EM activities,
- Identify, prioritize, and select *experts* to target for follow on activities,
- Identify the *expertise* most critical and most at-risk of loss for that position, and
- Establish conditions for success.

<u>Stage 1. Setting the groundwork with stakeholders</u>

No EM program will succeed without the support of the organization, in particular from key stakeholders. These include leadership at all levels, who must appreciate both the need and the solution. A first order of business should be to establish a steering committee of stakeholders whose roles are explicitly invested in the loss of expertise, including labor leaders.

A closely related next order of business should be informing the stakeholders about the need for EM, particularly in the broader context of workforce trends. FRA and other sources's published works on the topic provide an excellent starting point, including:

- A Guide to Building and Retaining Workforce Capacity for the Railroad Industry (National Academy of Sciences, 2015);
- Railroad industry modal profile: an outline of the railroad industry workforce trends, challenges, and opportunities-update (Stewart and Parker, 2016);
- Leadership and Knowledge Management Best Practices Guide (Jefferson Solutions, 2014).

The literature on knowledge management is extensive. But a few additional, easy to explore publications may also prove useful for informing stakeholders of the value and overall approach of EM.

- For a quick and easy to digest article based in the utilities industry, see: Moon et al. (2009), "How did you do that? Utilities develop strategies for preserving and sharing expertise," in *Electric Perspectives* magazine.
- For a deeper dive, including additional strategies for influencing stakeholders, see: Milton, N., & Lambe, P. (2019). *The knowledge manager's handbook: a step-by-step guide to embedding effective knowledge management in your organization*. Kogan Page Publishers.

For even an informed stakeholder group, however, making the case for EM can be challenging for several reasons. EM is a time-consuming and thus expensive endeavour. Expenses are introduced mainly through the experts' time and the time required to implement the program, as well as travel and other costs expected of program rollouts. Such costs may be questioned in the context of questions about return on investment (ROI) and other KM solutions that may already be in play, including software products, mentoring programs and succession planning, which can create competition for scarce resources. While some decision makers in human resources and training departments may be familiar with KM traditions and requirements for success, KM may not translate well to front-line managers who stand to gain the most from it but may also be quick to focus on the costs, particularly the time of their most valued performers. Thus, providing a straightforward and palatable answer to the ROI question can difficult, but there are tools to help.

Expertise Loss Risk Assessment

In the past decade, the broader KM community has put forward tools to answer the ROI question, with a focus on assessing the costs involved in losing knowledge. For example, Black and Garcia (2017) offered a risk assessment model for the nuclear industry, and Jennex (2014) offered an industry-generic model that has gained significant interest.

By focusing explicitly on an organization's experts, Hoffman and Wilson (2013) built a method for calculating the risk of expertise loss. Table 1 provides their method, which is recommended for use under the EM Framework.

Of course, risk is not the same as uncertainty. Gaining an firmer grip on the the uncertainties about expertise loss is just as important as calculating risk. Such uncertainies may include but are not limited to:

- Future directions of the organization; while the rail is mostly fortunate in this regard as it enjoys stability over time, these uncertainties may include expectations about the future of the customer base and technologies,
- Single points of failure in individual performers; these include major work bottlenecks that must be addressed by single performers;
- Future expectations about infrequent or one-off tasks; these include major reconfigurations and program implementations and/or sunsetting.

These and other aspects of uncertainty should be included in any case made for EM.

Table 1: Outline of a method for calculating the risk of expertise loss

1. Make a list of individuals who have been identified as experts who have knowledge that is critical to the organization and is tacit (see *Stage 3 of the Identify phase*).
2. For each person, make a list of five critical job functions they perform. Ask whether the organization could exist if it lost all of those functions.
3. For each of function, indicate the frequency (daily, weekly, etc.) with which it has to be performed.
4. For each function, indicate the approximate time it takes for the worker to accomplish the primary task goals.
5. Calculate the total annual cost, the cost of achieving all the critical functions.
6. For each of the functions, list five consequences to the organization if the function were lost. For each of those consequences, generate an upper and lower bound estimate of lost revenue.
7. For each of those consequences, generate an upper and lower bound estimate of lost opportunity cost.
8. For each of those consequences, generate an upper and lower bound estimate of retraining cost (say, over 10 years).
9. Add up all the upper and lower bounds.
10. To both sums, add the cost of achieving the functions' goals (Step 5).
11. Now go back in and erase every number that is linked to an identified expert who is 45 years old or less.
12. Determine again the sum of all the upper and lower bounds.
13. The difference between this sum and the first sum, divided by 20 (years to retirement of the 45-year olds) tells you how long your company has to exist in a worst case (upper bounds) and dangerous case (lower bounds).

