Transport Canada   Transports Canada

Best Practices for Crew Resource Management Training

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Canada

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1. BACKGROUND

Transport Canada (TC) defines crew resource management (CRM) as:
"A set of practices that focuses on threat and error management, communication, situational awareness, decision-making and leadership skills in environments where human error can impact on safety."
(Transport Canada, 2021)

1.1 The Motivation for Creating a Best Practices Document

Over the last few years, TC has been working on modernizing the existing regulatory requirements found in the current *Railway Employee Qualification Standards Regulations* (REQSR). The importance of this work was highlighted in a Transportation Safety Board (TSB) recommendation of 2018 (R18-02), where the TSB called for a review of these regulations. As part of this work, TC is proposing to introduce the concept of Crew Resource Management (CRM) as a component of the training regime. This would include requirements for both initial training and continuing (refresher) training, as stated in TC's discussion paper on the Let's Talk Transportation website. The CRM training requirements would be applicable to operating crews, remote control locomotive operators, yard persons, and rail traffic controllers, in addition to contractors, supervisors and management employed in these positions.

More recently, the TSB final investigation of occurrence R19W0002 asserted that CRM issues were identified as "Findings as to Risk" (which are "conditions, unsafe acts or safety deficiencies that were found not to be a factor in this occurrence but could have adverse consequences in future occurrences") in the main-track collision and derailment that took place on January 3, 2019 near Rivers, Manitoba. As such, the TSB issued recommendation R22-05, which states:
"*The Department of Transport require, under the Railway Employee Qualification Standards Regulations, Canadian railways to develop and implement modern initial and recurrent crew resource management training as part of qualification training for railway operating employees."* (Transportation Safety Board of Canada, 2022)

In response to the TSB recommendation above, TC has developed this best practices document for industry relating to CRM training.

1.2 Brief History of CRM

Crew Resource Management (CRM) originates from a series of serious accidents in the aviation industry in the late 1970s. Root causes were identified as human factors issues relating to ineffective teamwork, including lack of leadership, over focusing on technical problems, poor communication, inadequate task allocation, and poor judgement and decision-making. CRM training emerged in the early 80s as a way to address these issues. Over the years, CRM training has evolved to include aspects such as optimization of the human-machine interface and interpersonal activities (e.g., effective team building and maintenance, information transfer, leadership, problem solving, decision-making and maintaining situation awareness (SA). Modern CRM training also includes a focus on threat and error management, which can be defined as managing risks to safe operations, and includes both human errors and equipment related issues.

The guidance developed by the Office of Rail and Road (ORR – rail regulators in the UK) states that although CRM is a fundamental component to managing risks, it is important to remember that it will not address all the risks associated with peoples' cognitive abilities. Some cognitive abilities are innate, hardwired, and not trainable. Risks relating to the limitations of cognitive abilities are therefore best addressed by other means such as equipment design and task design.

Since the 90s, CRM in aviation has been extended to included broader groups involved in flight operations, such as maintenance workers, and air traffic controllers, as opposed to just the flight crew. It has also been adapted for use in other high-consequence, high-risk, time-critical industries, including the marine, health care, offshore oil and gas, and rail industries. The motivation to address CRM in rail in the US stems from US FRA data showing human factors as the primary cause in 42% of all train accidents between 1992 and 2003[1] . Ineffective CRM has been identified as a contributing factor in rail accident investigations by the National Transportation Safety Board (NTSB) in the US and the TSB in Canada. The NTSB recommended the development of a "Train CRM" program in **1999**[2].

2. OBJECTIVES

There are two objectives of this guidance document:

1. Identify CRM training best practices from other countries and industries; and
2. Adapt the identified best practices to provide guidance for Canadian railways.

3. SCOPE

A review was carried out of current training approaches for CRM within the following organizations:

- Federal Railway Association (US FRA);
- Federal Aviation Authority (FAA);
- International Civil Aviation Organization (ICAO);
- Office of Road and Rail (UK ORR), and the UK Civil Aviation Authority; and
- Australian Office of the National Rail Safety Regulator.
- Beyond the rail industry, the study will incorporate material from TC's existing aviation standards on CRM.

The training approaches of these organizations were reviewed because, like TC, they are regulators for an industry in which effective communications plays a large role in ensuring the safety of operations. In addition, they are organizations that see the value in CRM and are already implementing CRM training. It is important that the FRA is included due to the similarity in US railways operations and Canadian operations, and the fact that some railways operate in both countries.

