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Evaluating Processes, Outcomes, and Sustainability for FRA's Confidential Close Call Reporting System (C^3RS)

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14. ABSTRACT
The Federal Railroad Administration (FRA) tasked the Volpe National Transportation Systems Center (Volpe) to conduct an evaluation of the Confidential Close Call Reporting System (C3RS) implementation processes, sustainability, and safety outcomes. The research team assessed program effectiveness and suggested modifications to sustain and institutionalize the program. The team conducted the evaluation between September 2022 and June 2024 using a mixed-methods approach that included focus group discussions, workshop activities, and web surveys to obtain qualitative data from a cross-section of stakeholders. To assess outcomes, researchers reviewed corrective action (CA) documentation provided by railroads, FRA's publicly available accident/incident data, and quantitative data related to report intake and safety-related communication from a trusted third party responsible for processing event reports, the National Aeronautics and Space Administration (NASA).

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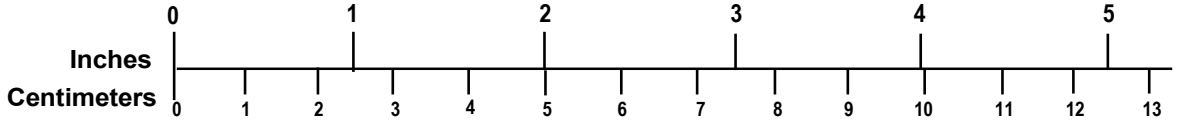

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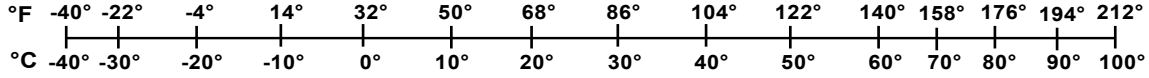

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Executive Summary

The Federal Railroad Administration (FRA) tasked the Volpe National Transportation Systems Center (Volpe) to conduct an evaluation of the Confidential Close Call Reporting System (C^3RS) implementation processes, sustainability, and safety outcomes. The research team assessed program effectiveness and suggested modifications to sustain and institutionalize the program.

The team conducted the evaluation between September 2022 and June 2024 using a mixed-methods approach that included focus group discussions, workshop activities, and web surveys to obtain qualitative data from a cross-section of stakeholders. To assess outcomes, researchers reviewed corrective action (CA) documentation provided by railroads, FRA's publicly available accident/incident data, and quantitative data related to report intake and safety-related communication from a trusted third party responsible for processing event reports, the National Aeronautics and Space Administration (NASA).

Process Evaluation: Strengths of the C^3RS implementation process include FRA's training support to peer review teams (PRT); prior improvements to the Multiple Cause Incident Analysis (MCIA) tool; and NASA's work to maintain reporter anonymity and confidentiality, reduce barriers to reporting, and improve report processing. FRA and NASA support for education and outreach activities also was seen as a strength of the pre-implementation phase. Many of these processes benefited from improvements made by FRA and NASA after soliciting and responding to user feedback.

Weaknesses identified across implementation phases include ambiguity in the implementing memorandum of understanding (IMOU) agreements; PRT makeup and succession planning; gaps in rollout and training; reporter confidentiality at smaller railroads; lack of detail in event reports; prolonged report processing times and callback response rate; PRT challenges with event analysis; and challenges implementing, documenting, and tracking CAs. The team found that stakeholders have acted, or are in the process of acting, to address many of these weaknesses. Researchers also documented the adverse impact of the COVID-19 pandemic on C^3RS activities.

Outcome Evaluation: Using a safety barrier taxonomy, the research team categorized CAs provided by railroads and analyzed the frequency of implementation in each category. Results indicate that 43.5 percent of CAs are administrative/organizational, 27.2 percent are symbolic, 15.5 percent are engineering, and 13.8 percent are behavioral.

A passenger railroad in the northeast, Metropolitan Transportation Authority (MTA)'s Metro-North Railroad, implemented several good practices that the team identified as playing an important role in growing and sustaining a successful C^3RS program. These practices include the creation of a dedicated position to manage C^3RS activities, enhanced data collection and analysis methods using a Microsoft Power BI dashboard, and strategic outreach and education efforts.

Sustainability Findings: FRA conducted outreach and engagement to inform potential participating railroads about the value of C^3RS and adapted C^3RS to meet stakeholder needs. Railroads have made efforts to increase communication, document C^3RS activities and use C^3RS data to inform safety. Remaining barriers to C^3RS sustainability include a lack of ownership and accountability from railroad managers, and resource constraints and staff turnover within the railroads.

Institutionalization Recommendations: Institutionalizing the C^{3}RS program will require more involvement from railroad management during the post-implementation phase, paired with less involvement from FRA's C^{3}RS implementation team.

The research team suggests railroads move toward imbedding C^{3}RS within their safety management practices. Hiring a dedicated C^{3}RS employee to take ownership of the program could ease the burden on the PRT for activities such as outreach, training, and sharing C^{3}RS successes. An internet portal for employees could also support resource and data sharing.

FRA should continue to streamline its implementation processes where possible, provide standalone resources to railroads to support training and outreach, and leverage the PRT to act as a conduit between railroad management and the C^{3}RS implementation team. PRT members can support a railroad's team as needed, while providing feedback to the C^{3}RS implementation team on the organization's successes and challenges. FRA should continue to model continuous process improvements and experiment with ways to adapt the C^{3}RS model to fit stakeholder needs. Researchers suggest exploring the Federal Aviation Administration (FAA)'s Aviation Safety Analysis Program (ASAP) as a model for future improvements.

1. Introduction

The Federal Railroad Administration (FRA) tasked the Volpe National Transportation Systems Center (Volpe) to conduct an evaluation of the Confidential Close Call Reporting System (C^3RS). The evaluation documents strengths and weaknesses of the C^3RS implementation process, safety-related outcomes, and barriers to sustainability. The report concludes with stakeholder considerations for sustaining and institutionalizing the program.

1.1 Background

C^3RS is an FRA-funded, voluntary, confidential reporting program that enables employees to report "close call"[1] events anonymously (NASA, 2024a). C^3RS allows railroads to learn about unsafe conditions that could potentially result in more serious consequences. In many cases, these close call events would otherwise go unreported.

The goals of the program are listed below.

- Provide an environment in which railroad employees can voluntarily and confidentially report close calls without fear of discipline or punishment.
- Analyze close calls to identify trends, new sources of risk, and corrective actions (CA) to address them.
- Track the impact of CAs to measure safety outcomes.
- Distribute reports on trends and other information to participating parties.

Following an influx of railroad participation to the C^3RS program (Figure 1), FRA's Safety Partnership Division (SPD) within the Office of Railroad Safety (RRS) initiated this evaluation in 2021 to assess the current state of program effectiveness and understand what modifications could be made to sustain, improve, grow, and institutionalize the program.

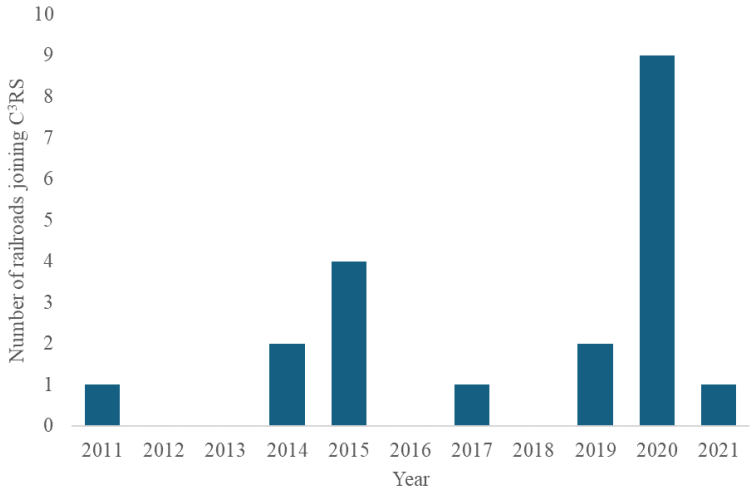

Figure 1. Number of railroads that implemented C^3RS by year (2011-2021)

[1] Close calls are defined as potentially unsafe events or conditions.

Although the primary audience for this evaluation is FRA's SPD, the National Aeronautics and Space Administration (NASA) C^{3}RS team, C^{3}RS-participating railroads, and labor unions may also benefit from many of the findings and recommendations identified in this evaluation.

1.2 Objectives

The evaluation questions (EQs) that guided this work are shown in Table 1.

Table 1. Evaluation focus areas and evaluation questions

Focus Area	Evaluation Questions
Process	1. What are the strengths and weaknesses in the C^{3}RS pre- and post-implementation phases from the end-user perspective?
Outcomes	2. To what extent has the C^{3}RS program improved safety at participating railroads? 3. How has the C^{3}RS program influenced participating railroads' safety-related processes, actions, or communication/teamwork/collaborative work?
Sustainability	4. What are the barriers to sustaining the C^{3}RS program, and what modifications are needed to sustain and grow the program? 5. How can C^{3}RS be institutionalized at railroads and within FRA?

The research team worked with FRA stakeholders in SPD and the Human Factors division of FRA's Office of Research, Development, & Technology (RDT) to determine the evaluation objectives.[2]

1.3 Overall Approach

The research team employed a mixed-methods approach for the evaluation that included the following:

- Focus groups and interviews with C^{3}RS stakeholders
- Virtual workshops
- Web surveys
- Corrective action coding and analysis
- Case study methodology
- Document findings
- Recommendations

1.4 Scope

The team conducted the evaluation between September 2022 and June 2024. The evaluation process included focus group discussions, workshop activities, and web surveys to obtain qualitative data from a cross-section of stakeholders. To assess outcomes, the team received CA documentation provided to FRA by railroads, as well as an analysis of FRA's publicly available

[2] The EQs originally included in the draft evaluation design plan (Volpe Center, 2022) were streamlined for clarity and the framing of this report (see Appendix A).

accident/incident data. Researchers also obtained quantitative data related to NASA close call event report intake and NASA safety-related communications, although the team did not have access to the reports as directly submitted to NASA.

1.5 Organization of the Report

Section 2 presents the evaluation methodology. Section 3 discusses evaluation findings by focus area (i.e., process, outcomes, and sustainability). Section 4 presents concluding remarks.

2. Methods

The research team conducted planning activities including stakeholder interviews, logic model development, and a literature review. Evaluation activities included focus groups, workshops, web surveys, and quantitative and qualitative data review and analysis.

2.1 Planning Activities

2.1.1 Stakeholder Interviews

The team interviewed stakeholders in FRA's RRS and RDT to identify evaluation goals and priorities.

2.1.2 Logic Model Development

The team developed a logic model[3] (Table 2) as a framework for the evaluation, and referred to the logic model when developing focus group question sets.

The *input, activity,* and *output* components of the logic model guided how the team approached the process EQ. The inputs describe the resources needed to support the activities that take place in C^{3}RS, and the outputs represent what the activities produce. The process evaluation assesses the degree to which the program includes the inputs needed to conduct the activities and produces the outputs described in the logic model.

Short- and long-term outcomes guided how the team approached the outcome EQs. Researchers developed questions to assess C^{3}RS outcomes and sustainability based on these short- and long-term outcomes.

The team made the following assumptions when constructing the logic model as an evaluation framework:

- Sharing event data with a third party/data trust gives stakeholders access to anonymous safety-sensitive data they would otherwise not receive.
- Railroad operations are increasing in complexity and involve interdependencies among stakeholders and technology.
- Stakeholder collaboration is helpful for solving complex safety concerns.

[3] Logic models visually depict program processes (inputs, activities, and output components) and desired outcomes. For more information about logic models and how they are used in program evaluation, refer to the Centers for Disease Control and Prevention Evaluation Guide.

Table 2. C³RS logic model

Input	Activity	Output	Short-Term Outcomes	Long-Term Outcomes
• Funding • FRA regulatory waivers • Railroad partners • Trusted third party • FRA staff • Governance structure (Implementing Memorandum of Understanding [IMOU]) • IT infrastructure • Event analysis tool • Marketing & education materials	• Market C³RS: Identify and invite railroad partners to participate • Educate stakeholders on program value • Adapt and implement IMOU • Employees submit reports to trusted party • Process reports and share with railroads • Analyze data for selected study topics • Perform event analysis • Identify and implement corrective actions • Track corrective action impact • Communicate lessons learned	• Railroad partners identified and invited to participate • Stakeholders educated on program value • IMOUs adapted and implemented • # Reports submitted • # Reports processed and shared • # Safety alerts • # Carrier heads up • # Events analyzed • # Corrective actions implemented • Safety outcomes tracked • Lessons learned shared	• Reporting increases • Identify emerging safety risks earlier in time • Identify solutions that address symptoms	• Railroads focus more on systemic factors and institutionalize learning from mistakes • Railroads apply less discipline to employees • Stakeholders mitigate safety challenges that were previously unsolved • Accident rate improves • Communication improves across organizational units

2.1.3 Literature Review

The research team conducted a review of existing evaluation literature, including an earlier evaluation of the C³RS pilot demonstration (Ranney, Davey, Morell, Zuschlag, & Kidda, 2019) and similar voluntary reporting programs in other industries. The literature review focused on barriers to voluntary reporting, best practices for event review committees, and the relationship between voluntary reporting and accidents in transportation. The team noted key findings of each report, taking note of highlighted best practices, common barriers and efforts to neutralize them, and other notable outcomes. Findings from the literature review supported recommendations and considerations for program improvement and sustainability detailed in Section 3.3.

2.2 Evaluation Activities

2.2.1 Peer Review Team and Support Team Focus Groups

The research team conducted virtual and in-person focus groups with five railroads that participate in C^{3}RS. For railroads that had both a PRT and a support team (ST), the team conducted focus groups with each group separately. Three of the five railroads that participated in focus groups did not have a separate ST, opting to include a senior-level manager on the PRT instead (this practice is typical at smaller railroads).

Researchers also conducted a one-hour focus group at the 2022 C^{3}RS annual user group meeting held in Scranton, PA. This conference brought C^{3}RS stakeholders together to discuss challenges and lessons learned. Focus group participation was open to all railroad representatives at the conference, but only PRT and ST representatives from passenger railroads opted to participate.

The team used focus groups to obtain feedback about C^{3}RS processes and outcomes from end-users. Table 3 includes a breakdown of the focus groups.

Table 3. Focus group participation

Entity	Format	Service Type	PRT	ST
Railroad 1	In-person	Passenger	✓	✓
Railroad 2	Virtual	Passenger	✓	✓
Railroad 3	Virtual	Passenger	✓	-
Railroad 4	Virtual	Passenger	✓	-
Railroad 5	Virtual	Freight	✓	-
Annual user group meeting	In-person	Passenger	✓	✓

2.2.2 Trusted Third Party Focus Group

The team also conducted a virtual focus group with NASA, a C^{3}RS trusted third party. This focus group session included questions about the event report form and submission methods, report processing, data analysis, training, and reporting activities.

2.2.3 Focus group data analysis

Upon focus group completion, the Volpe team coded the qualitative data by theme to facilitate report writing. Themes were organized according to evaluation focus area: process, outcomes, and sustainability. Within each theme, the data were further coded by phase (e.g., pre-implementation or post-implementation) and activity, safety outcome type, or subject.

2.2.4 Virtual Workshops

The research team held two virtual workshops with labor, industry, and FRA stakeholders during the summer of 2023 to solicit stakeholder feedback about C^{3}RS, generate ideas to improve the program, and share successes.

The first workshop took place in June and was attended by PRTs and STs from C^{3}RS participating railroads, FRA PRTs, and the NASA C^{3}RS team. The second workshop took place in August with FRA's C^{3}RS implementation team. The team conducted these workshops to allow the groups to speak candidly about their perspectives.

Researchers took a similar approach in both workshops by serving as facilitators and asking breakout groups of participants to prioritize challenges, causal factors, and solutions across the four stages of the C^{3}RS post-implementation process:

Stage 1: Event submission and processing

Stage 2: Event analysis

Stage 3: Corrective action process, implementation, and impact

Stage 4: Communication, outreach, and sustainability

A table with synthesized output from both workshops is included in Appendix B.

2.2.5 Web Surveys

The team designed two online data collection instruments to obtain data from samples of employees and managers working in C^{3}RS-participating crafts. Researchers used these voluntary and anonymous surveys to capture similar data from employees and managers regarding their experiences with C^{3}RS.