Stage 2. Communicating the EM program

In parallel with Stages 1 and 3, communication of the EM program should be prioritized. The organization should be brought into awareness about the purposes of the program, and the experts who will share their expertise must be carefully introduced to their role.

Stress points for broad communication

Communication to the organization should stress the following themes:

- Managing the most important risk to the organization – expertise loss
- Recognizing the value of senior employees and the importance of the professional development of the current and future workforce
- Approach is systematic about processes that otherwise will happen – for example, mentoring and on-the-job training – EM is about accelerating these processes
- NOT: Replacing, 'extracting', building replacement capacity or capabilities (e.g., artificial intelligence)

Sample language for communicating with experts

Communication with the experts who will share their knowledge requires careful consideration. As Moon et al. (2015) have identified, the workforce can bring many of their own ideas about the

purpose of a program to the process, and these must be anticipated and countered through communications. Table 2 suggests language for introducing the EM program to experts.

(Organization) has recognized that the industry faces workforce changes in the coming years. One of the most serious is the loss of experience that will come with retirements. In preparation, the (organization) is introducing approaches to help mitigate this experience loss. One such approach is to work with identified experts – like you – to begin to build training exercises that can help others learn from their experience. We are using tools already used in other industries. These tools include methods for interviewing experts and building training from what experts share. These tools have been studied and promoted by FRA (perhaps link to FRA documents). We have identified you because of your status as an expert in the rail industry – one of the 'superexperts' described by cognitive scientists (perhaps link to FRA or cog sci documents). This is an opportunity to share your expertise with the future generation – to ensure their safety and the safety of the rail-using public. No process can fully capture everything you know – the goal of this project is to demonstrate how to preserve some of your hard-earned experience so that others in the rail industry may learn from it. In the coming weeks, we want you to spend some time with our team to help us explore your expert knowledge. The time you spend will be within your routine workdays, and you will not need to do any preparatory work. The information you share will only be used for the organization – it will have no bearing on your professional performance review. You will be free to share your experience as you see fit. We stand ready to answer any questions you may have, and hope that you see this opportunity as beneficial.

Table 2: Sample language for communicating EM program to experts

If the expert is interested in learning more about the process, set up a 30-minute meeting to discuss EM and the project. This introductory meeting will help get a sense of their willingness and availability to participate. During the meeting, inform the expert that interviews typically last between two and four hours, that they can be conducted online or in-person, and that the number of such sessions will be determined as the project proceeds – note the expected number if that is known. The level of effort expected is typically an experts' main concern.

It is also important to ask the expert if they are comfortable with recording and transcribing the interviews but ensure that their information will only be used for the purposes of EM. Depending on organizational policies, it may be necessary to discuss confidentialty. This may depend on both the comfort of the expert and the topics to be discussed.

WatchOuts

Early and consistent discussions about expectations are critical for ensuring the engagement of experts. Communication should be handled with the level of sensitivity afforded to similar engagements, such as employment terms.

Stage 3. Identify Experts

With stakeholders engaged, identifying the experts who will be the focus of the EM program will be the next order of business. Application of EM should primarily focus on proficient performers who:

- plan to retire soon, and/or
- fill a particularly important role, and/or
- are responsible for a particularly valuable and/or rare or infrequent events task, and/or
- are recognized as being the only expert on something of high importance, and/or
- are so exceptionally skilled at a task or knowledgeable about topic(s) that the organization stand to improve if their expertise were more broadly possessed.

Fortunately, identifying such professionals is often a straightforward affair. Managers and collegues typically know who they are, primarily because they are reliant on the experts' proficient performance. That said, knowing the characteristics of experts can help to hone in on the targets for EM activities.

