Canadian Pacific Railway

Risk Assessment / Risk Management Protocol

Overview / Outline

At Canadian Pacific Railway, we conduct risk assessments of our activities and operations for a number of different reasons;
• Control and reduction of hazards that could impact our employees, our property, third party property, and the public at large
• Compliance with legislation and standards
• Control and reduction of insurance costs
• Improvement of the effectiveness of the safety management effort

Questions we are trying to answer in Risk Management;
• What are the hazards inherent in our business?
• What are the undesirable events that can occur at the risk source?
• What can their impacts be on the receptors? How likely are they?
• Should we try to eliminate or reduce the risk?
• If we should........how can we?

The concept of risk includes four components;
• Hazards inherent in an activity otherwise deemed beneficial, and an undesirable event which brings out the hazard.
• Adverse consequences of the undesirable event.
• Uncertainty of whether the undesirable event will happen or not (likelihood).
• Perception about the combined importance of the three

We often base our decisions on perception. Accurate understanding of the inherent hazards and consequences, and likelihood of undesirable events, will lead to;
• More balanced perceptions
• Better decisions in "managing that activity" or "managing the risks associated with that activity".

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Proactive risk assessment can provide many benefits, including:
• Identifying the key risk areas to enable cost-effective controls to be identified
• Determining the safety impact of changes to systems, processes & equipment
• Assessing the compliance of existing risks with established risk acceptability criteria
• Allowing comparisons to be made among different options to eliminate or mitigate risks
• Prioritizing safety critical investments based on cost/benefit analysis
• Driving continuous improvement and innovation in company business processes

What is Risk Management?
• Building safety into physical assets, as well as the way people think, behave and work.
• Application of management principles and systems to identify, understand, and control hazards to prevent undesirable events.
• Proactive identification, assessment and mitigation or prevention of undesirable events that could occur as a result of failures of processes, procedures and equipment.

What is the focus of Risk Management in CPR operations context?
• Personal, operating, equipment and transportation related aspects of risk management (rather than market, currency or insurance related aspects).
• Development of;
  • the necessary expertise, experience and judgment capability, and
  • a culture of commitment and proactive initiative in employees, and
  • the appropriate structure in the organization, to properly develop, implement and maintain programs and systems for managing risks related to our operations.

The basic question that everyone should be asking all the time;
• How can I do my job in a manner that will make it safer for;
  • the things that I value
  • myself
  • my fellow workers
  • my community
  • my environment
  • the equipment I work with
  • my company
  • my investors
Why bother?
- Safety issues present significant risks to business performance.
- The potential impact on the profit and loss of an organization can be significant.
- An undesirable event typically includes;
  - A relatively small (10-20%) *direct cost* (readily identifiable tip of the iceberg). Direct costs may include items such as repair and cleanup.
  - A relatively larger (80-90%) *indirect cost* (inherent soft or hidden costs). Indirect costs may include items such as management time, investigation costs, compensation claims, increased insurance costs, increased regulatory intervention, business interruption, loss of good will, impact on corporate reputation, impact on stock values, etc.
- Assuming a 5% profit margin, an undesirable event that appears to cost $20,000 may require $2 to $4 million in extra revenue to cover the total costs.
- How easy is it to generate the additional revenue required to compensate for poor safety performance?

Requirements for success in balancing the needs of stakeholders and achieving superior risk management performance;
- Executive management *(top-down) commitment* to risk-based decision making for balancing the needs of the stakeholders (safety "culture").
- Employee and management *(bottom-up) awareness, involvement, understanding and commitment* throughout the ranks about their safety management responsibilities and accountabilities (safety "culture").
- A line organization structure conducive to effective communication and cooperation, with risk management responsibilities built into the performance criteria of all personnel (safety "culture").
- Sufficient human and physical resources.
- A risk management process model that is understood by all.
- A common risk management standard that reflects the values of the organization and the requirements that are asked of it.
- Availability of an appropriate variety of integrated risk assessment and cost/benefit analysis tools, which are used as suitable during the daily and/or strategic decision making process. These tools are used to determine the level of risk, using appropriate risk measurement parameters, and to evaluate suitability of control actions.
- Appropriate risk control strategies.
Risk Management Process Steps

- The complete process of stakeholder participation, risk assessment, control and monitoring.
  1. Identify stakeholders and ensure their participation
  2. Identify hazards
  3. Identify undesirable events
  4. Risk analysis - Estimate/produce a measure of the risk (what can go wrong, what are the consequences, how likely is it?) using frequency analysis, consequence analysis, and their integration.
  5. Risk evaluation - Develop values and judgments of consequences, and identify a range of alternatives for managing the risks, plus risk communication and consultation (stakeholder participation) (do we need to do anything about it?)
  7. Risk control - Develop, select and implement measures to eliminate, reduce or contain risk, taking into account their cost and benefits and their enforcement (if we need to do something about it, what should it be?)
  8. Risk monitoring - Monitor whether all the risk control measures are implemented and functioning as intended (auditing, tracking performance measures) (are we doing the things we said we should do, and how well?)
Risk Management Process

1. Initiation: Identify the Activity to be Managed, Identify the Stakeholders / Risk Receptors

2. Scope Definition: Define Boundaries, Identify Needs of Stakeholders

3. Risk Assessment
   3a. Risk Analysis:
       - Hazard Identification (at-risk behaviour and physical conditions)
       - Consequence Analysis
       - Likelihood Analysis
       - Risk Estimation/ Ranking
   3b. Risk Acceptability Evaluation: Do we need to reduce risk?