Ten railroads agreed to participate in the survey. SPD facilitated initial email outreach to railroad PRTs using the name recognition of the C^{3}RS implementation team to bolster participation. Once a railroad agreed to participate, the research team handled all remaining contact. Within their respective organizations, PRT contacts assisted with participant recruitment to employees and managers, using outreach materials prepared by the research team. Contacts worked closely with the team to distribute tailored participation requests and survey data collection links to the relevant management and employee groups within their respective organizations. The team used this strategy because only the railroads themselves have access to employee email addresses, and to leverage the familiarity and name recognition of the respective PRT leaders to mitigate potential non-responsiveness (Newcomer & Triplett, 2015).

Researchers designed the survey instruments to take no more than five minutes to complete. Each version included 12 items specific to C^{3}RS and 3 non-identifying demographic questions. The team collected responses for at least 14 days across all railroads.

2.2.6 Corrective Action Taxonomy

The research team analyzed a March 2024 FRA-compiled list of close call reports and associated CAs taken by participating railroads in response to reported C^{3}RS events. This list contains written descriptions of close calls and CAs and was voluntarily provided by participating railroads' PRTs.

To categorize the list of CAs, researchers adapted Hollnagel's "safety barrier taxonomy" (Hollnagel, 2004). Table 4 shows the adapted safety barrier taxonomy and example CAs. Using the adapted taxonomy, the team assigned safety barrier categories across 232 CAs (four entries could not be coded, as it was unclear how the information presented could be considered a CA). Coders assigned a secondary code when more than one category applied to the CA.

Table 4. Adapted safety barrier taxonomy and example CAs

Safety Barrier Code	Example CAs
Administrative/Organizational	Operating procedures/practices/rules, training, supervision, norms, coordination
Behavioral	Wear personal protective equipment, use proper tools, stop work, use proper procedures, job safety briefing
Engineering	Safer design of process (hardware/software) technology (interlocking, gates, lights, software and hardware (e.g., positive train control), sensors, physical barriers (e.g., tank car wall)
Symbolic	Signs, job aids, communications, paperwork, digital displays

2.2.7 FRA Safety Data

FRA RRS provided an analysis of existing, public FRA safety data to present accident/incident data over time, as well as access to the data through a MS PowerBI dashboard. The FRA data compared accident/incident rates for railroads participating in C^{3}RS versus non-participating railroads.

2.2.8 Illustrative Case Study

The team used the U.S. Government Accountability Office's (GAO, 1990) methodology to provide an illustrative case study example to highlight key aspects of a successful implementation of C^{3}RS at Metro-North Railroad (MNR). The team collected data for the case study through an in-person visit to the railroad and a follow-up, unstructured interview. The case study is presented in Section 3.2.3 and provides useful good practices for other railroads to consider based on the various process improvements implemented by MNR.

2.3 Study Limitations

It was not possible to conduct focus groups with each railroad that participates in the C^{3}RS program due to resource constraints and time limitations. The research team reached out to a sample of railroads that was intended to be representative of the number of passenger and freight railroads participating in C^{3}RS at that time. However, the number of freight railroads that accepted the invitation were fewer than the number requested.

There were limitations to measuring program outcomes quantitatively at the organizational level. These limitations stem from the informal processes used by most participating railroads for collecting, tracking, and analyzing C^{3}RS report data and CAs. As such, the team focused its efforts on analyzing and synthesizing available qualitative data.

Finally, C^{3}RS continued to evolve while the study took place. The number of participating railroads expanded, while some participating railroads withdrew from C^{3}RS during the study period. FRA continued to introduce new efforts devoted to addressing railroads' concerns. Some of these efforts addressed issues identified in the study.

3. Findings

This section presents evaluation findings related to the C^{3}RS implementation process, outcomes, and sustainability. Some findings overlap between these three areas, so findings may be discussed in more than one section.

Throughout this section, the team offers stakeholder considerations for improving processes and facilitating sustainability and institutionalization. These considerations are synthesized and included as a table in Appendix F.

3.1 Process

The objective of the process evaluation was to identify strengths and weaknesses of C^{3}RS implementation activities from the perspective of end-users (i.e., PRTs, STs, and railroad employees).

Strengths and weaknesses described below stem from analyzed data from focus groups, workshop discussions with end-users, and researcher observations.

3.1.1 Overview

Pre- and post-implementation activities are shown in Figure 2. Pre-implementation activities are consecutive, single-session activities jointly conducted by FRA, railroad management, and labor. Post-implementation activities are continuous and are primarily led by the railroads themselves with support from SPD. Report processing is solely conducted by NASA.

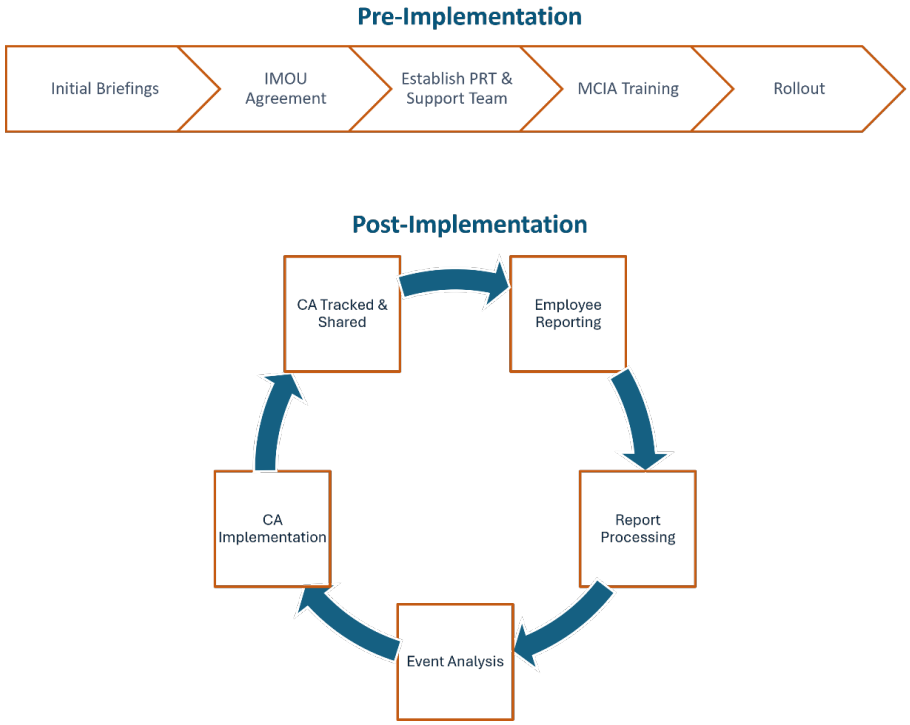

Figure 2. C^{3}RS pre- and post-implementation activities

Observations below provide context for the strengths and weaknesses described in Section 3.1.2 and Section 3.1.3, respectively.

Strengths and weaknesses identified in this evaluation may not apply equally across railroads. Management's attitudes or buy-in toward the program, resources available, crafts participating, railroad size, and how long the program has been implemented at the railroad are all factors that may affect the program.

Users provided more feedback about the post-implementation phase than the pre-implementation phase. This is likely because post-implementation activities are ongoing, whereas pre-implementation activities are typically one-time events. Where staff turnover had occurred since the program's inception, there was no one available to share firsthand experiences with pre-implementation activities.

This evaluation was conducted in the years immediately following the COVID-19 pandemic. The effects of the pandemic on pre- and post-implementation activities may be partly responsible for the weaknesses that users described, particularly as many railroads joined the program in 2020. The impact of COVID-19 is described in detail in Section 3.1.4 as a factor that exacerbated existing weaknesses.

3.1.2 Strengths

Strengths of the implementation process are based on stakeholder feedback solicited by SPD and NASA, both during and prior to this evaluation. This theme is discussed more broadly in Section 3.3.

Improvements initiated during this evaluation are in various stages of completion. Only improvements that are *complete* are described as strengths in the sections below. For a comprehensive list of SPD and NASA initiated improvements, see Appendix C and Appendix D, respectively.

In some cases, railroads have initiated improvements to their program processes. These improvements are not considered strengths of implementation activities, but rather safety outcomes that have come about because of C^{3}RS implementation activities. These improvements are described in Section 3.2.

3.1.2.1 Pre-implementation Strengths

This section documents strengths of the pre-implementation phase as described by end-users and observed by the research team.

3.1.2.1.1 Training Support to PRTs (SPD)

Railroad PRTs and STs expressed high levels of satisfaction with the support that the C^{3}RS implementation team provides during pre-implementation activities. PRT members indicated that SPD provided "great" and "thorough" training on the Multiple Cause Incident Analysis (MCIA) event analysis process and the MCIA tool. PRT members appreciated that SPD spent several days working through the MCIA process and agreed that the updated training where SPD works through an example event report using the MCIA tool was particularly helpful.

Despite indicating high levels of satisfaction with SPD's training support, PRTs noted weaknesses in the MCIA event analysis process and software. However, since the MCIA software has since been revamped, it is therefore described as a strength in this report.

3.1.2.1.2 Improvements to the MCIA Software (SPD)

SPD has made significant updates to the MCIA software tool in response to user feedback. The updated tool, rolled out in March 2024, addresses each of the weaknesses that PRTs described:

- **Ability to upload report files directly into the tool.** Previously, the scribe was responsible for manually entering report data into the tool. The updated tool increases efficiency by letting the PRT upload case files directly into the tool. This step frees up scribes' time, allowing them to work on event analysis instead of handling the data during meetings.
- **Ability to 'tag' cases to enable searches for similar events.** Tags give the PRT a quick and easy way to look for trends among cases. Tagging can also provide a PRT with an easy way to review whether a CA was already implemented for a similar event.
- **Corrective action planning, tracking, and sharing.** The updated tool supports PRTs in planning, tracking, and sharing CAs identified during the MCIA process.
    - *Planning.* The tool guides the PRT to consider the party responsible for implementation, which stakeholders are involved, and the due date for implementing the CA.
    - *Tracking.* The tool allows the PRT to track the number and type of CAs they recommend, and the status of each CA. PRTs can set CA status to *draft, rejected, on hold, approved, implemented,* or *no action taken.*
    - *Sharing CAs with SPD.* PRTs can share CAs with SPD from within the tool.
- **Reports page to support PRT newsletters.** The "reports page" supports the PRT in visualizing overview information about event reports and contributing factors that can be used in PRT newsletters and C^{3}RS report-outs. For example, using the reports page the PRT can access data such as the number of cases over time, cases by status (analyzed, under review, not analyzed), tags (described above), and contributing factor information using the Human Factors Analysis and Classification System (HFACS).

  Additional improvements to consider:

    - SPD: Consider additional ways that the MCIA software can support PRTs in trend analysis (e.g., to observe patterns of information from close call reports). One example would be to map events to a track chart so PRTs can look for patterns by location.[4]
    - SPD: Consider whether the MCIA tool can support PRT sharing of the CA implementation planning information page to the ST, in the same way it supports sharing of implemented CAs with SPD.

[4] While the Reports menu may support this recommendation, implementation may depend upon the skill of the MCIA user to create charts that the software does not currently support.

3.1.2.2 Post-implementation Strengths

This section documents strengths of the post-implementation phase as described by participating stakeholders.

3.1.2.2.1 Rigorous Processes to Protect Confidentiality and Anonymity (NASA)

NASA takes extensive measures to maintain the confidentiality and anonymity of reporters and railroads through their de-identification, cybersecurity, and data protection efforts. Employees at railroads using the C^{3}RS program indicated high levels of trust in the confidentiality of the reporting process.

NASA also invested in improvements to their information technology security between 2020 and 2023, increasing cybersecurity and data protection by making upgrades to PRT portals, servers, and systems.

NASA's commitment to confidentiality and anonymity may make it difficult to improve ease of reporting, report tracking, and callback response due to data security related concerns (discussed in Section 3.1.3). Improvements or investments in data security measures may enable these options in the future.

3.1.2.2.2 Reducing Barriers to Reporting (NASA)

NASA conducted a telephone survey with C^{3}RS reporters in 2019 to understand potential barriers to reporting. Results from the survey led to the following improvements:

- **Mobile-responsive forms.** Mobile-responsive forms are formatted for easy and efficient completion on a mobile device, and became available in April 2023. Using mobile phones for reporting enables employees to promptly submit reports after experiencing an event. Previously, the C^{3}RS reporting form was accessible via a browser but was not formatted for use on a mobile device, making it more difficult for reporters seeking to submit from their mobile phones.
- **Mandatory fields.** Reports were modified from "free form" fields to making certain fields mandatory.
- **Clarifying reporting fields, adding drop downs.** NASA updated the "carrier" field to read "railroad carrier" after noticing that reporters would incorrectly provide their phone carriers in this field. NASA also engaged in ongoing work to clarify reporting fields and streamline the reporting process using drop-down boxes with multiple choices.
- **Clearer Guidance.** NASA added text providing guidance for filling out the narrative section to support a more detailed narrative.

3.1.2.2.3 Improvements to Report Processing (NASA)

NASA made the following improvements in response to PRT feedback:

- **Report legend**. NASA now provides PRTs with a legend alongside each event report. The legend allows the PRT to identify certain fields that NASA has de-identified to ensure confidentiality. These fields are primarily related to track location information. This process maintains the confidentiality and anonymity of the reporter and railroad

when the report is submitted to NASA's publicly available C^{3}RS report database query tool (DBQT) but allows PRTs to obtain additional detail about the event.

- **Reduced hold times.** In 2024, NASA modified its report processing timeline to reduce hold times for matching, callback response, and follow-up letter response times.
- **Cellphones to support callback response.** NASA continues to improve the callback response rate by providing analysts with cell phones to mitigate callback response issues that arise from NASA analyst/reporter scheduling incompatibility (discussed more thoroughly in Section 3.1.3).
- **Carrier heads up.** NASA implemented a process called the "carrier heads up" (CHU) to notify individual railroads of safety critical events. If a NASA analyst determines the event to be time sensitive, NASA will provide the PRT with a heads up about the event. This process helps railroads respond to time-sensitive events more quickly.

  Users reported two caveats regarding this process: (1) there is still a delay between when the incident occurs and when NASA conducts the CHU, and (2) NASA's decisions regarding which incidents warrant a heads up are subjective. NASA does not solicit information about railroads' specific safety concerns to inform this process.

  Additional improvements to consider:

  - NASA: Provide railroads with an opportunity to identify specific concerns or event types (e.g., grade crossing activation failures) for which they would like to be given a CHU.
  - NASA: Consider whether artificial intelligence (AI) can be used to scan reports immediately for potentially time-sensitive information (e.g., by referencing a list of keywords provided by individual railroads).

3.1.2.2.4 C3RS Education and Outreach Support (SPD, NASA)

The research team documented examples of SPD and NASA providing additional education and outreach support to PRTs during post-implementation, called "refresher training." Refresher training is often requested due to turnover and/or decreased reporting levels.

SPD provides additional MCIA training to PRTs on an as-needed basis. PRTs usually request additional training when turnover occurs and newly appointed PRT members have not received on-the-job training for their new role or were not mentored by the outgoing PRT member. This refresher training is typically conducted on-site at the railroad. PRTs have also requested support from SPD to conduct a "re-rollout" or new round of outreach to invigorate the program. PRTs typically request this when reporting numbers decrease, or after considerable new hiring occurs. PRTs and NASA indicated that employee reporting increases after re-rollout activities.

NASA supports PRTs by creating outreach materials to facilitate employee education about C^{3}RS[5]. NASA dedicated a quarterly newsletter to educating employees about providing detailed reports called *Tips for Excellent Reporting* (see Section 3.2.2 for more information). NASA also

[5] At the time this report was published, NASA was in the process of creating a narrated video for employees on how to submit a report.

produced two brochures to support employee education: a C^{3}RS brochure to educate employees about the program and a brochure about the ID strips NASA provides reporters to track report submission. NASA also provides PRTs with magnets and website cards that can be handed out to employees during awareness campaigns.

3.1.3 Weaknesses

This section describes the weaknesses associated with pre-implementation and post-implementation phases from the end-users' perspective. Where a weakness has been positively affected by researcher-observed or documented stakeholder improvements, the improvements are noted as *actions taken to address this weakness*.

3.1.3.1 Pre-implementation Weaknesses

This section documents weaknesses of the pre-implementation phase as described by participating stakeholders.

3.1.3.1.1 IMOU Agreement May Be Ambiguous or Outdated

Implementing Memorandum of Understanding (IMOU) agreements can cause confusion among labor and management when the language is ambiguous or when agreements have not been updated with changing railroad processes and technologies. As an example, the introduction of positive train control (PTC) early in the program meant that previously unknown speeding events became known events. This necessitated revisions to the IMOU so the PRT and ST can apply the program consistently to these events.