Characteristics of Experts

Borrowing from the world of professional sports, Hoffman et al. (2011) describe the top performing professionals in an organization as "franchise experts," whose performance often exceeds those of their peers. The characteristics of experts are by now well understood. Table 2 delineates the unique attributes of performance that the most highly experienced practitioners exhibit in any domain.

Cognitive Capacities	Experts "see the invisible." They recognize the uncommon or irregular. Experts rarely say, "I don't know." In the occasional case in which they find themselves at a loss, experts engage in problem-solving techniques to make sense of a situation. Experts create comprehensive and thorough mental models. They anticipate not only consequences throughout a system, but also the collateral consequences to other systems.
Action Capacities	Experts are willing to improvise. They know how and when to improvise, particularly when situations go beyond the typical. Experts rarely say, "This is what I believe." They are constantly on the hunt for formal, empirical evidence. Experts create and rely upon "treasure maps." They develop and use memory artifacts that are unique organizing schemes and reinforce the structure of their knowledge.
Affective Capacities	Experts "live for the edge." They recognize that in order to achieve the mission, work needs to be done at the edge of the familiar. Experts revel in tough cases. Experts have unique incentives. Experts expect to be compensated, but typical compensation packages are not the only, or even most important, "carrots" they seek.
Social Capacities	They are an "ad-hoc solution provider." By virtue of their continuously demonstrated success, they become the "go-to" pro. The absence of the experts causes trauma. For colleagues who rely on experts, their absence can be a disruptive event. Experts have the ability to consider the perspectives of others involved in the situation. Unlike the expert who may become engrossed in the problem at hand, experts have the ability to consider the perspectives of others involved in the situation. Experts lead, but often only by example. They have the admiration of their peers and subordinates and develop knacks for employing their special position in furtherance of the mission. While they may find themselves in management roles, they are not always comfortable there.

Table 3: Characteristics of Experts (from Hoffman, 2023)

Armed with these features, finding the initial set of experts to focus discussion around with stakeholders should not be a complex task. Once identified, the next decision activity should be on *which aspects of their expertise* to focus subsequent activities.

Identifying tacit and persistent knowledge and cognitive skills

No EM program should be expected to be comprehensive – it is not possible to identify, let alone manage, *all* of the expertise in an organization. Nor is it necessary, as much that qualifies as expert-level knowledge and even skill is diffused across the organization.

EM must focus on expertise that is tacit and persistent. Tacit knowledge and cognitive skills are those that experts draw on without much reflection. Persistent knowledge and cognitive skills are those that the organization anticipates will remain valuable after the expert has departed. Table 4 identifies features of tacit and persistent knowledge that can help further hone the application of Phases 2 and 3 of the EM Framework.

1. Identify the tacit
    a. Not captured in formal, corporate or other published documentation
    b. Not shared with other advanced performers in a significant way
    c. Broadely identified as a domain of one – "only s/he knows that"
    d. Features of performance where one clearly displays a "knack" or automaticity that others do not have
2. Identify the persistent
    a. Comprises core mission
    b. Technology-neutral
    c. Technology-dependent
    d. Historically informs current and future operations – "we do it this way because…"
    e. Enabling across roles and tasks – e.g., features of being an exceptional employee

Table 4: Features of tacit and persistent knowledge

As noted, some persistent knowledge and skill will be necessary no matter the future of the organization – in particular, Key Impact Skills. Some expert knowledge and skill may be considered to be rendered obsolete by technology. However, caution should be used in determining whether an experts' capabilities may be overtaken by future advances, as some experts are the only remaining professionals who understand the historical development of current technologies, which may actually end up being in use for longer than the current obsolecense plan dictates.

Determining which tacit and persistent knowledge and cognitive skills to focus on should include the stakeholder group and the identified experts. It should be expected that the two groups may have differences of perspective for where to focus the activities.

When engaged in an EM effort, there is always another aspect of the expert's experience that could be explored. A healthy respect for depth and breadth of expertise – an appreciation for the limitations of any EM effort – must be maintained during discussions about experts and the topics they know.

Concept maps for diagramming expertise

A key task in this stage is tracking the emergent topics and the perspectives offered about their priority. The Expertise Manager should use any tools they are facile with that fit this purpose.