6. Learning: Broaden Scope, Increase Detail to Reduce Uncertainty

Continuous Improvement Loop

4. Risk Control:
   - Add/ Modify Controls (New safety programs/ design changes/ training, land use planning, emergency response)
   - Risk Avoidance
   - Risk Transfer
   - Risk Financing
   - Risk Control

5. Risk Monitoring:
   Carry on with Activity / Monitor Controlled Risks / Audit

Classical Management Process Steps
- Set Policy and Direction
- Assess
- Plan
- Implement
- Review
Transport Canada - Risk Management Process

Step 1: Identification of Safety Issues and Concerns

Step 2: Risk Estimation - assessment of the probability and severity of the safety issue/concern either qualitatively or quantitatively.

Step 3: Risk Evaluation - evaluate and determine whether the associated risk is tolerable, tolerable with mitigation, or unacceptable, using a predetermined company risk classification methodology.

Step 4: Risk Control - introduce control measures to eliminate the situation, substance, condition or activity that generates the risk, or to reduce the probability of occurrence, or to mitigate the consequences.

Example – Risk Resolution Matrix

<table>
<thead>
<tr>
<th>PROBABILITY</th>
<th>Catastrophic</th>
<th>Critical</th>
<th>Marginal</th>
<th>Negligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent</td>
<td>unacceptable</td>
<td>unacceptable</td>
<td>unacceptable</td>
<td>tolerable with mitigation</td>
</tr>
<tr>
<td>Probable</td>
<td>unacceptable</td>
<td>unacceptable</td>
<td>tolerable with mitigation</td>
<td>tolerable with mitigation</td>
</tr>
<tr>
<td>Occasional</td>
<td>unacceptable</td>
<td>tolerable with mitigation</td>
<td>tolerable with mitigation</td>
<td>tolerable</td>
</tr>
<tr>
<td>Remote</td>
<td>tolerable with mitigation</td>
<td>tolerable with mitigation</td>
<td>tolerable with mitigation</td>
<td>tolerable</td>
</tr>
<tr>
<td>Improbable</td>
<td>tolerable with mitigation</td>
<td>tolerable with mitigation</td>
<td>tolerable with mitigation</td>
<td>tolerable</td>
</tr>
</tbody>
</table>
## Typical Railway Hazards/Risks/Events and Potential Risk Control Strategies