Confusion about IMOU agreement language surrounding "event eligibility" can create situations where employees submit reports for events that they believe are C^{3}RS-eligible, but then face discipline when the PRT determines that they are not covered. These incidents cause the program to lose credibility and weaken employee trust, resulting in fewer reports and/or reports that are vague in detail because reporters withhold information that may identify them in situations where the report is not eligible for C^{3}RS protection from discipline.

Actions taken to address this weakness: SPD provided ad-hoc support to railroads by answering questions related to the IMOU on a 24/7 basis. PRTs expressed satisfaction with the support provided by SPD for this issue. However, this may not be sustainable as more railroads join the program, each with different IMOU agreements, while SPD resources remain the same.

SPD has sought to standardize IMOU agreements across the industry to avoid confusion and to relieve the administrative burden surrounding the agreement process. Railroads have expressed opposition to this potential solution, indicating a desire to have more control over their own IMOU agreements through individual railroad negotiations.

Improvements to consider:

- Railroads, Labor: Increase training about which close call events are and are not covered under the C^{3}RS program.
- SPD, Railroads, Labor: Work together to understand sources of ambiguity and address them. When possible, standardize IMOU agreements for consistency across railroads.

- SPD, Railroads, Labor: As new technologies are implemented there may be fewer "unknown" events reported. Work together proactively to determine whether an amendment to the IMOU should be made to prevent confusion about which types of events are eligible for C^{3}RS protection.
- Labor: Encourage employees to report and provide as much detail as possible to facilitate understanding of the causal factors and development of effective corrective actions.
- Labor, Railroads: Reiterate that C^{3}RS is not a program for avoiding discipline. It is designed to report any and all safety concerns, not just those involving compliance with operating rules and regulations.

3.1.3.1.2 PRT Makeup

PRT makeup varies by railroad but is typically comprised of mostly labor employees (including union elected officials), management, and FRA inspectors.

Some railroad managers expressed concern regarding a possible overrepresentation of labor, which can lead to conflicts of interest. If labor PRT representatives place a disproportionate focus on protecting employees and not on identifying and implementing CAs, management may perceive the program as being a "get out of jail free card."

Others noted that management may focus blame on the employee during event analysis, rather than use it as an opportunity to uncover systemic factors that underlie the event.

Improvements to consider:

- SPD, Railroads, Labor: Develop best practices for defining how to select PRT members and consider including these best practices in the PRT handbook. The process should include stipulations for obtaining input from management, labor, and FRA, and consider possible conflicts of interest and potential turnover that may result from selecting PRT members with seniority who may be close to retirement or expect to participate on the PRT only for a short period. For example, rather than using the PRT as a patronage system for union elected officials or employees with seniority, stakeholders should consider selecting PRT members based on skills and/or personality traits (e.g., communicating clearly, likely to actively participate in event analysis and outreach, etc.).

3.1.3.1.3 PRT Succession Planning

When turnover occurs, the process manager, facilitator, and scribe are responsible for providing new PRT members with training per the C^{3}RS handbook. Findings suggest that this process is not often followed. Instead, PRTs indicated that turnover occurred before alternates were trained, resulting in inefficient and ineffective MCIA event analysis. PRT resource constraints (i.e., the time that PRT members are allotted to work on C^{3}RS activities) likely play a role in whether the handbook-documented successor training process occurs. As a result, railroads turned to SPD to train new members. This puts a strain on SPD's limited resources.

Actions taken to address this weakness: SPD is working to create training videos for the MCIA tool that can be used by PRTs (in progress as this report was published).

Improvements to consider:

- SPD: Spend more time promoting the C^{3}RS handbook during initial training, including documented processes for succession planning.
- PRT, ST: If a PRT or ST member is moving to a new position, a replacement should be selected and trained beforehand to support a smooth transition. The replacement should be included in PRT meetings to observe the MCIA process in-action.

3.1.3.1.4 Gaps in Rollout and Training

Rollout activities often occur in an informal manner (i.e., the C^{3}RS implementation team and PRT members speaking with employees as they come in and out of the break room in between jobs, or through handing out pamphlets in offices and break rooms). If an employee is out sick or marked off, they may miss the rollout completely. The geographic dispersion of employees also poses a challenge to SPD and PRTs. Feedback indicated challenges accessing and securing time with maintenance of way, mechanical, and signal employees to conduct rollout activities. An informal rollout process may improve awareness of the program for a subset of employees but is not a substitute for the type of training required to teach employees about the nuances of C^{3}RS, particularly because it is difficult to reach every employee at larger railroads.

Employees appear to receive varied degrees of formal training, depending on senior management's commitment to the program. PRTs are not granted the time or the authority to conduct or mandate these education efforts. When management exhibits low commitment to C^{3}RS, they may not be inclined to allocate time and resources to formal C^{3}RS training and educational activities.

When formal training activities do occur, another challenge is that they may be conducted by an employee in the training department who is not knowledgeable about the C^{3}RS program. Railroads reported that, in larger group training, employees may feel embarrassed that they don't know about the program and self-conscious to speak up and ask questions.

Improvements to consider:

- FRA, Railroads, Labor: Make efforts to set aside dedicated time in a quiet place to conduct rollout activities. Consider an extended rollout period to expose as many employees as possible to the program.
- Railroads: Employees should receive formal training (either imbedded in refresher training, or in new-hire training when employees are brought on) that can teach specifically about (1) which events are eligible under the program, (2) how to write detailed close call reports, (3) what happens to reports after they are submitted, including NASA's role in maintaining reporter confidentiality and anonymity, and (4) expecting a callback by NASA if their reports do not contain adequate detail. Some railroads have indicated that small group settings work best to encourage engagement from employees during training.
- Railroads, Labor: Provide additional support for C^{3}RS education and outreach. Act as champions, or liaisons, of the program. Employees should know who in management or which union representative they can approach when they have questions about the

program. This may require management and labor to receive additional training and education about C^{3}RS.

- Railroads: Consider including someone from the training department on the PRT to ensure that there is an employee with expert knowledge of the program who can answer employee questions during training.
- SPD, NASA: Create training videos to support accurate and consistent training across railroads.

3.1.3.2 Post-implementation Weaknesses

This section documents weaknesses of the post-implementation phase as described by end-users and observed by the team.

3.1.3.2.1 Reporter Confidentiality is Not Always Possible

Despite NASA's extensive processes to protect C^{3}RS data and the anonymity of reporters, PRT members at very small railroads pointed out that, even for unknown events, it is not difficult for managers to discern the identity of the reporter based on report details such as time of day or craft. Confidentiality for known events is also not possible. Some railroad managers have not fully bought into the program, and when these managers view the program as a "get out of jail free card," this issue is particularly problematic. Employees may opt not to submit a report for unknown events, fearing that management will identify them as the reporter and find ways to discipline them, either for the event or for future events.

Actions taken to address this weakness: SPD is working to improve the issue of confidentiality at smaller railroads through the implementation of a C^{3}RS demonstration in which PRTs comprise people outside the railroad (Multer and Kidda, 2024).

3.1.3.2.2 Event Reports Lack Detail

PRT members conveyed that C^{3}RS reports often lack the detail that would enable them to conduct a robust event analysis and identify appropriate CAs. This is usually due to employees not providing detailed reports. PRT members cited the following reasons why employees may not provide detailed reports:

- *Lack of training.* Employees are not properly trained about the program. Employees may not know what type of information to include in reports.
- *Lack of trust.* Employees do not trust the confidentiality of the program enough to share details that they believe might identify them. This may be particularly true at smaller railroads where maintaining confidentiality is known to be difficult.
- *Time constraints.* Employees may hurry to submit reports, thereby skipping fields or including only a short narrative.
- *Form fatigue.* Employees may tire of filling out the form partway through. Because the narrative is the last section, this section may receive the least attention or care.

NASA's de-identification process, whereby an analyst redacts information they perceive as compromising the anonymity of the reporter, also contributes to this challenge. NASA indicated that dispatcher reports are redacted more rigorously than others to protect anonymity.

Actions taken to address this weakness: SPD and NASA have made efforts to educate employees about the type and amount of detail that is helpful to include in event reports. SPD has emphasized this issue during rollout and refresher training. NASA devoted a newsletter issue to educate employees about how to submit detailed reports called *Tips for Excellent Reporting* (included as Appendix G). NASA also included a discussion about the importance of detailed reporting during callbacks. Finally, the report legends that NASA now provides the PRT significantly alleviated the issue of missing data due to NASA's redaction process.

Improvements to consider:

- SPD, Railroads, Labor: Provide employees with more training and access to information about how detailed reporting can improve CAs to support safety at their railroad. Show examples of detailed reporting during training (e.g., NASA's *Tips for Excellent Reporting* newsletter).
- PRT: For known events, consider conducting interviews with the reporting employee to obtain additional information. A representative from the labor union that sits on the PRT should conduct the interview to foster trust with the employee.
- NASA: Explore whether making the narrative the first piece of information field on the report results in more detailed reports. Consider pilot testing a version of the reporting form that asks narrative information at the beginning of the report to combat "form fatigue" and identify trade-offs to obtaining detailed narrative information (information in dropdown boxes that captures event conditions and categorical information about the employees involved currently comes first in the reporting form). Consider a pilot whereby NASA conducts A/B testing to evaluate the value of organizing the forms with different sections appearing first.
- NASA: Develop and test an employee reporting form that can be filled out using voice-to-text.
- Railroads, Labor: When the number of reports with insufficient details rises to a level that concerns the PRT, reach out to employees to remind them of the need to provide more detail in their reports.

3.1.3.2.3 Report Processing Times Result in Delays to Event Analysis, CA Implementation

A significant weakness to the C^{3}RS process involves the delay between when a close call occurs and when the PRT begins an MCIA event analysis. This is due to NASA's report processing timeline and is often exacerbated by PRT meeting frequency (e.g., if the next meeting is not scheduled to occur for some time). NASA's report processing timeframe can take anywhere between 30 to 90 calendar days. The timeframe is influenced by:

- *The number of reports received for the same incident.* Part of NASA's processing requires the report to be held for 10 days to see if other reports are submitted for the same incident. If other reports are received, an analyst works to match the different perspectives of the incident, which adds a step to the processing time.
- *Whether the report requires a callback to obtain additional details, and whether the reporter responds to the callback.* If NASA determines that a report does not contain

adequate detail, they conduct a "callback" whereby NASA tries to reach the reporter – first by phone (two separate phone calls), and if not successful, then by letter (the reporter is given 10 days to call NASA after receipt of the letter) to obtain more information about the event.

- *The quantity of reports submitted program-wide in consideration of NASA resources.* During periods of decreased program-wide reporting, processing times may decrease, and the opposite may occur when program-wide reporting increases.

Imbedded in NASA's report processing is a mandatory 30-day holding period, meaning that the earliest a PRT can receive a report is 30 days from the time the employee submits it. This holding period is meant to create a buffer between when the incident occurs and when the railroad receives the information, to protect the identity of the reporter.

PRT meeting frequency can also exacerbate this issue. The time between when the incident occurred and when event analysis is performed can be further delayed depending on the PRT meeting schedule, due to constraints on the time PRTs can devote to C^3RS activities.

Actions taken to address this weakness: NASA implemented the CHU process to notify individual railroads of safety-critical events. If a NASA analyst determines the event to be time-sensitive, NASA will provide the PRT with information about the event as soon as it is identified. This process can take up to five days. CHU notifications have made it possible for railroads to respond to time-sensitive events much faster than previously. In 2024, NASA changed report-processing procedures to reduce hold times for report matching, and to reduce hold times for callbacks and follow-up letter response times. However, NASA was unable to quantify resulting reductions in hold times.

Improvements to consider:

- NASA: Consider whether the 30-day minimum holding period can be reduced. NASA can work with PRTs to consider the tradeoff between a potential safety impact and maintaining the anonymity of the reporter. If railroad confidentiality is a concern, NASA can keep this 30-day holding period for DBQT submission. Discuss the trade-offs with C^3RS stakeholders during the quarterly meeting NASA holds and at the annual user meeting to solicit feedback from stakeholders.
- NASA: Track reporting for incidents with multiple event reports. What is the distribution of the timing of reports being submitted to NASA? If a majority of matched reports arrive within a five-day window, can the matching period be reduced to five days? Consider the tradeoffs to matching reports and send the report to the PRT for analysis. Can reports be matched after-the-fact, where the PRT would instead receive an edited report to account for additional details?
- NASA: Consider ways to accelerate the carrier heads up process. For example, determine if AI can support this process by scanning event reports to search for keywords/phrases that are deemed time-critical (e.g., homeless encampments) and flagging for immediate review by a NASA analyst.
- Railroads: Provide PRTs with sufficient time to meet on a regular basis to avoid additional delays between when the event occurs and when the PRT can analyze the event.

3.1.3.2.4 Callback Response Rate Could Be Improved

When employees submit reports that lack detail, NASA conducts callbacks whereby an analyst calls the reporter and asks questions to obtain more detail about the event. NASA has reported that the response rate for these calls is approximately 50-60 percent. PRTs believe that callbacks may go unanswered for several reasons, such as lack of trust (they do not trust the confidentiality of this process), or lack of training (they do not know to expect these calls, which come from an unlisted or unknown number which they are unlikely to answer). Another challenge involves the timeframe during which NASA conducts callbacks, as the availability of the NASA interviewer may be incompatible with some employee schedules.

Actions taken to address this weakness: Employee training focuses on educating employees about the callback process and emphasizes that the callback comes from an unknown number. NASA described upticks in callback response rates after railroads conducted refresher rollouts, indicating that more awareness and training about the callback process can improve this issue. To combat scheduling issues, NASA has recently moved to providing analysts with cell phones to extend callback hours.

Improvements to consider:

- NASA: Consider modifying the event reporting form to ask the reporter if NASA has permission to schedule a callback if necessary (and allow the reporter to specify a personal cellphone or email address where they would like to be contacted).
- NASA: When technology permits, move toward real-time processing of reports to determine if a callback is needed. Also, consider word count and level of detail in making this decision. Attempt a callback as soon as possible after the employee submits the report. Conducting the callback close to the time of report submission helps ensure improved recall of event details.
- NASA: Consider implementing technology (e.g., chatbots) to automate and supplement human interviewers for callbacks.

3.1.3.2.5 Challenges with Event Analysis

PRTs described challenges with event analysis, particularly due to time constraints and reports that lack sufficient detail. The MCIA process consists of asking "5 whys" to get to the root cause of an event. PRT members described this process as being too time consuming relative to the duration of meeting time they are provided for C^3RS activities. PRT members also reported difficulty remaining objective when using this process. PRTs indicated that there was a tendency to include their own theories instead of relying on the facts of the report when a report lacked details.

PRTs also described inefficiencies with the MCIA software tool that exacerbated the challenges PRTs face when conducting event analysis. SPD responded to user feedback by updating the MCIA software to address these inefficiencies (described further in Section 3.1.2).

Actions taken to address this weakness: SPD addressed this issue through additional training and by updating the MCIA software tool. During initial training, SPD conducts the MCIA investigation with an existing event report to model the correct implementation of the process. SPD also updated the MCIA software tool to address usability concerns and support the

efficiency of the MCIA process (by including prompts for the "5 whys" and drop down menus in the tool that are consistent with PRT-provided literature on HFACS to identify contributing factors). SPD and STs have also encouraged PRTs to seek the expertise of subject matter experts when they need additional context or support to ascertain contributing factors.

Improvements to consider:

- Railroads: Consider creating a full-time C^{3}RS position and hiring someone with research, operations, and data analysis skills to support the event analysis process. Alternatively, consider including an employee with more formal training in data analysis methods from the safety department as part of the PRT.
- PRT: When possible, collect and analyze secondary sources to corroborate event report details to support event analysis. One way to do this is by interviewing reporters when reports are submitted for known events.

3.1.3.2.6 PRT May Lack Authority or Resources to Implement CAs

For many railroads, once the PRT has completed its event analysis, the implementation of CAs depends on the relationship between the PRT and the ST. In some cases, the PRT is empowered to take action to implement a CA. They may work with administrative staff to develop job aids and signs, or to modify documentation. In other situations, interorganizational cooperation is needed to implement a CA (e.g., modifying an operating rule requires working with the operating rules staff; a safety concern identified by the transportation department may require working with the mechanical crafts or engineering crafts). In a situation where the CA requires significant resources (human or capital), leadership may delay, defer, or decide against implementation.