One tool worth noting is Applied Concept Mapping (Moon et al., 2011), a diagramming tool that enables flexibile representation of emergent knowledge structures. Concept maps promote linking together concepts (e.g., knowledge topics, experts) in ways that make their connective meaning explicit. Their flexibility supports the sort of diagramming that should be expected in "mapping out" an organizations knowledge. Figure 1 shows a concept map developed to show the categories of expertise explored in the FRA-sponsored EM demonstration project, and the connection of the topics to the experts who shared their expertise about them.

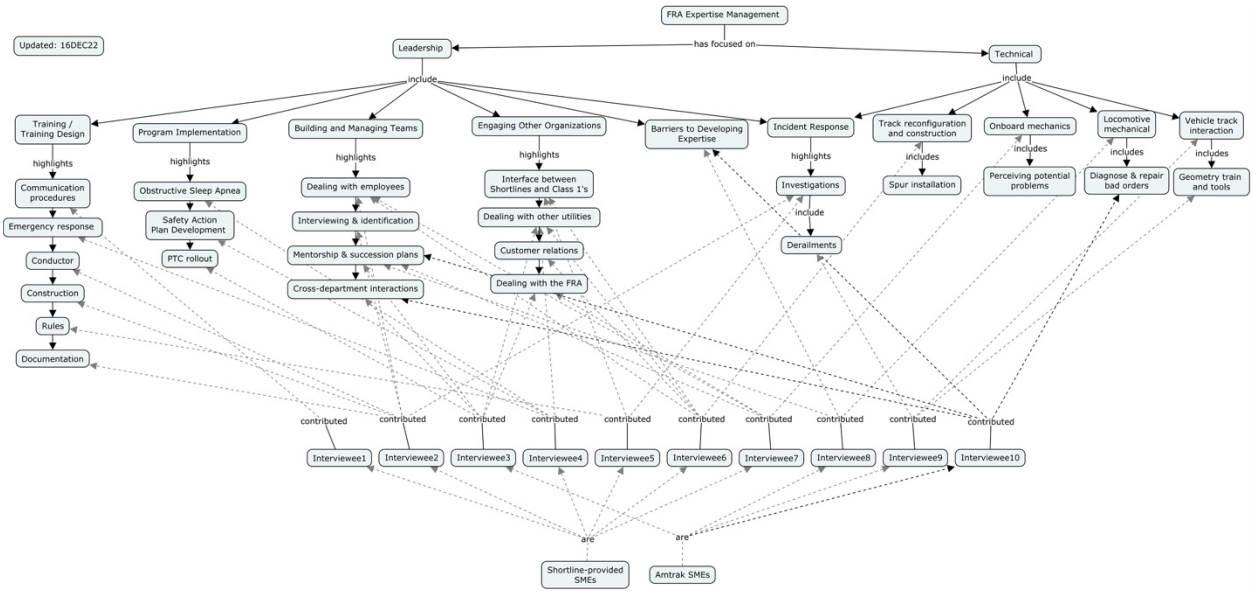


Figure 1: Concept Map of EM topics

WatchOuts

The most important WatchOut for the *Identify* phase is to avoid skipping stages or the phase altogether. Organizations that move directly to the Articulate phase run several risks, including:

- Personnel concerns about the purpose and expectations of the program, which could create challenges for expert participation,
- Reinventing the wheel by focusing on expertise that has already been accounted for through other means,
- Scope wandering due to a lack of clarity about which topics should be the focus and to what depth they should be articulated,
- Organizational disconnects between EM and related efforts – including with human resources, learning and development, and workforce planning – and confusion about ownership of the processes and outputs.

Phase 2: Articulate

The purpose of *Knowledge Capture* is to capture and articulate, using CTA methods, the internalized mental models, critical decision paths, and core information sources used by senior leaders for safety critical decisions to help identify and guide potential product development that can be infused back into the organization.

The goals of Phase 2 are:

- Articulate aspects of expertise, and
- Organize captured knowledge.

Stage 1. Preparing for capture

After identifying and confirming the experts who will participate in the EM project, it is time for the EM interviews. It may be necessary to exercise flexibility in confirming the expertise capture sessions, as experts' schedules may be frequently disrupted due to operational demands.

It is important to remind experts of the purposes of the overall effort and each session, and any changes to either since the last program contact.

The following should be organized prior to the start of all sessions:

- Location (virtual or in-person),
- Means of recording audio,
- Coordination of any note-takers or observers, and
- Any artefacts that might be used to prompt the expert.

