



THE EXPERTISE MANAGEMENT FRAMEWORK FOR RAILROAD SAFETY LEADERSHIP

SUMMARY

Due to shifting demographics and an aging employee population, certain rail safety leadership skills, including both technical and non-technical skills, are at risk of disappearing.

The sheer volume of railroad workforce turnover suggests that neither succession-planning nor workforce-promotion programs alone will adequately mitigate seniority knowledge loss. Recognizing this risk, the Federal Railroad Administration (FRA) Office of Research, Development, and Technology's Human Factors Division sponsored TrueSafety Evaluation and Perigeon Technologies to develop an Expertise Management (EM) framework for identifying, capturing, and transferring critical areas of expertise for safety leadership positions.

The EM Framework (see [Figure 1](#)) 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 to accelerate their own proficient performance. The EM Framework uses Cognitive Task Analysis (CTA), which previous FRA-sponsored initiatives have found valuable in eliciting expertise. CTA comprises three phases:

- 1) *Identify* refers to approaches for identifying expertise on which to focus the subsequent activities.
- 2) *Articulate* focuses on knowledge capture activities, especially CTA conducted by experienced knowledge elicitors working one-on-one with identified experts.
- 3) *Engage* covers activities that are intended to facilitate the acceleration of expertise in others, including sharing articulated expertise

through representations and learning exercises.

Beyond just methods and processes, the EM Framework also incorporates experience as guidance for the application of each of these elements in an organization.



Figure 1. The Expertise Management Framework

Knowledge managers, trainers, workforce development professionals, and anyone concerned about the loss of expertise in the railroad industry may use the EM Framework.

This project builds on previous FRA-sponsored CTA initiatives and methods by applying the EM Framework to safety critical railroad operations and strengthening organizational touchpoints with the rail industry.

BACKGROUND

FRA conducted a series of CTA tasks for safety critical positions and operations in the railroad industry, including dispatchers, roadway workers, locomotive engineers, teamwork communications, and technology applications (Roth, Rosehand, & Multer, 2013, 2020; Roth & Multer, 2007; Roth, Malsch, & Multer, 2001).

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.

Building on conceptual frameworks suggested by Klein (1992) and Ackerman et al. (2003), the term "Expertise Management" emphasizes the



importance of focusing knowledge management efforts on the most critical knowledge within an organization: expertise (Moon et al., 2015). Of particular value for EM is the Critical Decision Method (Hoffman et al., 1998). The EM approach builds on the basic goals of knowledge management (i.e., identifying, capturing, evaluating, retrieving, and sharing an organization's information assets).

OBJECTIVES

In this project, the goal was to mitigate the risks of knowledge loss in railroad safety leadership positions by (a) establishing the EM Framework, and (b) demonstrating the use of the EM Framework for safety expertise management at railroads.

METHODS

The EM Framework uses CTA in three phases to provide a structured process for identifying at-risk knowledge. EM 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. 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.

RESULTS

The team produced the EM Framework, which is presented in detail below.

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.

Phase 1 core goals are (a) identify key stakeholders to coordinate buy-in for EM activities, (b) identify, prioritize, and select experts to target for follow-on activities, (c) identify the expertise most critical and most at-risk of loss for that position, and (d) establish conditions for success.

Stage 1: Setting the groundwork with stakeholders. No EM program can succeed without the support of the organization, in particular from key stakeholders, including leadership at all levels. An organization should establish a steering committee of stakeholders whose roles are explicitly invested in the loss of expertise, including labor leaders.

Stage 2: Communicating the EM program. In parallel with Stages 1 and 3, the organization should be made aware of the program's purposes, and the experts who will share their expertise must be carefully introduced to their role.

Stage 3: Identify Experts. With stakeholders engaged, the experts who will be the focus of the EM program should be identified. Application of EM should primarily focus on proficient performers.

Phase 2: Articulate – The purpose of knowledge capture is to use CTA methods to capture and articulate how problems are individually mentally formulated and understood, critical decision paths, and core information sources used by senior leaders for safety critical decisions. This helps identify and guide potential product development that can be infused back into the organization. Phase 2 goals are (a) articulate aspects of expertise, and (b) organize captured knowledge.

Stage 1: Preparing for capture. After identifying and confirming the experts who will participate in the EM project, EM interviews are conducted.

Stage 2: Methods of capture. Use CTA methods to help experts articulate their expertise.

Stage 3: Organizing the captured expertise. Organizing expertise begins as topics are identified in Phase 1, and the approach for organizing which topics to pursue can be carried into Stage 3. During knowledge capture in Stage 2, organize interview data using the topics scheme devised in Phase 1. The initial scheme may change as new topics are suggested or existing topics deemed unnecessary by the experts.



Phase 3: Engage – Knowledge transfer refers to the process of introducing the EM products back into an organizations’ training environment, 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, share specific knowledge of the organization and industry, and help others understand what it means to be an expert and achieve expertise themselves.

The goals of Phase 3 are (a) convert Phase 2 data into documents and experiences, and (b) integrate these knowledge transfer products into the organization.

Stage 1: Developing products. Knowledge transfer products can take many forms, depending upon the following:

- 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)

Stage 2: Rollout Strategies. Approaches to integrating EM products into organizations include:

- Incorporate EM products into existing formats/delivery methods
- Display job aids on bulletin boards, in handbooks, and throughout workspaces
- Facilitate Decision Games (DGs) with an expert facilitator, with options to:
 - Deliver the content
 - 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

CONCLUSIONS

Applying the EM Framework to the domain of rail operations can help mitigate critical expertise loss and strengthen highly skilled areas of technical expertise, such as in derailments, track reconfiguration and construction, on-board mechanics, diagnosing and troubleshooting locomotive repair, and train-track interactions. The EM Framework also can help strengthen non-technical safety leadership expertise, including foundational impact skills, abilities, and competencies related to social and emotional intelligence (e.g., self-awareness, relationship and team building, systems awareness, and community and industry relations) considered essential for building strong organizational impacts (Coplen & Moon, 2023).

The EM Framework is a guide for getting serious about managing expertise. Full implementation of any EM program will require the use of other organizational development tools (e.g., change management), and the development of professionals who are responsible for the overall EM program and its integration into the organization.

FUTURE ACTION

Organizations and individuals may engage in other activities intended to promote the EM Framework, such as:

- EM workshops to the railroad industry-at-large that bring industry experts and trainers together to discuss the nature of expertise, the role of emotional intelligence in safety leadership positions, and to experience the EM DGs.
- The EM Final Report including links to the full EM Framework and the available EM products immediately available.
- EM webinars and demonstrations to specific railroads or railroad associations.



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