When the PRT is not empowered to implement a CA on their own, they must defer to the ST or other departments that have authority to make changes. These CAs often require significant resources that leadership may not be inclined or in a position to allocate. At some railroads, the ST may want the PRT to provide more data to support the need for the CA, such as trends and risk analysis. STs also indicated a desire for PRTs to provide more detail regarding how to implement the proposed CAs (e.g., budget, scope, timeline).

PRTs often lack the skillsets to provide the information that the ST requires before agreeing to commit resources to CA implementation, nor do they have the time to do so. Most PRT members are craft employees who spend only a small portion of their time on PRT activities.

Improvements to consider:

- SPD: Update the MCIA tool to further support the CA implementation process (e.g., guide the PRT to include details about scope, budget, and timeline). Enable the PRT to share the proposed CA with the ST directly via the MCIA tool.
- Railroads: An employee with analytical skills that can devote part- or full-time to C^{3}RS can support the PRT and facilitate conversations that cross organizational boundaries.

3.1.3.2.7 CA Documentation, Tracking, and Analysis Challenges

Railroads varied in the level of rigor they reported regarding tracking and monitoring CAs and CA implementation. Except for one railroad, PRTs indicated that they lacked formal processes to

document CAs and track CA implementation but did so informally. For example, one PRT monitored subsequent reports on the event and solicited oral feedback on the CA from employees.

Documentation and tracking of CAs is critical for assessing impact and measuring safety outcomes but can be challenging to perform systematically and consistently. Because these activities often do not occur, they are also not communicated to the workforce as successes of the C^{3}RS program.

More information on tracking CAs is found in Section 3.2.2. The illustrative case study in that section also provides details of one railroad's good practices around formal CA documentation, CA implementation tracking, and analysis. Additionally, Section 3.3.2 discusses how the tracking and analysis of CAs contributes to program sustainability.

Actions taken to address this weakness: The revised MCIA software will allow PRTs to track the implementation status of CAs, as well as the accountable parties, including which party is responsible for implementing the CA and the identification of relevant stakeholders. PRTs have begun to implement processes to communicate C^{3}RS successes to the workforce (e.g., using newsletters). However, these communications primarily include information about CA implementation and not about safety impact.

Improvements to consider:

- Railroads: A part- or full-time employee with analytical skills can support the PRT in these activities.

3.1.4 Exogeneous Factor: Impact of COVID-19

The COVID-19 pandemic adversely impacted all the railroads in a variety of ways. Figure 3 shows the date when each of the railroads began participating in C^{3}RS. The pandemic significantly reduced operations for all participating railroads, which reduced opportunities for employees to submit reports to C^{3}RS. While this posed a challenge for all railroads, it particularly impacted railroads that began C^{3}RS participation around March 2020, when lockdowns began across the United States, as many of these railroads were smaller operations with a lower level of revenue service.

This illustrates the fragility of C^{3}RS to exogenous factors as well as factors within the railroad that can impact system performance. The impact of COVID-19 resulted in many employees being furloughed or retiring as the need for revenue service declined, affecting employees at all levels of each railroad. The loss of people knowledgeable about C^{3}RS resulted in fewer employees submitting reports, a loss of knowledge for the PRT regarding how to perform event analysis and develop CAs, and a loss of knowledge among senior managers about the value of the reporting system and how it worked. With fewer people available, limited resources meant less time for addressing event reports, and event analysis skills declined as PRT members had fewer opportunities to practice them.

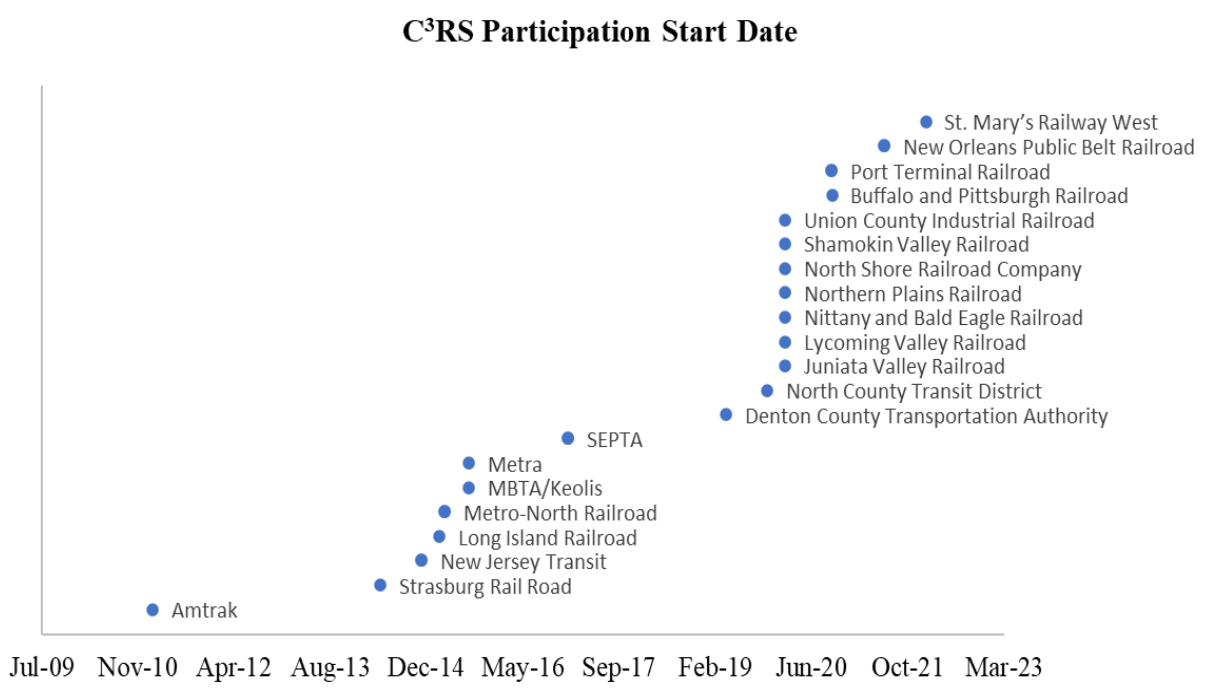

Figure 3. Railroad C³RS participation by date

Report submissions dipped by 64 percent from 2019 to 2020 (refer to Figure 4 in Section 3.2.3). While reporting has increased since 2020, as of May 2024, rates have yet to return to the peak reached in 2018, despite the number of participating railroads having grown.

Further, the ability for PRTs to meet in person, including holding meetings with the ST, was compromised due to concerns around virus transmission. Whereas PRT meetings resumed virtually within weeks to months of the pandemic, PRT meetings with the ST were slower to resume. Currently, the railroads the research team spoke with have resumed face-to-face meetings, except for one that had not yet reconvened PRT and ST meetings in late fall of 2022. Resumption of C³RS activities at pre-COVID levels took place only after SPD intervened to assist the railroad through additional education, outreach, and training.

3.2 Outcomes

This section addresses program outcomes related to safety and process improvements, including communication, and/or collaboration and teamwork.

3.2.1 Safety

Demonstrating safety outcomes requires formally maintaining and tracking records of close call reports from NASA, CA tracking, and safety data tracking and analysis to investigate trends. The research team determined that only one of the information sources for this evaluation formally performed these actions (see the railroad case study in Section 3.2.3 for more detail).

However, during focus groups, the team learned that, *informally*, some of these activities are being performed by PRTs. These activities include:

- Documenting examples of CAs that the PRT considered successful in reducing incidents

- Publishing PRT-issued newsletters that review cases/incidents
- Tracking systematic issues that become known to the PRT through C^{3}RS reporting

Although participating railroads studied for this evaluation typically do not maintain, track, or analyze safety data related to C^{3}RS, FRA staff performed an analysis using its public accident/incident database, and allowed the research team to access and use this data on a MS Power BI dashboard. The team found that accident/incident rates per million train miles at railroads participating in C^{3}RS were lower in some cases versus non-participating railroads. However, this finding is not consistent over time and cannot account for confounding variables, such as interventions implemented independently of C^{3}RS.

3.2.2 Process Improvements, Communication, and Collaboration

Report submission data from NASA, data on CAs received from SPD, and qualitative data from participating railroads that provide insight into the safety-related processes, communications, and collaboration associated with participating in the C^{3}RS program are highlighted in this section.

3.2.3 Event Reporting

Report intake data received from NASA are shown in Figure 4. Starting in 2011, when the C^{3}RS program launched, reporting increased steadily as additional railroads joined, particularly between 2015-2016 (see Figure 3 in Section 3.1.3 for a timeline of participation).

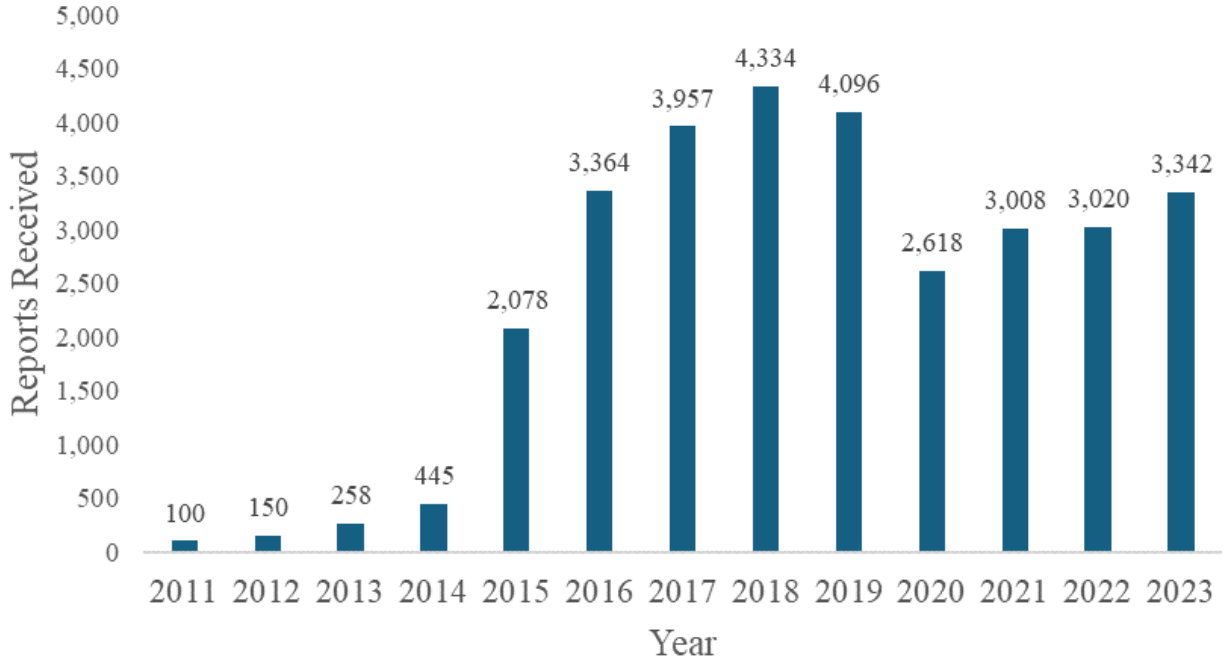

Figure 4. C^{3}RS reports received by year

This trend continued, with a slight dip in 2019, until the industry experienced the effects of the COVID-19 pandemic in 2020. Starting in 2021, during pandemic recovery, event report intake at NASA rebounded. However, this increase should be considered in light of 13 additional, mostly smaller revenue service railroads initiating their participation in the program during this same

timeframe. Overall, documented reporting increases over time suggest the growth and success of the C^{3}RS program.

3.2.4 Analyzing Corrective Actions

Using the safety barrier taxonomy presented in Section 2.2.6, the team analyzed CA primary codes only, as 82 percent of CAs did not warrant assignment of a secondary code. Tallying the results of the coding analysis yields the frequency of implementation for each category of safety barrier (see Table 5). Most commonly, 43.5 percent of the time, railroads reported implementing CAs that the team categorized as administrative/organizational. This was expected, as making administrative changes at an organization is often easier and/or faster than implementing behavioral, engineering, or symbolic safety barriers.

Table 5. Tallies and percentages of CAs by safety barrier code

Safety Barrier Code	Count of CAs	CAs (%)
Administrative/Organizational	101	43.5%
Symbolic	63	27.2%
Engineering	36	15.5%
Behavioral	32	13.8%
Total	232	100.0%

The team also summarized and grouped CA descriptions into various categories, shown in Table 6 for all categories with a tally of five or more CAs. Like the data presented in Table 5, the four most common CA summary categories – written communications (19.8 percent), visual indicators (13.8 percent), procedure change (11.2 percent), and training (8.6 percent) – are all administrative/organizational or symbolic in nature.

Table 6. Tallies and percentages of CAs per summary category

CA Summary Category	Count of CAs Per Summary Category	CAs Per Summary Category (%)
Written communication	46	19.8%
Visual indicator	32	13.8%
Procedure change	26	11.2%
Training	20	8.6%
Modify equipment	19	8.2%
Review operating rule/procedure	19	8.2%
Follow regulations/procedures	11	4.7%
Oral communication procedure	11	4.7%
Operating rule change	7	3.0%
Install equipment	5	2.2%

The willingness of railroads to manually provide CA data to SPD signifies a commitment to documenting and communicating safety-related processes. As discussed in Section 3.1.2, recent improvements to the MCIA software replaced this manual process with an automated process that allows CAs to be directly shared with SPD. Other MCIA improvements noted in Section 3.1.2 (e.g., the ability to document the amount and types of CAs recommended by the PRT, link

related CAs, and track CA implementation planning and implementation) make it even more likely that PRTs will take additional actions to enhance safety-related processes at their railroads.

3.2.5 Training

One CA, developed by a railroad in response to multiple C^{3}RS reports, led to the creation of a form of training called Scenario Based Training (SBT), which exposed new and experienced employees to events reported through C^{3}RS (Young & Multer, 2023). In this training, employees played the role of one or more of those involved in a C^{3}RS event (e.g., a conductor operating on the head end of a locomotive during a shoving movement). Participants received feedback on their actions from training instructors and experienced employees while other students observed. Following the development of this training, other railroads adopted SBT with support from FRA. This innovative training provided a safe environment for employees to learn to address challenges that they would likely face during revenue service.

3.2.6 Information Sharing

The team found evidence of information sharing between participating railroads about C^{3}RS successes and challenges, though much of this was focused on reporting and lessons learned and not CAs or safety outcomes. As discussed in Section 3.2.1, largely this was because CAs, and consequently safety outcomes, were not formally tracked.

SPD's annual user group meetings represent a key opportunity for participating railroads to share specific safety concerns they have addressed as well as lessons learned. At these meetings, NASA presented the types of events historically reported over the prior year, as well as information about contributing and causal factors. In addition to SPD's formal annual meeting, some railroads with common interests (e.g., operating over each other's territories) met to discuss shared challenges and ways to address them. In March 2024, one railroad hosted a symposium for C^{3}RS participating railroads to review CAs, collaborate, present innovative C^{3}RS tools and processes, and interact with SPD and NASA stakeholders. These types of meetings contribute to the transfer of knowledge and implementation of CAs across participating railroads.

Additionally, information sharing within railroads was cited as an intangible benefit, simply by having the PRT and ST "sitting in the same room." Open lines of communication between these groups provide a space to discuss safety challenges at a higher level, beyond the issues identified through reporting alone. These discussions can promote shared understanding between management and labor regarding issues that are important to each group.

3.2.7 NASA Communications and Processes

NASA produces regular communications that include a publicly available quarterly newsletter, *Inside the Rail*, and safety alerts that are disseminated to interested C^{3}RS parties. Each newsletter focuses attention on one or more types of reported events. Example topics include air brakes, blue signals, automation, and various operating procedures. General alerts highlight specific topics that are common across more than one railroad, such as blue signal protection, overspeeding, defective track conditions, coordination of track authority, and overreliance on PTC. These alerts communicate potential areas of risk that railroads may want to investigate to determine the degree of relevance to their operation. NASA also issues alerts to time-sensitive issues that require immediate attention (e.g., a malfunctioning gate at a highway grade crossing). Section 3.1.2 expands on this topic, including a discussion of CHUs.

After making de-identified event reports available to the railroad, NASA adds the reports to the publicly accessible C^{3}RS DBQT (NASA, 2024b). This database allows anyone interested in railroad safety to access the events submitted to C^{3}RS and includes de-identified employee narratives along with coded fields to facilitate human factors research, analysis, and risk identification. While this database allows users to identify patterns and trends in reported events, the usefulness of this information could be improved by making it available in data visualization software like Microsoft Power BI or Tableau. This type of software facilitates data exploration and the ability to investigate patterns and trends in the data through visual data displays.