It may be advisable to develop an interview guide prior to the knowledge capture session. Such guides may be useful for interviewers – i.e., knowledge elicitors – whose experience is limited. They might also highlight the specific, identified topics for elicitation. As Stage 2 explains, however, it is not necessary to script the discussion.

WatchOuts

Knowledge capture sessions may end much earlier for practical reasons, especially because the expert must get back to work (Moon et. al, 2015). Flexibility in scheduling must be maintained throughout the engagement with any expert.

Stage 2. Methods of capture

In EM, helping experts articulate their expertise is achieved through the application of Cognitive Task Analysis (CTA). CTA comprises a set of techniques for eliciting, analyzing, and representing the cognitive work inherent in domain tasks (Hoffman and Millitello, 2008; Crandall, Klein, & Hoffman, 2006). CTA methods have been developed, applied, and refined over the past four decades across numerous domains. Of particular value for expertise management is the Critical Decision Method (Hoffman, Crandall and Shadbolt, 1998).

Critical Decision Method (CDM)

CDM is an interviewing technique widely used in the field of knowledge capture. CDM provides an interview structure and probing questions that enable a knowledge capture professional to help experts articulate their cognitive experience in the context of a incident in which their cognitive performance had an effect on the outcome of the incident.

CDM is structured around four phases:

- Incident identification and selection
- Timeline verification and decision point identification
- Deepening and probing
- "What If" queries.

Figure 2 provides an industry standard guide for conducting a CDM interview. While the four phases are distinct in their purposes and probing questions, in practice they need not be separated. With experience, you can execute the phases with significant overlap, enabling the interview to feel like a conversation about a familiar time. CDM interviews can be time consuming – on the order of 1 to 2 hours or more. With overlap of the phases and rapid pacing, a high-quality interview can be obtained more quickly.

There are three keys to executing a successful CDM interview. The first two occur during the first phase. Incident selection must target an incident that is from the professional's own experience – i.e., not a second-hand story. And the incident must contain some form of cognitive performance that had some type of effect on the outcome of the incident. The third key occurs throughout the remaining phases. You must ensure that the performer remains within the incident. This can be achieved by continuously prefacing questions with reminders – e.g., "in this particular incident…" The results of a CDM interview will be a rich incident description of the cognitive performance and its contexts.

Other CTA questions

The key to successful CTA lies in asking questions that prompt an expert to articulate expertise – i.e., the tacit and persistent knowledge that enables them to perform at the highest levels. In many domains, including railroading and managing railroad operations, such knowledge includes noticing aspects of the work environement that others don't, and using tricks of the trade to perform tasks efficiently. These and other aspects of expertise can be explored using "knowledge auditing" questions that help experts share their expertise through examples and stories. Figure 3 provides a starter set of knowledge auditing questions, or probes, organized around features of expert performance.