4. Approach

The information sources listed in the scope (detailed references are listed in section 6) were reviewed and summaries were created of the CRM training topics, training methods, and other best practices addressed in these documents. These summaries are available upon request. The topics, methods and

[1] Federal Railroad Administration, *Rail Crew Resource Management (CRM): Pilot Rail CRM Training Development and Implementation (Washington, DC, 2007),* 1.

[2] Federal Railroad Administration, *Rail Crew Resource Management (CRM): Pilot Rail CRM Training Development and Implementation (Washington, DC, 2007),* 1.

other best practices were then compared to identify those that were common (or mostly common) across the organizations (information sources). In addition, those practices that were not necessarily common, but were considered by the reviewers to be good practices were also identified.

5. BEST PRACTICES

The following subsections contain the best practices relevant to the Canadian rail industry that were extracted from the information sources listed in the references. The best practices are categorized according to training topics or content, training methods, and any other relevant best practices that do not fit under topics and methods.

5.1 Training Topics

While nine different topic areas are presented in this sub-section, it is recognized that the areas overlap with each other as they all play an integral role in successful CRM. With the exception of the Introductory Module and Module 2 - Human Cognition, there is no prescribed order in which these modules should be presented. In addition, there is flexibility in which topics to group together under one module.

1. Introductory Module

A CRM training program should begin with an introductory module, providing an overview of the training content and agenda. This module should include the following:

- A brief history of CRM, describing its relevance to operational rail safety and how it can assist in mitigating team-based human factors related safety risks, enhance task efficiency, improve the use of resources, and increase job satisfaction.
- CRM should be defined as a means to develop attitudes and behaviours to contribute to teamwork skills and performance, but it should be emphasized that it is not a cure for all causes of safety occurrences.
- The main training topics to be addressed in the training should include: human cognition, threat and error management (TEM), leadership, teamwork, communication, decision-making, safety management, and emergency management.

2. Human Cognition

Understanding human cognition is key to understanding the value of CRM, as it provides information about how humans think and why people behave the way they do. Some of the topics listed below are addressed again in later modules. The purpose of this module is to identify the theory required to understand these aspects of human performance. The focus of the later modules is to explore these aspects of human behaviour in practice in the operational context. This module should include the following topics:

- the causes and consequences of human error
- perception – how humans detect information in their environment

- information processing – how this information is used to understand and diagnose the situation, and determine appropriate actions
- attention, vigilance and monitoring
- workload – discussions about the impact of high and low workload, prioritization, delegation, and planning of tasks, verification of others' work to reduce errors during high workload and low workload, time management, and managing automation where overreliance or under reliance can lead to errors
- how humans behave in emergency and stressful situations
- situational awareness (SA), –definition and identification of the impact of SA on team performance, an overview of the three levels of SA (perception of the relevant inputs and information, comprehension of what the information means, and projection which is the determination of an appropriate response) factors affecting SA, such as attention, workload, working memory, automation, and interface design, loss of SA, and recovering from the loss
- decision-making error and skills,
- stress management include defining job-related stressful situations, developing skills to manage stress, how to recognize and cope with stress in teams
- sleep and fatigue – circadian rhythms, time awake versus time working considerations; how fatigue affects judgement, decision making, performance, and communications; potential barriers to good quality sleep including age, stress, alcohol, caffeine, medication, environment, and sleep disorders; how to recognize fatigue in oneself and others; and how countermeasures such as napping, physical activities, and eating can help mitigate fatigue. (This topic may be left out of CRM training if it addressed in another training program, or a brief refresher can be included. If fatigue is not addressed to this extent in CRM training, it should be at least discussed that fatigue can adversely impact crew communications.)
- training and experience, –how training and experience can impact upon performance in teams
- attitudes toward technology, such as trust or lack of trust of automation
- personality and culture – the impact upon human performance
- attitudes toward safety

3. <u>Threat and Error Management (TEM)</u>

A risk assessment should be carried out to identify the threats and errors which can impact safety within the organization. TEM within CRM should address the following topics:

- external threats (e.g., environment, time pressure, equipment limitations, rules and procedures, etc.)
- internal threats (fatigue, team familiarity, experience, etc.)
- potential human errors (i.e., actions or inactions that lead to unintended outcomes)
- how threats can be managed, including the identification of steps to avoid, recover from, or mitigate against the consequences of errors

4. Leadership

This module should address the following topics:

- different types of leadership (e.g., autocratic, democratic, and laissez faire)
- appropriate assertion of authority and the authority gradient
- identification of characteristics of effective versus ineffective leadership
- accountability
- decisiveness
- maintaining standards of performance
- facilitating participation of other team members

5. Teamwork

The following topics should be addressed in this module:

- relationship between leadership and followership and the influence it has on the group
- shared mental models - that is a shared view of how processes and procedures work, as well as how equipment and technology function
- situational awareness
- workload management and stress
- supporting team members through assistance, and development of their understanding
- preventing and resolving conflicts
- group decision-making
- positive behaviours, and the identification of behaviours that can have a negative impact on teamwork
- developing best practices to improve teamwork

6. Communication

A key to successful leadership and teamwork is effective communication. Training relating to communication should include the following:

- speaking and listening skills
- body language
- appropriateness
- assertiveness
- tone and clarity
- content of communications
- quality and timing of communication such as the use of briefings, debriefings, radio procedures, and shift handovers
- role of communication in establishing shared mental models and situational awareness
- where and how communications can fail and how communication breakdown can lead to human errors

7. Decision Making

The following key aspects of decision-making should be addressed in this module:

- involving all team members in decisions relating to normal and special circumstances (e.g., in emergency situations, and situations where employees are fatigued)
- steps to diagnose the issue, identify an appropriate response, assess risks, implement solutions, and assess the outcomes
- conflict resolution when the team cannot agree on a common path

8. Safety Management

This topic does not need to be a module by itself but the content should be integrated within the other training modules, and should include:

- training on mechanisms for communication of safety issues to management, including reporting of occurrences

9. Emergency Management

CRM training should identify specific emergency situations where the CRM skills will be imperative to the success of emergency prevention or emergency response, and should address:

- the diagnosis and evaluation of the situation
- regular risk reassessments if the emergency progresses
- decision-making to prioritize needs
- providing support to others by reassuring them and helping them to remain calm, while taking actions to ensure the safety of passengers and other rail employees

5.2 Training Methods

A variety of different methods should be used to teach CRM, since the theory is important to understanding the concept, but much of the success of the program hinges on participatory exercises.

1. Classroom learning should be used for the following:

- the history of CRM and theory of human cognition, and the other topics to be addressed within CRM
- both passive and interactive (participatory) activities
- relevant case studies to demonstrate both the effective and ineffective uses of CRM
- video and audio recordings of relevant occurrences showing positive results of effective teamwork, and voice recordings of effective communication
- facilitated discussion on the above topics to engage participants
- role plays which allows participants to practice skills during fictional scenarios. Participants can roleplay in their actual job function, or switch roles to promote appreciation of the demands of the other roles. Feedback can be provided by partners, or through re-watching video recorded of the session and conducting a self-assessment.

2. Simulator Training

Beyond the classroom, the training can be strengthened and practiced prior to implementation in the field using simulators. It is acknowledged that not all railways have access to a simulator, and it is not suggested that the railways should make this investment in order to address CRM, but if available this is a useful training tool to use. These sessions can be video recorded for debriefing and feedback purposes. Simulators can be used for the following purposes:

- carrying out role playing exercises
- practicing a wide range of realistic scenarios, both normal operational circumstances (to improve efficiency), and emergency situations
- videoing the exercises so performance can be observed afterwards, and feedback can be provided and discussed.

3.On- the Job Training:

- After initial training in the classroom and the simulator, CRM should form a component of on-the-job training so that CRM can be practiced in real circumstances
- CRM practices should form part of the evaluation criteria during on-the-job training
- CRM practices should be reinforced during operations activities such as pre-job briefings.

4. Refresher Training:

- CRM training should form part of the continuing (refresher) training required for recertification and return to work purposes
- CRM practices should be integrated into other operations training programs to cement the concepts of CRM into everyday behaviours.

5.3 Other Best Practices

The following practices were also considered important to the success of the CRM training:

- detailed content of the training should be based on a risk assessment of the organization's specific activities
- the CRM training should be scaled to the size of the organization and the nature of the operations
- the training should be piloted with a test group is to ensure that content is relevant, delivery is effective, and the timeliness of the training is acceptable
- instructors should have relevant experience in developing and delivering training and in evaluating performance, as well as operating experience, in addition to experience using CRM principles (ideally)
- participants should include all the job roles that interact to safely move the train, and so should include Locomotive Engineers, Conductors, Rail Traffic Controllers, Maintenance personnel and any other employees involved in the movement of trains, including Managers who temporarily take on any of these roles

- contractors and subcontractors, who carry out the role of employees identified in the bullet above, should also receive CRM training,
- evaluation of trainee performance should be based on behavioural markers (i.e., observable behaviours), which should be identified based on an organization's own operational context
- effectiveness of the training program should be evaluated. Options for evaluation of the program's effectiveness include post-training questionnaires, and observation of non-technical work performance (in non-emergency situations and in a non-punitive fashion).

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