Communication across stakeholders is also facilitated through NASA's PRT quarterly teleconferences and other activities (e.g., special studies). In quarterly meetings, NASA typically highlights a safety topic and conducts an analysis of existing reports on that topic, called a "safety spotlight." NASA's analysis considers contributing factors across reports and CAs. Topics presented by NASA as part of various communication forums are found in Appendix E.

NASA also conducts special studies to address specific safety concerns of interest to FRA. In one case, NASA developed a set of questions to ask about PTC during the callback process to better understand how this technology affects safety; a 2021 report documented the findings of this special study (Hooey, Marfise, Broderick, Weaver, & Pina).

3.2.8 Illustrative Case Study: Metro-North Railroad

This illustrative case study of MNR serves as an example of good practices for other participating railroads to consider. The research team conducted a site visit at MNR and separately interviewed the railroad manager hired into a dedicated position to fully support and maintain the C^{3}RS program.

3.2.9 Good Practices

The actions performed by MNR to prioritize safety, enhance transparency, and improve the outcomes of the C^{3}RS program fall broadly into three main areas, as discussed below. Illustrative quotes from the manager's interview are offered to provide further context.

3.2.9.1 Dedicated Position

MNR hired a Deputy Director-level managerial position dedicated to serving as a bridge between the PRT and other parts of the organization. The C^{3}RS manager is uniquely positioned at the railroad in the Operations department rather than the Safety department. Working in Operations provides a greater opportunity to communicate and interact closely with those in the operating crafts who can directly effect change.

Roles and Responsibilities

In addition to holding both institutional and C^{3}RS program knowledge, the C^{3}RS manager interacts regularly with relevant labor unions, the PRT and ST, and other key stakeholders. The C^{3}RS manager also has access to information and data from other safety programs at MNR that run parallel to C^{3}RS.

The C^{3}RS manager serves in a third-party role external to both the PRT and ST to maintain neutrality between management and labor. This role provides a variety of additional program support and oversight tasks, including:

- Responding to PRT requests for C^{3}RS or other safety-related data
- Attending the first 15 to 20 minutes of PRT meetings to provide program-level updates or assist with administrative tasks (e.g., performing mark-offs)
- Training the PRT on the incident analysis process and other relevant techniques or tools
- Reviewing the IMOU with the PRT and ST to ensure mutual agreement and understanding
- Facilitating communication between the PRT, ST, and labor unions

The C^{3}RS manager also maintains meaningful involvement in program activities and initiatives, and is a major proponent of the success of the C^{3}RS program at this railroad.

> *"I am not part of the PRT… so, in reality, the way it works is I provide them with a breakdown of the data because they don't have time to do a lot of the data themselves… They say, 'Hey, these are the trends we think we have; can you help us do a bigger deep dive?'"*
>
> *"We make sure they [the PRT] operationally have everything they need, making sure mark-offs are occurring, if there is a question of [the IMOU] from either labor or management, those questions generally go to me."*
>
> *"I don't want to influence the PRT's decision. So, we give them all the tools; I give them training on all the different tools we want them to implement… I'm essentially more of a guidance tool for them."*

Communication and Collaboration

The C^{3}RS program thrives when there is successful and regular communication among key stakeholders across the organization. The C^{3}RS manager ensures that, when barriers to successful C^{3}RS implementation arise, all parties communicate and compromise, as necessary, to identify solutions.

For example, when faced with challenges related to determining a meeting time, the C^{3}RS manager worked with the PRT and ST to jointly create a solution that reduced costs, yet still allowed C^{3}RS activities to occur.

> *"[Our transportation PRT] was essentially having meetings every week; that's 20+ employees getting marked off for PRT business every week – that's very costly… Working between the [ST and PRT] we came up with, and what we decided with transportation, is now instead of weekly meetings, we're going to have a three-day conference every month for the PRT to get together."*

3.2.9.2 Enhanced Data Collection and Analysis Methods

Without detailed event reports, PRTs often cannot perform event analyses that allow for the identification of appropriate CAs. The C^{3}RS manager implemented a process to enhance the richness of event report data. The manager also created a C^{3}RS report data dashboard display to improve data transparency at MNR, as well as the availability of event data for additional PRT analysis and data visualization purposes.

PRT Interviews

For known events, the C^{3}RS manager established a process for PRT interviews to supplement reports with follow-up information, when possible. Employees who may have been involved in the reported incident are invited by the C^{3}RS manager and PRT to complete a confidential interview process to provide more detail to the report. Any interviews that take place are conducted with the assistance of labor leaders and prioritize employee protection and confidentiality.

> *"We're calling them Peer Review Team Interviews. Where, for known events or reports that we kind of do know about and we do know the employee – whether it's through labor that knows them – we provide them with full confidentiality to now come and sit in front of the PRT…"*

> *"I provide my question set that I'd like to see, the PRT will provide theirs… Then generally how we like the process to work is we let management still in the room, the PRT management members, but we let labor…run that process in terms of asking the questions because it breaks down those walls."*

These PRT interviews supplement the C^{3}RS reports beyond NASA's callbacks, allowing for the development of a more complete event analysis. Follow-up interviews like these facilitate tailoring questions to the circumstances surrounding the particular event, which increases the likelihood that as much relevant information as possible is collected.

> *"We've done it now with transportation only as a pilot run and we're getting full risk analysis reports out of this now, based off of what may have [started as] a one sentence report. We're able to dig a little bit deeper now."*

Safety Management System and C^{3}RS Dashboard

In addition to implementing a PRT interview process to supplement report data for known events, the C^{3}RS manager worked extensively to optimize MNR's safety management system (SMS) by transitioning the C^{3}RS data entry process from one that required manual input by employees to a computer-automated system. Automated data input reduced data entry errors, allowed for data to be shared and reviewed in near real-time, and facilitated quicker report turnaround times.

To facilitate data processing and visualization, the C^{3}RS manager also developed a Microsoft Power BI dashboard that aggregated de-identified C^{3}RS report data-to-date, and other relevant safety data, in a concise and intuitive way for *all* employees to access and review (see Figure 5).

The dashboard allows the PRT to perform trend analyses that go beyond what is possible using the existing MCIA software tool and offers the ability to filter the data by variables such as "event type," "craft," and "station." Additionally, the dashboard produces data visualizations, such as a heatmap showing the geographical distribution of reports, and bar charts displaying grouped information of the number of event records by type of anomaly and the number of records by operating craft.

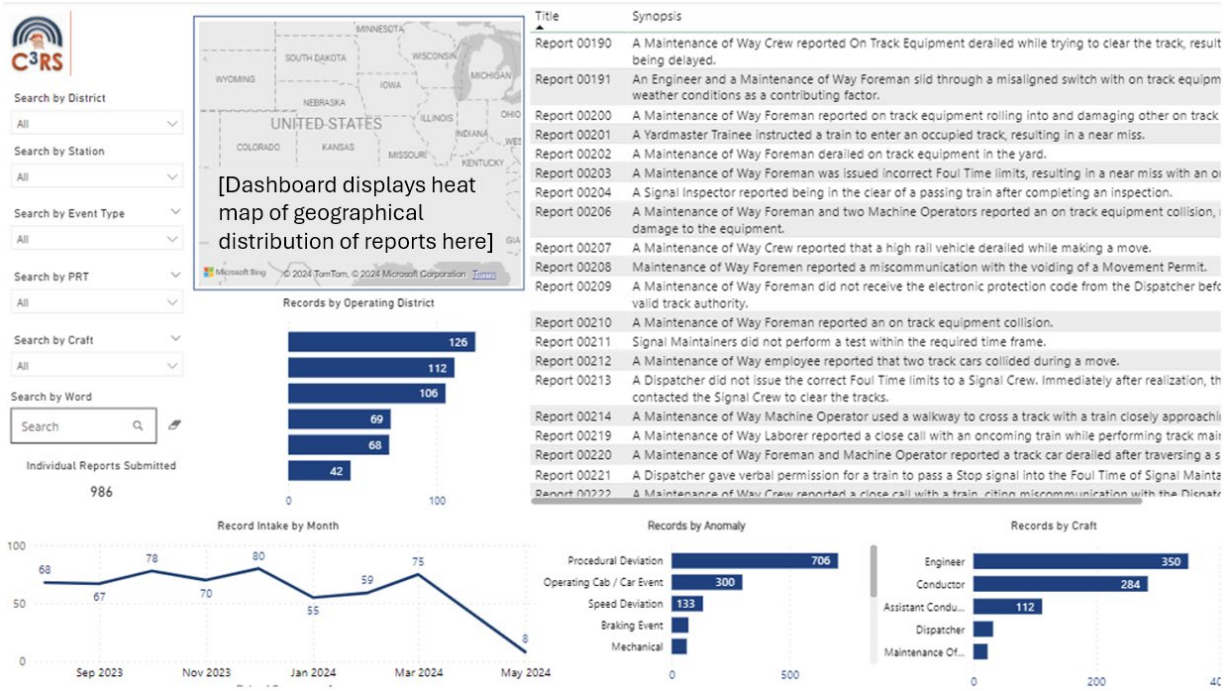

Figure 5. Sample of the MNR Power BI C³RS report data dashboard display

Benefits of maintaining C³RS data in this manner include:

- Increasing data transparency to build trust between employees and C³RS program members
- Reassuring employees that their concerns are heard and efforts are being made to address them
- Identifying safety trends for use by the PRTs to inform effective CAs
- Supplying the ST with evidence of the need for certain CAs

  "The focus on the C³RS data is because for so long, people really never saw anything coming out of C³RS. So, when we started this data optimization, we wanted to focus on C³RS first to show the entire – railroad employees, management, labor – that there is data, and here is the data."

  "So now we have a dashboard with all of this C³RS data. The PRTs have a version of it, but now we have a SharePoint that anybody with a [railroad] email… they have access to a SharePoint with that C³RS data."

3.2.9.3 Outreach and Education Efforts

A large part of the C³RS manager's workload is dedicated to strategic outreach and education around the C³RS program. Particularly notable efforts are described below.

C³RS Training Materials

MNR put in place concurrent outreach and training activities to ensure employee awareness and easy access to information about the C³RS program. A variety of training materials (e.g., video

and slide content) were added to new-hire orientations to ensure all employees have general C^{3}RS awareness upon hiring. The design and development of these training materials was done in collaboration with the training department, and this content may also be integrated into annual refresher training in the future. The C^{3}RS manager and certain PRT members maintain their involvement in these trainings by contributing to the content development and helping to deliver them in-person when possible.

> *"We're doing two things… I'm going to go to certain new hire trainings, the PRT will go to certain new hire trainings. We can't all be there all the time because we're hiring so many new people. So, we're actually developing, with our training department, a video where it's all of these key C^{3}RS talking points…and that video will be played at all new trainings, or even some re-trainings. That way the message is concise and it's always consistent."*

Whistle-stop Tours

This railroad implemented a safety-related outreach activity called *Whistle-stop Tours,* in which the C^{3}RS manager and management travel to meet face-to-face with employees. Outreach activities of this kind may be beneficial for:

- Building employee buy-in by increasing C^{3}RS program awareness and clarifying the benefits to program participation
- Distributing accurate and consistent program information regarding how and why to participate
- Establishing a sense of management support for the program and a positive safety culture

Whistle-stop Tours consist of general program discussions and open question-and-answer sessions. The C^{3}RS manager and other C^{3}RS parties developed handouts and infographics to supplement these conversations (see Figure 6). These materials are also available to all employees on the company's C^{3}RS SharePoint site.

> *"[We're] doing what we're calling a 'Whistle-stop Tour' where me and senior management, we're going to go to all of our management centers, all of our workforce centers, day by day and say, 'Here are the myths; here is the reality,' and then have a question-and-answer section so that employees can better hear me."*

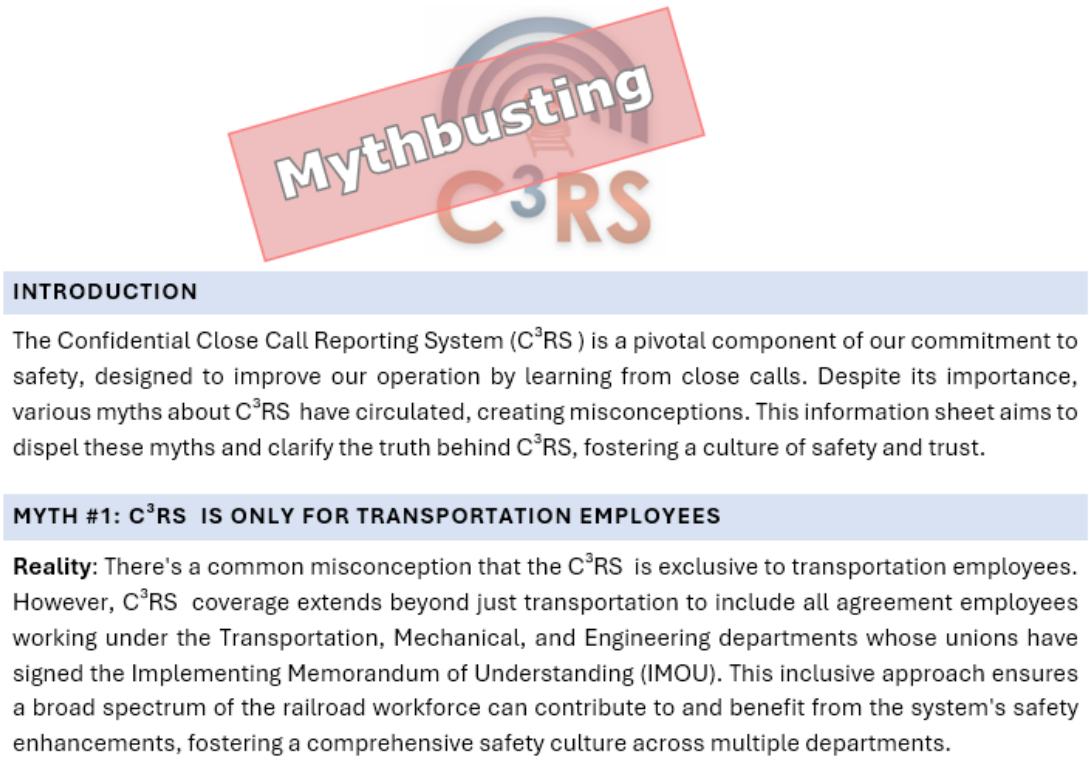

Figure 6. Example portion of the "Mythbusting C³RS" handout[6]

3.2.10 Effectiveness

The effectiveness of MNR's C³RS process improvement, communication, and collaboration efforts are revealed in tracked program outcomes. These include:

- *Reporting*: event reporting has exceeded pre-pandemic levels over the most recent 12 month period
- *Callback rate increases*: the railroad noted a 10 percent increase in callbacks since 2022, to 62 percent
- *CAs related to station operations*: the railroad has seen significant reductions in incidents at its three most common locations

3.3 Sustainability

This section highlights barriers to sustaining C³RS, documents researcher observations on stakeholder processes that contribute to sustainability, and describes steps towards institutionalizing the C³RS program.

3.3.1 Barriers to Sustainability

The research team identified three overarching barriers to sustaining the C³RS program: a lack of ownership and accountability by management (including the ST), resource constraints, and staff

[6] The complete "Mythbusting C³RS" document highlights 11 common C³RS myths encountered by the railroad.

turnover. These barriers interact with and exacerbate weaknesses identified with C^{3}RS implementation processes (described in Section 3.1). Conversely, taking steps to mitigate identified challenges would be expected to improve the previously identified weaknesses.

Barriers to program sustainability are described in more detail below.

3.3.2 Ownership and Accountability Within the Railroad

C^{3}RS ownership and accountability was often focused on the PRT. When working to implement CAs, PRTs may be expected to remedy unsafe conditions or behaviors without support from other parts of the organization. However, PRTs may lack the time and resources needed to address proposed CAs. C^{3}RS would benefit from greater involvement from the ST and railroad managers.

There are a variety of reasons why STs might provide insufficient support to address specific CAs. Some STs may distance themselves to support ownership of the process by the PRT. This can show reduced ST ownership of the process and less commitment to C^{3}RS. Other STs may not understand the importance of their role in supporting C^{3}RS. Active involvement from the ST is essential when implementing CAs that involve significant time, expense, or coordination between different departments. Educating these STs about their role in supporting the PRT and demonstrating accountability for its success may help address this perceived lack of support.

Boundaries between transportation, engineering, and mechanical departments can hinder an organization's ability to solve problems that require interorganizational cooperation. If a close call is experienced by one department (e.g., transportation) but the resources needed to solve the problem come from another department (e.g., engineering), resentment may arise when resources required to implement a CA impact that department's budget and their ability to meet other business goals.