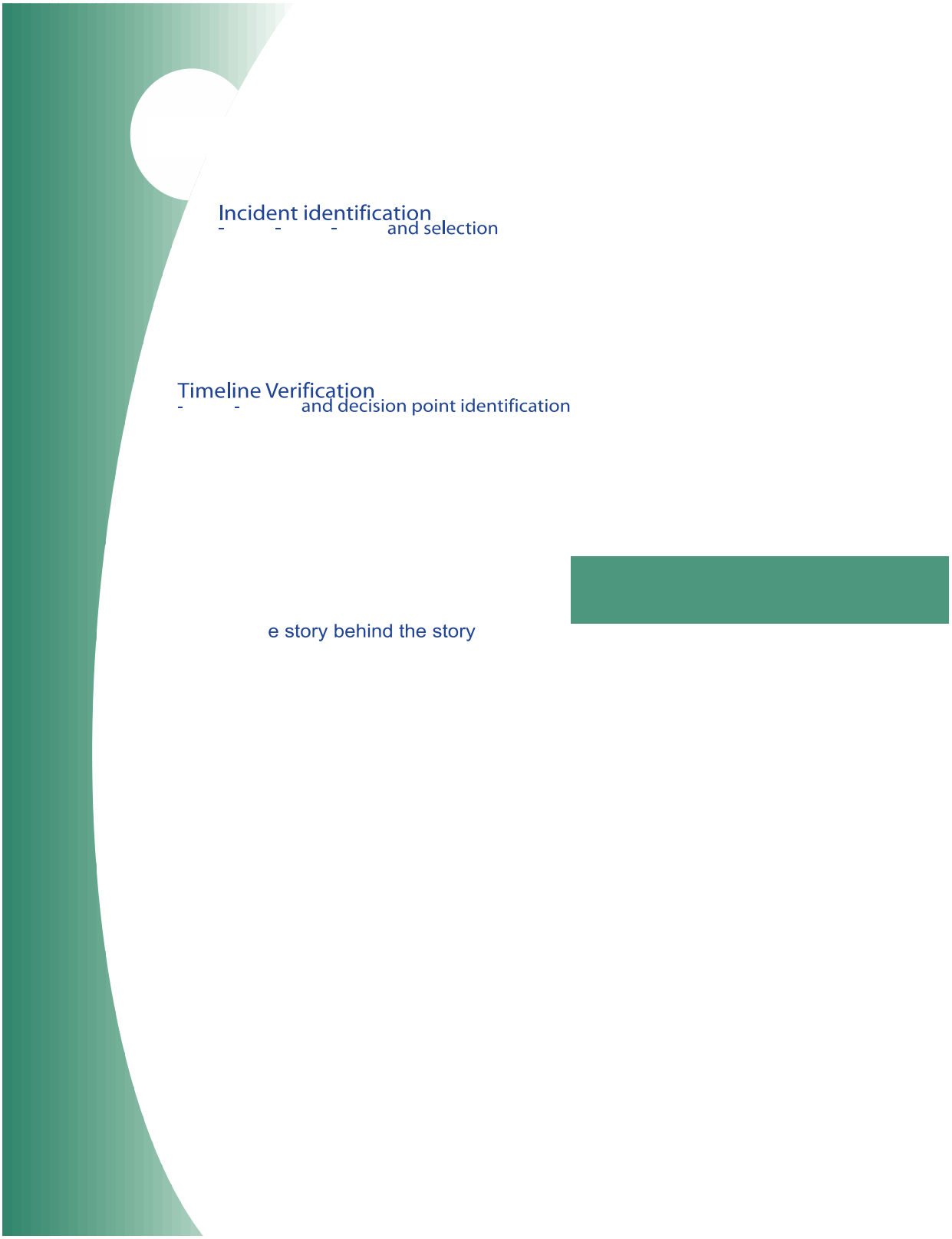


Figure 2: Critical Decision Method

- **Past & Future** Experts can figure out how a situation developed, and they can think into the future to see where the situation is going. Among other things, this can allow experts to head off problems before they develop.
  Is there a time when you walked into the middle of a situation and knew exactly how things got there and where they were headed?

- **Big Picture** Novices may only see bits and pieces. Experts are able to quickly build an understanding of the whole situation—the Big Picture view. This allows the expert to think about how different elements fit together and affect each other.
  Can you give me an example of what is important about the Big Picture for this task? What are the major elements you have to know and keep track of?

- **Noticing** Experts are able to detect cues and see meaningful patterns that less-experienced personnel may miss altogether.
  Have you had experiences where part of a situation just "popped' out at you; where you noticed things going on that others didn't catch? What is an example?

- **Job Smarts** Experts learn how to combine procedures and work the task in the most efficient way possible. They don't cut corners, but they don't waste time and resources either.
  When you do this task, are there ways of working smart or accomplishing more with less—that you have found especially useful?

- **Opportunities/ Improvising** Experts are comfortable improvising—seeing what will work in this particular situation; they are able to shift directions to take advantage of opportunities.
  Can you think of an example when you have improvised in this task or noticed an opportunity to do something better?

- **Self Monitoring** Experts are aware of their performance; they check how they are doing and make adjustments. Experts notice when their performance is not what it should be (this could be due to stress, fatigue, high workload, etc.) and are able to adjust so that the job gets done.
  Can you think of a time when you realized that you would need to change the way you were performing in order to get the job done?

OPTIONAL PROBES:

- **Anomalies** Novices don't know what is typical, so they have a hard time identifying what is atypical. Experts can quickly spot unusual events and detect deviations. And, they are able to notice when something that ought to happen, doesn't.
  Can you describe an instance when you spotted a deviation from the norm, or knew something was amiss?

- **Equipment Difficulties** Equipment can sometimes mislead. Novices usually believe whatever the equipment tells them; they don't know when to be skeptical.
  Have there been times when the equipment pointed in one direction, but your own judgment told you to do something else? Or when you had to rely on experience to avoid being led astray by the equipment?

Figure 3: Knowledge auditing questions

WatchOuts

While the value of CTA methods is in the the elicitator's ability to 'get inside the head' of the expert, it takes time and practice to become a skilled knowledge elicitator. The CTA Institute is the premier source for training CTA methods that describe cognitive performance. But even beyond learning about the methods, all knowledge elicitors must practice the craft, preferably in circumstances that allow for coaching.

CTA comprises a set of retrospective interviewing techniques. It can sometimes be difficult for experts to recall and recount instances when they are many years removed from them. That said, it is also well known that expert performers tend to carry strong memories of their biggest successes and even their failures. They recall the failures so well because they have spend significant cognitive effort in figuring out how to avoid them in the future.

Stage 3. Organizing the captured expertise

Organizing expertise begins in Phase 1, as topics are identified. The approach for organizing which topics to pursue can be carried into Stage 3. As topics are covered during Stage 2, the artefacts from the interviews should be organized using the topics scheme devised in Phase 1; however, the initial scheme may also change as new topics are suggested or deemed unnecessary by the experts.

All knowledge capture sessions should be logged by date and time, according to the expert interviewed. But artefacts of knowledge capture should be organized based on the topic scheme and/or by expert.

Artefacts may include, but not be limited to:

- Interview recordings, transcripts, and additional notes,
- Digital artefacts and tools that experts share (e.g., documents, spreadsheet)
- Digital artefacts created during knowledge capture sesssions (e.g., diagrams, photos).

Decisions about organizing schemes, as well as the digital storage location(s) and formats, should be made as early as possible in the EM effort, and in accordance with any existing knowledge management schemes available in the organization.

Keep a running list of all topics that are covered over the interviews, so you can see the overlap across all the interviews.

WatchOuts

It may be important to respect and maintain the expert's confidentiality and anonymity regarding some of the content shared during knowledge capture. It may thus be necessary to scrub the content of identifiable names and positions to maintain expert confidentiality.

Phase 3: Engage

Knowledge Transfer refers to the process of introducing the EM products back into an organizations' knowledge sharing ecosystem, including the design and delivery of learning and training activities, development of reference resources, and enabling other personnel to engage with expertise.

EM products are intended to share what expertise looks like, specific knowledge of the organization and industry, and to help others understand what it means to be an expert and achieve expertise themselves.

The goals of Phase 3 are:

- Convert Phase 2 artifacts into documents and experiences, and
- Enable implementation in the organization.

Stage 1. Developing products

Knowledge transfer products can take many forms, depending on the:

- Nature of the shared expertise – e.g., stories and incidents; task guidance and tricks-of-the-trade; history and background knowledge,
- Envisioned implementation – e.g., reference material; learning/training content; workplace guidance,
- Intended users – e.g., current and/or future employees; instructional system designers and/or workforce development personnel.

Table 5 describes a variety of knowledge transfer products that may be developed from knowledge capture artifacts.

WatchOuts

Ideally, all knowledge transfer products should be reviewed by the experts who provided their expertise. All products should be marked as "Draft" until the experts are able to review the content. Their comments should be incorporated as appropriate. It is also important to expect that experts will vary in the degree to which they provide feedback. Some experts may not not want to spend the time reviewing the content. Other experts want to add or delete parts of the content that they think it misrepresents their perspective. Iterations will add more time to the product development process.