Some senior managers expressed frustration with C^{3}RS and questioned the value they receive from the program. For senior managers to perceive value, the event analysis and CA process must result in positive, tangible change instead of simply identifying contributing and causal factors. Accountability and feedback are critical elements in determining whether implemented CAs are having the desired effect.

The railroad must implement CAs and document the impact of these changes. Failing to follow through on this part of the process can lead to loss of confidence in the reporting system and its ability to achieve the railroad's safety objectives. Management may not support efforts to provide accountability in implementing CAs and measuring their effectiveness, nor is there a formal process to do so.

Demonstrating impact is important for showing the value of specific CAs and whether the CA is having the desired effect. Participating railroads could benefit by better supporting PRTs in assessing the impact of implemented CAs (e.g., the safety department could provide resources to measure the impact of specific CAs on the specific events or conditions they were intended to address).

3.3.3 Resource Constraints

Resource constraints pose a challenge for virtually all C^{3}RS stakeholders. Employees must find time to submit a detailed report, which requires sufficient cognitive resources. When NASA

receives a report lacking in detail, it must devote resources to calling the employee back for additional information. When a PRT lacks sufficient details to evaluate an event, it takes more time to process the event and may result in an incomplete or inaccurate analysis.

PRTs often are challenged to find the time to conduct event analysis and develop CAs. Most members' PRT work occurs in addition to their regular train service or maintenance work. Further, event analysis is a challenging skill to acquire and requires regular practice to maintain. Inadequately detailed reports impair the ability of the PRT to work effectively.

For railroad managers, resource constraints can limit opportunities for PRTs to meet because of competing obligations, and budget limitations may hamper allocating funds for some CAs. Some CAs may compete for resource allocation with other measures already in place (e.g., a CA recommending training displaces another content area for which training has been ongoing).

NASA experienced limitations in staff resources available to process reports. As the number of participating railroads has grown and the number of employees submitting reports has increased, NASA must find ways to allocate resources to process each report. Similarly, FRA has a limited budget to allocate to NASA for its activities and limited staff to oversee management of the C^3RS program.

To address these resource constraints, organizations must find ways to streamline activities where possible and prioritize some activities over others. Many of the improvements that SPD initiated streamline one or more of the processes around event analysis or shift the burden from one stakeholder to another (e.g., developing videos to support educating employees about how C^3RS works, or training PRT members in event analysis). Finding ways to intervene early in the C^3RS process by encouraging detailed event reports creates downstream benefits, allowing PRTs to conduct their event analysis more quickly and with more thorough analysis. PRTs and STs can also track and trend event reports to prioritize some reports and CAs over others.

3.3.4 Staff Turnover

Staff turnover at all levels of the organization, from management to front-line employees, presented a challenge to sustaining C^3RS.

- **Senior Leadership**. Senior leadership plays a key role in the success of C^3RS at each railroad. Senior leaders demonstrate varying levels of commitment to C^3RS through communications with managers and front-line employees, incentive systems, and resources allocation. Leadership changes have resulted in changes in how C^3RS is implemented and sustained. New leaders may have been unfamiliar with the system or did not understand its benefits, so their commitment to the program was observed to be lower than their predecessors. It sometimes fell to SPD to update new leadership on how C^3RS works and how it benefits the railroad. During the evaluation, senior management turnover at one railroad resulted in the railroad pulling out of the program completely.
- **PRT**. PRT turnover requires finding and training new members to take on the roles and responsibilities of this group and learn the skills necessary for event analysis. The outcomes of training new members varied by railroad. In some cases, new PRT members reported they did not understand SPD training on how to fulfill their roles and perform event analysis. Also, when PRT turnover occurs and no one at the railroad is equipped to

train new members in the skills they need to conduct their event analysis or effectively facilitate their meetings, there may not be further assistance available.

- **Front-line employees**. Finally, as experienced employees leave the railroad or move to other positions, new employees may not receive exposure to the benefits of reporting close calls and how to use C^{3}RS. New employee exposure to C^{3}RS varied by railroad; some railroads did not include the system in new employee training. After turnover, reporting by frontline employees declines, often due to lack of knowledge about the program. When combined with issues caused by PRT and ST turnover, this can result in a railroad struggling to learn from event analysis and identify CAs that positively impact safety. Typically, SPD responds to this issue by returning to the railroad to re-introduce the program and retrain the PRT. New ST members may also need an introduction to the value of C^{3}RS. The need to repeat these activities places a strain on SPD's limited resources.

Over time, turnover led to the loss of institutional knowledge of C^{3}RS at several participating railroads. This challenge resulted in SPD spending valuable time and limited resources re-educating the workforce on the benefits of C^{3}RS and how to submit reports.

To mitigate the adverse impact staff turnover can have on C^{3}RS, the Volpe team recommends that FRA: (1) leverage FRA inspectors on the PRT to notify the SPD leadership team when turnover occurs; (2) provide standalone resources like video or documentation for how to perform event analysis; and (3) communicate to PRT members that they should ask for help when they need it.

3.3.5 Informal CA Tracking, Documentation, and Determining Impact

Largely, participating railroads only informally track or monitor CAs they implement, and with one exception (see Section 3.2.3), the research team did not identify any cases in which the railroads measured the impact of the corrective actions, except through changes in event reporting. PRTs typically tracked CAs, but many did not document the responsible party or how long it took for implementation. Good practices for implementing CAs suggest identifying the employee accountable for the CA, measuring the impact, and documenting results (U.S. Department of Energy, 2006).

3.3.6 SPD Efforts Contributing to Sustainability

Since SPD began managing the program in 2011, the C^{3}RS implementation team has taken a variety of steps to sustain C^{3}RS.

3.3.6.1 Outreach and Engagement

SPD regularly engaged in outreach to promote the program at conferences and industry meetings. Participation in C^{3}RS increased from 3 railroads in 2014 to 25 railroads in December 2024, with an additional railroad in the implementation and development stage (Federal Railroad Administration, 2024).

3.3.6.2 Adapting C^{3}RS to Meet Stakeholder Needs

The team documented SPD responsiveness to C^{3}RS stakeholder needs both before and during the evaluation period. SPD adapted the program in response to feedback to better serve the needs of

participating railroads and to improve the effectiveness of the program. In one case, SPD used PRT feedback to improve the usability of the MCIA software for event analysis. SPD also responded to requests from various PRTs for additional mechanisms to submit reports, as well as to address NASA processing issues. As a result, NASA was able to improve the turnaround time for making reports available to PRTs and provided new options for employees to submit reports (e.g., moving from paper to electronic submission). Appendix C provides a comprehensive list of SPD-initiated improvements to C^{3}RS to improve program effectiveness and/or efficiency in response to stakeholder challenges.

In response to the increasing number of railroads participating in C^{3}RS, in 2021 and 2022, FRA requested and received a Congressional increase in funding to support NASA's report acceptance and processing activities. The additional funding, along with process efficiencies, enabled NASA to successfully accommodate the reporting increase.

Additionally, SPD has experimented with C^{3}RS models that vary how the PRT operates or the events that can be reported. For example, small short line railroads often lack the staff to support a PRT while also maintaining operations. In addition, the small number of employees makes it difficult to provide confidentiality when all employees know each other. To address these challenges, SPD supported a C^{3}RS demonstration whereby people outside of the railroad, but with knowledge of railroad operations, serve as members of the PRT (Multer and Kidda, 2024). Currently, personnel from the Short Line Safety Institute (SLSI) serves in this capacity.

SPD is also exploring a different C^{3}RS model with Class I freight railroads. In one demonstration with a Class I railroad, the number of known event reports that are permitted is limited, which differs from the current program that does not have a limit. Another demonstration will explore the viability of offering C^{3}RS to dispatchers, where events are all recorded or documented via electronic means and therefore all events would be known events. Each of these approaches represents SPD working with industry stakeholders to identify acceptable methods for reporting close call events.

3.3.7 Continuing Sustainability Efforts

This section highlights efforts that researchers recommend expanding.

3.3.7.1 Communication, Shared Understandings, and Safety Impacts

As a system for reporting close calls, a critical element in sustaining the C^{3}RS program is effective communication among the various stakeholders.

Stakeholders that make effective use of C^{3}RS engage in regular communication about the program and its processes, such as the general alerts and CHUs that NASA provides (described in more detail in Section 3.2.2). Effective event analysis requires listening to diverse views to understand the different perspectives of various PRT members, and enables development of a complete understanding of how events unfold. Meetings between the PRT and ST promote shared understanding of how unsafe events occur and what actions can be taken to address the root causes of these events. Further, STs can and should share tradeoffs and considerations used in determining whether a CA is practical with PRT members. Regular communication with the workforce is also needed to inform employees about how C^{3}RS works and how it objectively contributes to safety at their railroad.

Sharing the lessons learned (e.g., broad trends in event reporting and CAs implemented in response to these events) beyond participating railroads may also encourage more railroads to join C^{3}RS. The Government Accountability Office (GAO) also made this recommendation in their 2022 report evaluating C^{3}RS (Government Acountability Office, 2022).

3.3.7.2 Documenting C^{3}RS Activities

Written communications and documentation can facilitate organizational learning and institutional memory. The current version of the MCIA software documents the results of event analysis and allows the railroad to track CAs and share lessons learned.

3.3.7.3 Use C^{3}RS Data to Inform Safety Industry-Wide

To sustain C^{3}RS, SPD and railroads must show that the program positively impacts safety. The PRT can communicate about CAs implemented and other positive safety outcomes that occur at the railroad level. SPD can use C^{3}RS data across participating railroads to support industry-wide safety initiatives, such as when NASA conducted a special study on PTC using C^{3}RS event report data (see Section 3.2.2 for more detail).

FRA, railroads, and other interested parties can use the publicly accessible DBQT to identify research areas that support a greater understanding of the utility of the C^{3}RS program. Railroads can also leverage C^{3}RS by encouraging employees to submit reports on specific safety events they are concerned about to learn more about how they unfold and why they occur.

On its own, the DBQT is a powerful tool for identifying patterns and trends in event reports. However, as it is currently displayed, the database can be challenging to use. Making the database available in visualization software like Tableau or Microsoft Power BI can aid in data exploration and pattern identification (see Figure 5 for a Microsoft Power BI visualization of MNR C^{3}RS data). Providing a similar resource on the NASA C^{3}RS website or through the portal provided for each participating railroad could enable interested parties to make more effective use of this data.

3.3.8 Steps Toward Institutionalizing C^{3}RS

Drawing on findings from this evaluation, the research team offers the following opportunities for improvement as the SPD and participating railroads work toward institutionalizing C^{3}RS.

3.3.8.1 Continue Adapting C^{3}RS to Meet Stakeholder Needs (SPD)

Researchers encourage SPD to continue experimenting with adapting the C^{3}RS model to fit stakeholder needs. FRA has identified and discussed the adoption of the Federal Aviation Administration (FAA)'s ASAP as a potential program model. The team agrees that this would be a good model to explore.

In this model, an employee's confidential reports are sent to the railroad instead of a third party, and the employee receives similar protections in terms of confidentiality and protection from discipline. A benefit of this model is that the railroad, by knowing the identity of the reporter, can interview the employee and obtain more detailed information to understand and act on the event. The railroad also receives the information more quickly, since the employee's report is not delayed by third party processing of the report. The challenge in implementing this model is

creating the conditions under which the employees trust the railroad enough to provide this information directly.

3.3.8.2 Continue Efforts to Provide Standalone Resources (SPD)

A low level of program involvement by senior managers, resource constraints, and the loss of institutional knowledge due to turnover at participating railroads resulted in SPD continuing to revisit issues already addressed during initial training and roll out. As the program grows to involve more railroads, sustaining C^{3}RS at individual railroads will make it difficult for SPD to provide the same level of person-to-person contact with individual railroads. SPD has begun to address this challenge by providing standalone resources that include software tools, videos, and documentation for the railroads to use in addressing staff turnover and questions about C^{3}RS.

3.3.8.3 Leverage FRA Inspectors (SPD)

SPD can also benefit from using FRA inspectors that participate on the PRT to serve as a conduit between the railroad and SPD when person-to-person issues arise. When there are challenges, FRA inspectors can communicate PRT concerns to SPD. For example, when leadership changes take place on the railroad, the FRA inspector may be in the best position to learn about these changes and notify SPD, so the implementation team can introduce the value of C^{3}RS to new leadership. Leveraging FRA inspectors in this way will allow SPD to reserve face-to-face communications for the most critical issues surrounding trust, confidentiality, and what events can be reported.

3.3.8.4 Implement a Shared Portal for Resource Sharing (C^{3}RS-participating Railroads)

C^{3}RS can be institutionalized across the industry through the sharing of resources developed by individual railroads. Sharing these materials can provide ideas for other railroads to implement similar safety procedures.

While some sharing of materials already occurs, providing a central location for these materials could make sharing information easier and leverage limited resources for all participants. One railroad previously provided a secure, password-protected website for participating railroads to share C^{3}RS presentations and other materials. FRA could consider providing a portal through which railroads could securely share information.[7]

3.3.8.5 Integrate C^{3}RS into SMS (C^{3}RS-participating Railroads)

Participating railroads often operate C^{3}RS as a standalone program rather than an integral part of safety management. When railroads join C^{3}RS, some employees (ranging from senior managers to frontline workers) are skeptical that C^{3}RS will live up to its promise as a method for improving safety. Experienced employees have witnessed safety initiatives come and go, and frontline employees may see C^{3}RS as a "flavor of the month" safety initiative. Integrating C^{3}RS into a railroad's broader SMS shows employees that management has committed to the program and could increase employee trust levels and confidence to report.

[7] FRA might consider the Railroad Information Sharing Environment as a place for sharing safety sensitive information.

Integrating C^{3}RS into a railroad's SMS will also support information and resource sharing across departments, leading to greater support for the PRT in investigating events and identifying and implementing CAs. The case study described in Section 3.2.3 illustrates how, by integrating C^{3}RS into its SMS, MNR achieved a more holistic view of safety and can respond more effectively to early warning trends in incidents. By sharing this information with employees, MNR displays transparency about what the railroad is learning through close call reporting, and thus encourages employees to continue to report events. Displaying this information to all employees offers ownership and responsibility for safety at all levels of the organization. Finally, incorporating C^{3}RS into a railroad's larger safety management practices is consistent with system safety regulations for passenger and freight railroads.

4. Conclusion

The research team conducted an evaluation of C^{3}RS implementation processes, sustainability, and safety outcomes. The team assessed program effectiveness and suggested modifications to sustain and institutionalize the program. The evaluation examined C^{3}RS processes to identify strengths, weaknesses, and opportunities for program improvement. Using interviews, focus groups and workshops, researchers identified a variety of strengths and weaknesses as reported by SPD, NASA, and a sample of railroads.

Based on data collected during the evaluation, the team found that C^{3}RS is a complex system with many moving parts that change dynamically over time. The process by which employees submit reports and PRTs conduct event analysis has experienced the greatest number of process improvements compared to other parts of the C^{3}RS lifecycle. Researchers documented a variety of process improvements that make these post-implementation activities easier and more efficient.

The processes for implementing and monitoring CAs have received comparably less attention since C^{3}RS began. In part, this is because railroads spend less time analyzing the impacts of their CAs than they do performing event analysis, which makes it difficult to identify positive safety outcomes at almost all participating railroads. Demonstrating the value of implementing effective CAs can contribute to a virtuous cycle where employees and managers experience the value of reporting close calls. Additionally, documenting implementation and the systematic tracking of CAs present significant opportunities for safety improvements at most railroads.

The loss of institutional knowledge about C^{3}RS when staff turnover occurs has adversely impacted event reporting and analysis across all participating railroads. COVID-19 exacerbated these losses by increasing staff turnover and reducing the time available to devote to C^{3}RS-related activities. While SPD and NASA addressed these challenges by agreeing to re-educate and retrain employees when requested, railroads need to demonstrate their commitment to the program through integrating C^{3}RS into their safety management processes and relying less on assistance from SPD and NASA. The case study in Section 3.2.3 illustrates how MNR integrated C^{3}RS into its larger safety management process.

A positive outcome of C^{3}RS has been the consistent sharing of lessons learned among and across participating railroads (e.g., PRT newsletters, annual user meeting, etc.). The team encourages participating C^{3}RS stakeholders to continue sharing this information and leverage opportunities to distribute them to an even broader audience. Increased public promotion of the program's positive contributions to safety and safety-related processes (e.g., trade publication articles) may help additional railroads see the value of program participation. This will incrementally benefit safety in the railroad industry over time as more and more railroads opt to join C^{3}RS.

C^{3}RS is a system for learning from mistakes. All participating railroads could benefit from experimenting in small ways to improve upon their current use of C^{3}RS. The MNR illustrative case study described earlier shows the promise of this approach. Currently, SPD is experimenting with different models of C^{3}RS. One ongoing demonstration uses SLSI personnel as a PRT, while another tests a model of C^{3}RS at a Class I freight railroad using a different IMOU than that of currently participating railroads. SPD has modeled continuous process improvement through its efforts to address feedback from participating railroads and in initiating this independent evaluation.

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Appendix A.
Original Evaluation Questions

The table below shows the original set of EQs as found in the draft evaluation design plan (Volpe Center, 2022).

Focus Area	Evaluation Question
Program Processes	What are the strengths and weaknesses in the C^{3}RS pre-implementation and post-implementation phases, from the end-user perspective?
	How can the MCIA process/software be used more effectively?
Program Outcomes	Has the C^{3}RS program improved safety at participating railroads (and if so, how)?
	How has the C^{3}RS program influenced participating railroads' safety-related processes, actions, or communication/teamwork/collaborative work?
Program Sustainability	What are the barriers to management buy-in (i.e., participation in the program) and employee reporting of close calls? How might these barriers be overcome?
	What modifications are needed to sustain and grow the program (e.g., IMOU, other processes)?
	How can C^{3}RS be institutionalized at the railroads and within FRA?

Appendix B.
C³RS Workshop Output

This appendix consolidates data from two C³RS workshops led by the Volpe team to understand challenges associated with C³RS activities. Participants had a limited time during the workshop to work through challenges, examine causal factors, and propose solutions. Participants were asked to prioritize challenges. Only the challenges that participants indicated as "high priority" were further analyzed to produce causal factors and proposed solutions. Challenges that do not have associated causal factors and proposed solutions were considered lower priority.

The table below presents the comments made by the workshop participants.

Challenge	Causal Factors	Proposed Solutions
C³RS reports do not contain enough information Reports are vague or incomplete, they lack actionable information.	Lack of C³RS education (e.g., employees do not know what information is helpful to include) Employees may not trust the program / are worried about confidentiality and are therefore vague in the information they submit Time constraints/reports submitted at end of shift, causing people to rush through	Increased C³RS education and training for labor and management, including refresher training, consider training through external parties rather than FRA, NASA, or in-house. Secure funding for C³RS training Update guidelines; include in initial contract More support from management and labor (as liaisons/champions for the program) Break the culture of incomplete narratives by encouraging NASA to gather more critical information on callbacks. Continue to share the importance and benefits for reporters to answer callback as part of program/protection Easier access to information and better advertisement of available information (e.g., share success stories and use them in training, better access to training materials)
Difficulty getting C³RS reporters to answer the NASA callback	Call comes from an unknown phone number; reporters don't answer or check voicemail Reporters don't know to expect a callback The callback process may not be ideal	Request reporters reach out to NASA within 10 days of receipt of the outreach letter after unanswered callback. Increased C³RS education and training (e.g., put in the newsletter that reporters will hear from someone with a specific area code)

Challenge	Causal Factors	Proposed Solutions
Employee education/ rollouts/communication about C^{3}RS (particularly for new hires)	Related to the lack of management buy-in, commitment, and ownership (leaning too heavily on FRA) Management and labor have a responsibility but may lack sufficient knowledge on the program PRT does not have authority and is not involved in outreach as part of the C^{3}RS process Lack of trust in the program (possibly because of lack of management buy-in) PRT turnover Insufficient FRA resources (staff), FRA does not have enough time to speak to employees and management	Increased C^{3}RS education and training, including additional time for FRA outreach and training at carriers More support from management and labor (as liaisons/champions for the program), railroad ownership of the program More involvement from carrier safety department Additional resources, time and funding to supplement FRA training, create online resources), e.g. • "Train the trainer" courses • Staged video tutorial to demonstrate the C3RS process online available to everyone Simplify the protections so that employees are protected until after PRT process
Too much time passes before PRT works the case	Time required for callback due diligence can result in long processing times Dependent on the frequency with which PRT meets PRT may have a backlog of cases (due to infrequent meetings/many reports) Turnaround time for reports submitted to PRT from NASA	Eliminate callbacks if callbacks are the problem Provide more support to PRTs • More time to meet, more autonomy to make decisions regarding CAs
Program commitment (labor and management)	Cost of corrective actions Takes time away from inspectors and PRT members doing their jobs Skepticism within FRA (and the tension between approaches due to tendency toward discipline); "get out of jail free" mentality Skepticism within carrier management Poor leadership and lack of "skin in the game" from those involved	Provide carriers with additional resources (e.g., funding for putting corrective actions in place that were identified through C^{3}RS) Upper management support of the program Highlight successes of C^{3}RS (e.g., database of success stories) Enhanced training • Multiple professionally done video vignettes explaining the program, how to fill out reports, refresher training, etc.
Concern of misusing C^{3}RS to avoid discipline	Using C^{3}RS to avoid discipline Lack of understanding about the program	Increased C^{3}RS education and training for labor and management, including refresher training; consider training through external parties rather than FRA, NASA, or in-house.

Challenge	Causal Factors	Proposed Solutions
Lack of confidentiality for known events	Confidentiality is impossible for known events	Increased C^3RS education and training for labor and management, including refresher training; consider training through external parties rather than FRA, NASA, or in-house.
MCIA process not followed	PRT sees using the MCIA tool as time consuming (PRT is not given adequate time) Lack of knowledge of the process due to FRA having insufficient time to train Lack of buy-in for MCIA process Usability – is the MCIA tool easy to use, intuitive? C^3RS is not integrated with how safety is managed at the railroads	Involve the safety department in MCIA process Inclusion of C^3RS in SMS or Risk Reduction programs Additional resources, time, and funding to supplement FRA training, create online resources, e.g. • "Train the trainer" courses • Staged video tutorial to demonstrate the C^3RS process online that is available to everyone
Turnover and succession planning on PRTs	Failure to adhere to the handbook documented process of succession and not having a trained alternate when turnover occurs Carriers lean on FRA to train but FRA time/resources are constrained Training not properly integrated into new hire training within carrier Labor not assigning the right people (e.g., using PRT selection as a patron system – electing themselves to the PRT though they are close to retirement, not choosing PRT based on best fit) Promotions and employees seeking better work-life balance	Spend more time promoting the handbook (which includes the succession process) Ownership by labor, management, FRA for proper succession • Have safety department involved in C^3RS to assist Enhanced training • Professionally made video for re-training so carriers can adapt to turnover (note: initial training should be in person)
Getting the PRT to follow through with CAs	Labor leaders have an agenda If take the case, what is the CA? C^3RS is not a "get out of jail free" card Employee accountability: system issues with RR, but also human factor/human error Deck is stacked: 4 management members; 15-20 union reps. Large team, supposed to leave hats at door, but hard to get past labor agenda	Broaden representation on PRT More utilization of PRT Handbook/SOP (to stop and reset if agendas come into play)

Challenge	Causal Factors	Proposed Solutions
Failure to see the 'big picture'	MCIA does not have the ability to connect cases and look at trends Lack of expertise; turnover; inconsistent attendance Lack of education and a focus on the individual rather than the system	Enrich the MCIA tool, e.g., through visuals, capabilities to look at trending Expand education, e.g., emphasize use of DBQT and more tools and educate on the big picture Provide support from carrier safety department and connect the PRT to other statistics at the railroad; integrate C^3RS data with other safety statistics and trends
CA implemented before NASA report delivered	Turnaround time is too long (60-120 days) or variable. There is a lag before PRT can read report. Need to act sooner Inconsistent turnaround time What SOW is NASA bound by?	More frequent carrier heads up calls from NASA • Caveat: it is a judgement call on NASA's part regarding what rises to the top in terms of urgency. They don't know the organization as well as those working there. Faster NASA report turnaround time
Monitoring the effectiveness of the corrective actions	Time constraints Knowledge constraints (how to monitor for effectiveness?) Management buy-in Need proper rollouts of the corrective actions to ensure employees are educated on them	Consider evaluation and assign accountability When developing CAs, think through and develop a method to monitor effectiveness Assign someone to monitor for effectiveness Use DBQT and internal measurements
Not enough data from PRT to ST to implement CA	Not enough information from the narrative	Not enough data from PRT to ST to implement CA (making the safety case for CA)
Making the safety case (publishing success stories to the broader audience)	Lack of IT resources or trained personnel, access to IT resources	Opportunity for Labor to own a newsletter and publish these Consider what other railroads are doing, publish these more broadly
Railroad wants to use C^3RS information to apply discipline	Discipline is a fast way to collect data The culture of railroading contributes to this mindset - 'If he violates a rule, he is likely to violate again' There is a bad apple in every bunch. That affects the perception of the program if we have individuals who are mocking mid-level managers. Even after corrective actions are put in place, we still see safety issues emerge	The railroad could consider revising the IMOU Educate or incentivize workforce to properly fill out reports. Management education and buy-in, including education for management to show that discipline has not been effective in improving safety Assign ownership at each railroad to track CAs, goal of compiling success stories.

Challenge	Causal Factors	Proposed Solutions
Buy-in from labor will diminish if railroad uses data to target individual	Managers may not be familiar with the program and therefore may not understand that these reports cannot be used for discipline	Labor leadership and supervisors need to address known issues with employees
Insufficient time for FRA/PRT to communicate with employees (in particular, for passenger carriers and for initial training)	Time pressures Carriers introduce many safety measures/interventions and then move on (perception that C^{3}RS is one more safety intervention that won't stick around)	Enhanced training, e.g., professionally made videos Setting aside dedicated time in a quiet place to do rollouts and training, safety standdown
Logistics	Geographic dispersion, difficulty reaching lots of people (in particular, MOW, mechanical/signal)	Setting aside dedicated time in a quiet place to do rollouts and training, safety standdown Upper management support of the program
Labor representatives on PRT can cause conflict of interest		Develop a set of criteria defining how the PRT members are selected • this can be a handbook or in the IMOU • the process should be consensus, input from management, labor and FRA
PRT rush to conclusions	Time pressure, PRT does not have sufficient time to allocate to C3RS activities PRT faces pressure to rush/produce results	Enhanced training • Produce a video on the "5 whys" showing FRA implementation teamwork case from beginning to end FRA can play a role as guardians to the process to make sure it is working properly
Language discrepancy on C^{3}RS submission form (PRT wants to know about "on track safety briefing" instead of/in addition to "job safety briefing")	-	-
Funding/budget haggling for C^{3}RS program	-	-
Reporter gets protections despite not answering callback	-	-
Staffing PRT consistently to meet quorum requirements	-	-
Time given to PRT	-	-

Challenge	Causal Factors	Proposed Solutions
MCIA process is not viable for every case – because of lack of information or because there is no new information on the case	-	-
Not all PRTs have autonomy they need	-	-
Disconnect / lack of communication between PRT and NASA (and overreliance on FRA)	-	-
Rules in place (if there is a rule in place, PRT does not pursue corrective actions)	-	-
Growing the NASA newsletter to get more subscribers, getting word out about the website	-	-
No mechanism in place to update PRT contact information when turnover occurs	-	-
As technology changes, callbacks should include questions about problems associated with the changing technology	-	-

Appendix C.
SPD-initiated Improvements to C^{3}RS

The list below includes SPD's process improvements as provided by SPD.

- PRT MCIA refresher training
- Public speaking events at rail, labor, and railroad conferences espousing the benefits of C^{3}RS
- Responded to feedback from PRTs and facilitated significant program updates to the MCIA tool to meet end user needs
- Support refresher rollouts ad-hoc at railroad and labor request
- FRA C^{3}RS implementation request to fund an objective evaluation of C^{3}RS to assess the health of implementation activities post demonstration phase
- Provide ad-hoc response to PRTs 24/7 regarding close call event acceptance in relation to the IMOU
- Attend PRT meetings ad-hoc to assess case analysis with respect to following the MCIA process
- Expand the pool of FRA PRT member readiness by delivering formal instructor led training to FRA inspectors/chief inspectors
- Participate on NASA quarterly teleconferences and use this opportunity to update PRTs on latest C^{3}RS news from an FRA perspective

Appendix D.
NASA-initiated Improvements to C³RS

The list below includes NASA's process improvements as provided by NASA.

ENHANCING REPORT PROCESSING

- Revised and updated coding taxonomy and added PRT report legends to augment carrier-specific information and improve report understandability for PRT members (2018)
- Inventoried and continuously update station location / names by territory to improve the matching process / establish consistency across reports (2018 and ongoing)
- Created Standardized Callback Question Sets by event type based on input and feedback from Participating Carriers to augment reporter narratives with details needed by PRTs to better understand reported safety issues (2021)
- Created standardized synopsis syntax for consistency
- Instantiated continuous quality assurance feedback to C³RS Analysts for interrater reliability
- Changed processes to reduce processing times and increase speed of report transmission to portals including reducing hold time for report matching and reducing allowable callback and follow-up letter response times (2024)
- Provided cell phones to NASA analysts to support callback response rate (2020 to current)

REDUCING BARRIERS TO REPORTING

- Conducted a telephone survey (2019) with C³RS reporters to understand barriers to reporting which lead to subsequent improvements
- Created three mobile-responsive reporting forms (April 2023) to increase ease and efficiency of the reporting process and other improvements to the reporting form (e.g., making certain fields mandatory, adding clarifying text to certain fields, adding watermark to provide guidance for narrative)
- Continued efforts to educate rail workers on importance of detailed reporting and specific information to include in a narrative (Tips for Excellent Reporting newsletter (May 2019); Tips for Excellent Reporting posters and brochures (2019), note in newsletters, discussion during callbacks)

SAFETY PRODUCTS AND DATA SHARING

- Implemented file-share portals (2018) to send carrier-specific portals to PRTs
- Initiated quarterly PRT telecons to share insights from C³RS safety data with PRT members (2019)
- Implemented Carrier Heads-Up Notifications (2019) to supplement FYIs and Alert Bulletins (2016) for sharing time-urgent and carrier-specific safety concerns to carrier PRTs

- Increased number of ‘Inside the Rail’ Newsletter publications to quarterly (2021)
- Provided DBQT password-controlled access to Participating Carriers (2020)
- Published Database Query Tool on the C^3RS website (May 2021) making C^3RS data widely available. In Calendar Year 2023 there were over 2900 searches of C^3RS data

OUTREACH, EDUCATION, AND AWARENESS

- Develop, update, distribute outreach materials aimed at education and awareness of railway workers including: C^3RS Program Brochure, ID Strip Brochure, magnets, website cards, Tips for Excellent Reporting brochure
- Implemented QR Codes (for program information, newsletter signups, outreach form)
- Updated two outreach posters (11x17 and 8.5x11; 2024)
- Added educational notes in quarterly newsletters
- Provided a link for PRTs to order outreach materials (program sends between 25,000-40,000 annually)

IT AUGMENTATIONS

- Upgraded PRT Portals to increase cybersecurity and data protection (2022)
- Upgraded servers and systems to increase cybersecurity and data protection (2020-2023)
- Updated website (mobile friendly; added ‘Inside The Rail’ newsletters (past and current versions - April 2023); FAQs, etc.

Appendix E.
NASA Safety Topics

The table below lists safety topics chosen by NASA for discussion at various C^3RS forums. These topics are chosen based on reporting trends as determined by NASA.

Date	Topic	Forum
Jul-18	Traversing Crossings at Grade with Ditch Lights off	PRT Telecon
Nov-18	Analysis of Speed Deviations	Data Summary - Quick Response
May-19	Train Approach Warning Systems Summary	Data Summary - Quick Response
Dec-19	Dispatch Incidents	Data Summary - Quick Response
Jun-20	COVID Summary Report 1	Data Summary - Quick Response
Sep-20	COVID Summary Report 2	Data Summary - Quick Response
Dec-20	PTC Trends and Observations/Special Study Launched	PRT Telecon
Mar-21	Blue Flag Protection	PRT Telecon
Mar-21	Doors Off Platform	Data Summary - Quick Response
Jun-21	Emergency Application of Train Air Brakes	PRT Telecon
Sep-21	PTC Special Study	PRT Telecon
Dec-21	10 Years of C3RS	PRT Telecon
Apr-22	Operating Speeds when Onboard Control Systems Fail or Malfunction	PRT Telecon
Jun-22	Doors off Platform Presented	PRT Telecon
Oct-22	Class II Brake Tests	PRT Telecon
Dec-22	Shoving Movements	PRT Telecon
Mar-23	Year in review	PRT Telecon
Jun-23	Grade Crossing Notifications	PRT Telecon
Sep-23	Hand Brakes	PRT Telecon
Oct-23	Communication Breakdown	RailShare 2023/ MNR March 2024
Dec-23	Dispatcher / Local Dispatcher Protection	PRT Telecon
Apr-24	Inspection and Tests	PRT Telecon

Appendix F.
List of Opportunities for Improvement

This appendix provides a complete list of the opportunities for improvement identified by researchers in this study.