Decision Games	Decision Games place the learner in a particular role and ask them to make a decision, take an action, or prepare a product as if they are the expert. The games provide learners an opportunity to attempt to think like an expert in complex and uncertain circumstances. The learner receives feedback based on the expert's decisions in real life. There are several ways to implement Decision Games. They can be delivered in-person by a facilitator and/or an expert during training sessions or introduced as a self-serve activity to supplement training. Appendix B of this EM Final Report includes a Facilitator's Guide for Executing Decision Games.
Job Aids	Job aids provide an overview of a task or process with expert strategies and details to pay attention to. Job aids can be implemented into the organization in whatever format is most beneficial to them. For example, they can be put on employee's clipboards, laminated, and posted throughout physical workspaces, and/or introduced into training during onboarding.
Expert Content	Based on knowledge captured during the CTA interviews, expert content provides a deep dive into a given topic. They contain more information than a cursory review of a topic, particularly details that are not widely known within the organization. These details include history, technical knowledge, and things novices tend to miss. Organizations can deliver the expert content as stand-alone content or carve out particular pieces of the material to augment existing training.
Decision Requirements Tables	Decision Requirements Tables (DRTs) extract, organize, and analyze the key elements of expertise that were captured in the CTA interviews. DRTs make explicit the critical decisions and judgments, contexts, and other attendant cognitive elements that a person must perform to carry out a task. DRTs can be used as both an anlalitic and data collection technique. DRTs can augment existing training and sensitize learners to the cognitive elements required to perform particular tasks.
Stories	CTA interviews can capture stories about expert's experiences that were particularly challenging. Expert stories are effective for training real-life problems. Students learn about complex cases directly from the expert, giving them a sense of the cognitive skills required to perform effectively in difficult situations. The expert stories serve as the basis for the Decision Games; however, they can also augment existing training. Students are more likely to remember information when it is presented as a story and distributed throughout training sessions.
Knowledge models	Where knowledge capture makes use of Applied Concept Mapping (Moon et al., 2011), digital collections of concept maps that describe expertise – as well as any other digital artifacts – can be organized into knowledge models that organize and 'package' an entire corpus into a navigable and sharable resource. CmapTools, a freeware software package, offers extensive capabilities for creating knowledge models – see https://cmap.ihmc.us/

Step 2. Rollout

Look for opportunities to implement your products into organizations.
Have discussions with your partner organizations to understand their existing training programs. It is important to know what the organizations already utilize to determine how you can augment or create training content that fits their needs.
From there, adjust or remove content from the products depending on the training group.
Products can potentially be modified to best suit individual organizations.

Ask:

- What training currently exists?
- How could these products augment existing training?
- Where are opportunities to put these products?
- What types of training does the organization have coming up?
- Who will benefit most from these products?
- How can we tailor these products to organizations?

When implementing decision games specifically, consider a "train the trainer" approach. Walk through the decision games with the trainers to discuss why we do them, how we develop them, who might be using the decision games, and what the options are for facilitating the games. Ideally, have the trainers practice facilitating and co-facilitating the decision games. So long as the facilitators understand the content of the situation, they can provide feedback. It is also beneficial to include a Subject Matter Expert in the facilitation to provide their perspective.

WatchOuts

We wanted to see where these products might fit into organizations before fully creating the products; however, opportunities to demonstrate the products were more difficult to find than we initially thought. We had to walk a fine line to avoid overlapping what other training programs are already doing. We did not want to create products or training tools organizations already had or would not use. Although we received feedback that our products and tools would be useful, there was little effort to find opportunities to implement them. We wanted to work with our stakeholders to determine how to integrate our products with existing training, but it proved difficult to work with the trainers themselves and get in front of an actual training group.

Conclusion

A well-formulated and robust EM strategy that identifies, articulates, and provides strategies for engaging critical expertise requires careful and continuous planning and execution. The EM Framework provides the necessary steps to implement a successful EM strategy in the railroad industry. The approach and the stages outlined in this framework should encourage organizations to consider seriously where their expertise lies and how to keep it in their organization, especially as those experts approach retirement. Integrating an EM approach to preserve and disseminate critical expertise–before it is lost–should be a high priority across the railroad industry.

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Abbreviations and Acronyms

ACRONYM	DEFINITION
AAR	Association of American Railroads
ASLRRA	American Short Line and Regional Railroad Association
AVP	Acting Vice President
CDM	Critical Decision Method
CTA	Cognitive Task Analysis
DG	Decision Game
DRT	Decision Requirement Tables
EM	Expertise Management
KA	Knowledge Audit
L&D	Learning and Development
N	Number of Candidates
POC	Point of Contact
R&D	Research and Design
SME	Subject Matter Expert
SMS	Safety Management Systems
VP	Vice President