Opportunity	SPD	NASA	Railroad
Provide standalone resources that include software tools, videos, and documentation for the railroads to use in addressing staff turnover and communications about C^{3}RS.	✓	-	-
Provide training to FRA inspectors on how C^{3}RS works and how to evaluate a railroad's performance.	✓	-	-
Create a checklist for FRA PRT members to monitor feedback. This checklist can serve as a job aid in monitoring railroad status (e.g., has there been a change in leadership? Has the PRT developed innovate CAs to problems that can be shared industry-wide?)	✓	-	-
Set up periodic meetings between SPD and FRA PRT members to discuss items on the checklist and provide updates on railroad participation, including whether support is needed.	✓	-	-
Develop a secure portal for sharing resources among participating C^{3}RS railroads that provide items like ways to communicate about C^{3}RS (e.g., newsletters, videos, training materials, presentations, CAs in response to specific events, etc.).	✓	✓	-
Consider creating a full-time C^{3}RS position and hiring someone with research, operations, and data analysis skills. This employee can facilitate conversations that cross organizational boundaries and support the PRT with CA implementation, documentation, tracking, and analysis.	-	-	✓
Consider developing a demonstration with one or more railroads to assess the feasibility of a close call reporting program modeled after the FAA's ASAP.	✓	-	-
Encourage participating railroads to promote reporting on safety events for which they are concerned and want to learn more, so they can better address them. Just as NASA can do a special study on a specific topic, railroads can use C^{3}RS for known safety concerns to learn more about how they unfold and why they occur.	-	-	✓
Offer training to railroads on use of DBQT.	-	✓	-

Opportunity	SPD	NASA	Railroad
Consider making the DBQT available in visualization software like Tableau or Microsoft Power BI. Making DBQT available in this format could enable interested parties to make more effective use of this data.	-	✓	-
Create and maintain a list of current PRT members (e.g., as part of the MCIA software) so FRA and NASA can communicate with participating railroads.	✓	✓	✓
Identify mentors for railroads that are new to C^{3}RS. Identify people at other railroads who are willing to mentor their peers on the value of C^{3}RS and make C^{3}RS work to achieve their safety goals.	✓	-	-
Encourage more involvement from the ST in C^{3}RS activities, e.g., employee outreach, training, and implementing CAs.	✓	-	✓
Encourage more involvement from other railroad departments to support the PRT, e.g., with training, trending and data analysis, implementing CAs.	✓	-	✓
Support ST and PRT by providing them with adequate time to meet and conduct C^{3}RS activities including training and outreach.	-	-	✓
For railroads where the PRT and ST do not meet regularly, set up periodic meetings between PRT and ST to exchange information about C^{3}RS, to seek resources when needed, and to help show value or impact.	-	-	✓
Share C^{3}RS lessons learned, including broad trends in event reporting and corrective actions implemented in response to these events, to the broader railroad industry may encourage more railroads to join C^{3}RS.	✓	-	-
Increase training about which close call events are covered under the C^{3}RS program and which events are not.	-	-	✓
Work together to understand sources of ambiguity and address them. When possible, standardize IMOU agreements for consistency across railroads.	✓	-	✓
Work together proactively to determine whether an amendment to the IMOU should be made to prevent confusion about which types of events are eligible for C^{3}RS protection.	✓	-	✓
Develop a set of criteria to define how PRT members are selected, e.g., in the PRT handbook. Process should reflect consensus between management and labor, with input from FRA.	✓	-	✓

Opportunity	SPD	NASA	Railroad
If a PRT or ST member is moving to a new position, a replacement should be selected and trained beforehand to support a smooth transition. The replacement should be included in PRT meetings to observe the MCIA process "in-action."	-	-	✓
Consider including someone from the training department on the PRT to ensure that there is an employee with expert knowledge of the program who can answer employee questions during training.	-	-	✓
Spend more time promoting the handbook during initial training, including documented processes for succession planning.	✓	-	-
Make efforts to set aside dedicated time in a quiet place to conduct rollout activities. Consider an extended rollout period to expose as many employees as possible to the program.	✓	✓	✓
Employees should receive formal training (either imbedded in refresher training, or in new-hire training when employees are brought on) that can teach specifically about (1) which events are eligible under the program, (2) how to write detailed close call reports, (3) what happens to reports after they are submitted, to ensure an understanding of NASA's role in maintaining reporter confidentiality and anonymity, and (4) to expect a callback by NASA if their reports do not contain adequate detail.	-	-	✓
Provide additional support for C^3RS education and outreach. Act as champions, or liaisons, of the program. Employees should know who in management or which union representative they can approach when they have questions about the program. This may require management and labor to receive additional training and education about C^3RS.	-	-	✓
Provide employees with more training and access to information about how detailed reporting can lead to CAs to support safety at their railroad. Show examples of detailed reporting during training (e.g., NASA's *Tips for Excellent Reporting*).	✓	-	✓
When the number of reports with insufficient details rise to a level that concerns the PRT, reach out to employees to remind them of the need to provide more detail in their reports.	-	-	✓
Create training videos for railroads to use to support accurate and consistent training across railroads.	✓	✓	

Opportunity	SPD	NASA	Railroad
Pilot test an employee reporting form that prompts the employee to provide detailed information (e.g., using tool tips) when filling out the report that addresses the items in the NASA brochure *Tips for Excellent Reporting.*	-	✓	-
Pilot test an employee reporting form that can be filled out using voice-to-text.	-	✓	-
Explore whether making the narrative the first piece of information entered on report results in more detailed reports. Consider pilot testing a version of the reporting form that asks narrative information at the beginning of the report to combat "form fatigue" and identify trade-offs to obtaining detailed narrative information versus information in dropdown boxes that captures event conditions and categorical information about the employees involved, which currently comes first in the reporting form. Consider a pilot whereby NASA conducts A/B testing to evaluate the value of organizing the forms with different sections appearing first.	-	✓	-
Consider modifying the event reporting form to ask the reporter if NASA has permission to schedule a callback if necessary (and allow the reporter to specify a personal cellphone or email address at which they would like to be contacted).	-	✓	-
Consider whether the 30-day minimum holding period can be reduced. NASA can work with PRTs to consider the tradeoff between a potential safety impact and maintaining the anonymity of the reporter. If railroad confidentiality is a concern, NASA can keep this 30-day holding period for DBQT submission. Discuss the trade-offs with C^3RS stakeholders during quarterly meeting that NASA holds and at the annual user meeting to solicit feedback from stakeholders.	-	✓	-
Track reporting for incidents with multiple event reports. What is the distribution of the timing of reports being submitted to NASA? If a majority of matched reports arrive within a five-day window, can the matching period be reduced to five days? Consider the tradeoffs to matching reports and send the report to the PRT for analysis. Can reports be matched after-the-fact, where the PRT would instead receive an edited report to account for additional details?	-	✓	-
Consider ways to accelerate the CHU process. For example, determine if AI can support this process by scanning event reports to search for keywords/phrases that are deemed time-critical (e.g., homeless encampments) and flagging for immediate review by a NASA analyst.	-	✓	-

Opportunity	SPD	NASA	Railroad
Provide railroads with a formal process or opportunity to share specific concerns or incidents they would like to be given a 'heads up' on.	-	✓	-
Set up meetings with individual railroads to identify contextual elements to ask about specific event types. Use this information to inform callbacks with employees for specific railroads.	-	✓	✓
Explore whether the use of automation or AI can assess report detail and determine whether callback may be needed.	-	✓	-
When technology permits, move toward real-time processing of reports to determine if a call back is needed. Also, consider word count and level of detail in making this decision. Attempt a callback as soon as possible after the employee submits the report. Conducting the call-back close to the time of report submission helps ensure improved recall of event details.	-	✓	-
Consider training and adopting chatbot technology to supplement human interviewers for callbacks.	-	✓	-
When possible, collect and analyze secondary sources to corroborate event report details to support event analysis.	-	-	✓
For known events, consider conducting interviews with the reporting employee to obtain additional information.	-	-	✓
In MCIA software, add filtering and sorting for contributing causes, root causes, and CAs under the report menu.	-	✓	-
Consider additional ways that the MCIA software can support PRTs in trend analysis (i.e., to observe patterns of information from close call reports). One example would be to map events to a track chart so PRTs can look for patterns by location.	✓	-	-
Consider additional ways the MCIA tool can be used to support CA implementation (e.g., by guiding the PRT to include details about scope, budget, and timeline). Enable the PRT to share the proposed CA directly with the ST via the MCIA tool.	✓	-	-
Create and maintain a publicly shared (e.g., on FRA's website) list of CAs organized according to the safety hazard they address.	✓	-	-

Appendix G.
NASA's *Tips for Excellent Reporting* Newsletter Issue

This appendix includes the *Tips for Excellent Reporting* issue of NASA's *Inside the Rail* newsletter, published in May of 2019. This issue can be found online at https://c3rs.arc.nasa.gov/docs/itr/C3RS_InsideTheRail_Issue7.pdf

To view all of NASA's C^{3}RS *Inside the Rail* Newsletters, refer to NASA's C^{3}RS Safety Products page: https://c3rs.arc.nasa.gov/products.html

TIPS FOR EXCELLENT REPORTING TO C^{3}RS

C^{3}RS is a Confidential Close Call Reporting System designed to improve railroad safety by collecting and analyzing reports which describe unsafe conditions or events in the railroad industry. C^{3}RS has nine railroads currently participating in the program and has received over 16,000 reports since inception in 2011. Employees can report safety issues or "close calls" **voluntarily and confidentially**. What can you do to help? Here are some Tips and Tricks for Excellent Reporting.

Ways to Submit Your Report to C^{3}RS

NASA C^{3}RS has developed three report forms: Transportation, Mechanical, and Engineering, which are tailored to specific employee crafts. You should use the form that pertains to the craft you are working in. Even if you encounter a safety issue that involves a Mechanical or Engineering issue as a Transportation employee, you should fill out the Transportation Report Form. Submit your report through NASA's secure C^{3}RS website at https://c3rs.arc.nasa.gov. Or, return the postage paid paper report form to NASA via U.S. mail.

Who Can Report?

Employees whose carrier and craft are covered by a written Implementing Memorandum of Understanding (IMOU) can participate in NASA C^{3}RS and receive a waiver from discipline in exchange for providing your valuable safety information.

NASA **removes all personal and third party references, dates, times, and related information which could be used to infer your identity.** In the history of NASA safety reporting, reporter or carrier confidentiality has never been compromised.

What Can I Report?

C^{3}RS welcomes close calls and safety concerns. A close call is any condition or event that may have the potential for more serious safety consequences. Just a few examples of close calls include:

- A train going above authorized maximum speed (provide the overspeed amount and if PTC was involved)
- A train striking a derail without derailing
- Run-through switch incidents
- On-track protection
- Blue Flag Protection
- Equipment or signal failure
- Communication, Training, or Procedural Issues

What Shouldn't I Report to C^{3}RS (Outside the Scope)?

NASA C^{3}RS follows the Implementing Memorandum of Understanding (IMOU) between the carrier, affected labor organizations, and the Federal Rail Administration (FRA). According to Article 6.1 of the governing IMOU, incidents that are considered **outside the scope** of the program include:

- Damage that meets/exceeds FRA reporting threshold (currently $10,700)
- Any injury to a person
- An event resulting in an identifiable release of a hazardous material
- Real Time Observation / Efficiency Testing
- Tampering or willful act, alcohol or drug use, or sabotage

Tell Us Your Whole Story!

To ensure you are submitting a report that would result in a safety improvement, ask yourself:

- What was the event?
- When did it happen?
- Who discovered it and prevented it from becoming more serious?
- Where were the other crewmembers at the time of the event?
- Why do you think this happened or what might have contributed?
- Were there any human factors (communication, fatigue, distraction) that may have contributed?
- What was the result?
- What could prevent this event in the future (any ideas for corrective actions)?

Providing **detailed and complete reports** is vital to making the railroad industry safer. Once NASA de-identifies and analyzes your report, your carrier's Peer Review Team uses this information to develop corrective actions to help prevent more serious incidents or accidents in the future.

Will NASA Call Me?

A NASA C³RS Expert Analyst may call you if you do not include sufficient information or to better understand the safety issues you are sharing. It is very important that you **return our call within 3 days** so that your identification (ID) strip (sent by U.S. Mail) can be returned quickly. The more information you include in your report, the faster the ID strip can be returned to you!

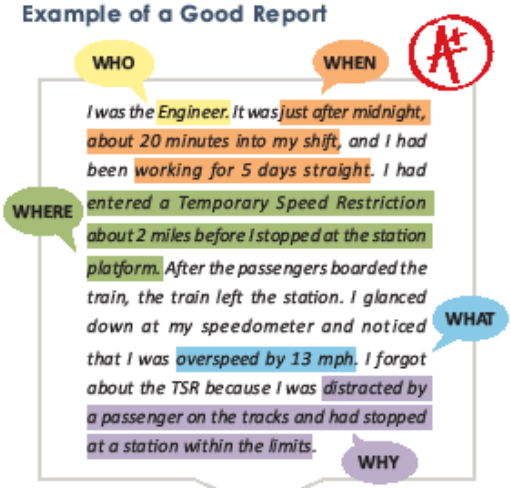
What Can I Expect after I Submit a C³RS Report?

- If you submit your report on the C³RS website, a page will pop up with a verification code. This verification code is proof that your report has been securely transmitted to C³RS, but is **not** your identification (ID) strip.
- Each report is read by two NASA C³RS Expert Analysts within 5 days to look for system-wide alerting potential.
- The report, including the text description you provided to us, is completely **confidential, de-identified, and analyzed** by C³RS Expert Analysts, each with over 10 years of railroad operational experience.
- A NASA C³RS Expert Analyst may call you to obtain additional information if you do not provide enough information for their analysis.
- NASA C³RS will remove the ID Strip at the top of your report, date stamp it, and return it to you by U.S. Mail. This ensures that your personal information (name, address, carrier name, etc.) has been removed from your original report. Retain this ID strip as it is your **proof of report submission**.

Example of a Report with Insufficient Information

A C³RS Expert Analyst would need to contact you to understand the who, when, where, what the overspeed amount was, and why you thought it happened. This may take longer to process and get your ID strip back to you.

Example of a Good Report



NASA C³RS Expert Analysts analyze and de-identify each report and may call you for additional information

NASA C³RS sends your de-identified report to your carrier's Peer Review Team (PRT)

PRT conducts Multiple Cause Incident Analysis (MCIA) on each report

PRT develops corrective actions for implementation at your carrier. Examples of successful corrective actions include:

- Speed restriction throttle reminder tags
- Switch position indicator lights
- Wayside signs and signals added and / or repositioned

Report Intake By Craft January to December 2018	
Transportation	4,078
Mechanical	175
Engineering	80
Signal	1

C³RS
Inside The Rail
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https://c3rs.arc.nasa.gov

Monthly Report Intake Previous 3 Months 2019	
February	311
March	353
April	386

A Safety Newsletter from **The NASA Confidential Close Call Reporting System** | P.O. Box 177, Moffett Field, CA 94035-0177

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Abbreviations and Acronyms

ACRONYM	DEFINITION
AI	Artificial Intelligence
ASAP	Aviation Safety Analysis Program
C^3RS	Confidential Close Call Reporting System
CHU	Carrier Heads Up
DBQT	DataBase Query Tool
FAA	Federal Aviation Agency
EQ	Evaluation question
FRA	Federal Railroad Administration
MCIA	Multiple Cause Incident Analysis
MNR	Metro-North Railroad
IMOU	Implementing Memorandum of Understanding
NASA	National Aeronautics and Space Administration
OMB	Office of Management and Budget
PRA	Paperwork reduction act
PRT	Peer Review Team
PTC	Positive Train Control
RDT	FRA's Office of Research, Development and Technology
RRS	FRA's Office of Railroad Safety
SLSI	Short Line Safety Institute
SMS	Safety Management System
SPD	FRA's Safety Partnerships Division
ST	Support Team
Volpe	The Volpe National Transportation Systems Center