<table>
<thead>
<tr>
<th>Area</th>
<th>Hazards, Risks, Events</th>
<th>Risk Control Strategies</th>
</tr>
</thead>
</table>
| **Train and Equipment Operations**| - missed or misunderstood communications  
- failure to follow rules or procedures  
- failure to see/obey signals  
- changes in timetable speeds  
- changes in frequency or times of operation  
- human reliability (alertness, ability to use equipment and follow procedures)  
Events:  
- unintended movements (runaways)  
Risks:  
- derailments  
- collisions | - uniform, coordinated development and implementation of operating rules and procedures  
- periodic review and revision of operating rules and procedures  
- training programs  
- monitoring of employees and supervisors  
- rules violation monitoring  
- human factors analysis  
- work process mapping |
| **Equipment, Infrastructure and Facilities** | - equipment failures leading to collisions, derailments and/or employee injuries  
- unsafe equipment  
- safety appliances  
- passenger cars  
- infrastructure failures  
- rail failures (broken, spread)  
- track condition (ties, ballast, cross level, spirals, tight rail)  
- areas of recent work  
- bridge failures  
- slope failures  
- washouts  
- flooding  
- avalanches  
- impact of significant changes to operations (type of service, speed, frequency, weight)  
- signal system failures  
- crossing automatic protection failures  
- unsafe facilities  
- passenger stations  
- shops  
- bulk storage facilities for dangerous goods (diesel fuel, methanol, propane, etc.)  
- pipelines and pipe crossings  
# devices on the right-of-way  
- hot box detectors  
- wheel impact load detectors  
- acoustic detectors  
- thermal imaging detectors  
- transponders for use in Advanced Train Control Systems  
# devices on railway equipment  
- washout and slide detectors  | - inspection and maintenance standards and procedures, including cycles, record-keeping procedures, and corrective action and implementation monitoring procedures  
- design and construction standards and procedures  
- modification review and approval process  
- procedures for the review and approval of modifications to equipment, systems, infrastructure, etc.  
- procedures to document changes to equipment and systems, including on as-built drawings  
- procurement procedures to prevent the introduction of defective or deficient materials and supplies or unauthorized hazardous materials  
- relevant safety policies, requirements and standards communicated to suppliers through purchasing documents or specifications  
- facility inspection procedures, including a hazard identification and elimination process, cycles, record-keeping procedures, and corrective action and implementation tracking procedures  
- safety technology  |
<table>
<thead>
<tr>
<th>Area</th>
<th>Hazards, Risks, Events</th>
<th>Risk Control Strategies</th>
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</thead>
<tbody>
<tr>
<td>Grade Crossings</td>
<td>Hazards:</td>
<td>• grade crossing construction and maintenance standards</td>
</tr>
<tr>
<td></td>
<td>• condition of crossing causing accidents not involving trains</td>
<td>• inspection frequencies and procedures</td>
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<td></td>
<td>• impact of anti-whistling prohibitions</td>
<td>• crossing safety assessments, including assessment frequencies</td>
</tr>
<tr>
<td></td>
<td>• changes in train or roadway speeds</td>
<td># traffic volumes</td>
</tr>
<tr>
<td></td>
<td>• changes in frequency or time of operation</td>
<td># traffic types</td>
</tr>
<tr>
<td></td>
<td>Events:</td>
<td># sight lines</td>
</tr>
<tr>
<td></td>
<td>• near misses causing emergency brake application</td>
<td># crossing surface</td>
</tr>
<tr>
<td></td>
<td>• crossing blockages impeding emergency services</td>
<td># frequency of obstruction</td>
</tr>
<tr>
<td></td>
<td>Risks:</td>
<td># protection of pedestrians</td>
</tr>
<tr>
<td></td>
<td>• collisions with vehicles</td>
<td>• application of the risk management process to crossing hazards and the development of appropriate location-specific controls</td>
</tr>
<tr>
<td></td>
<td># deaths</td>
<td>• a public awareness/education program with respect to crossing safety that involves road authorities and other affected parties</td>
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<td></td>
<td># injuries</td>
<td>• number posted at crossings</td>
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<td></td>
<td># derailments</td>
<td>• a process for identifying problem locations</td>
</tr>
<tr>
<td></td>
<td># equipment damage</td>
<td>• application of the risk management process to trespassing hazards and the development of appropriate location-specific risk controls</td>
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<td></td>
<td>risk to personnel such as flagmen</td>
<td>• a public awareness/education program with respect to trespassing</td>
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<td></td>
<td>• impact of noise from crossings on local residents</td>
<td>• involvement of local authorities</td>
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<tr>
<td></td>
<td></td>
<td>• fencing and physical barriers</td>
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<tr>
<td></td>
<td></td>
<td>• provision of alternatives crossings</td>
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<tr>
<td></td>
<td></td>
<td>• keeping right-of-way free of debris</td>
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<tr>
<td>Trespassing</td>
<td>Hazards:</td>
<td>• a process to ensure safe interface between railways and between the railway and customers</td>
</tr>
<tr>
<td></td>
<td>• objects on track</td>
<td>• methods of ensuring that other railways and customers are aware of their safety responsibilities</td>
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<tr>
<td></td>
<td>• changes in train speed</td>
<td>• procedures to assess the training and qualifications of customers and other parties whose activities may directly affect railway safety</td>
</tr>
<tr>
<td></td>
<td>• changes in frequency or time of operation</td>
<td>• supervision and proficiency testing</td>
</tr>
<tr>
<td>Interface with Other Railways and Customers</td>
<td>Hazards:</td>
<td>• a process to ensure that contractors are trained in the organization’s safety</td>
</tr>
<tr>
<td></td>
<td>• unauthorized track/yard occupancy</td>
<td>• equipment left foul</td>
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<tr>
<td></td>
<td>• equipment left foul</td>
<td>• failure to be qualified in or to follow standard rules and procedures</td>
</tr>
<tr>
<td></td>
<td>• failure to be qualified in or to follow standard rules and procedures</td>
<td>• receiving or delivering defective equipment</td>
</tr>
<tr>
<td></td>
<td>• operation on infrastructure not maintained to minimum standards</td>
<td>• operation on infrastructure not maintained to minimum standards</td>
</tr>
<tr>
<td></td>
<td>• restricted clearances</td>
<td>• restricted clearances</td>
</tr>
<tr>
<td></td>
<td>Risks:</td>
<td>• collisions</td>
</tr>
<tr>
<td>Contractors</td>
<td>Hazards;</td>
<td>• a process to ensure that contractors are trained in the organization’s safety</td>
</tr>
<tr>
<td>Area</td>
<td>Hazards, Risks, Events</td>
<td>Risk Control Strategies</td>
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<tr>
<td><strong>Employee Safety</strong></td>
<td>Hazards;</td>
<td>• an employee safety program and health controls that meet the requirements of the Canada Labour Code (Part II)</td>
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<tr>
<td></td>
<td>• fitness for duty</td>
<td>• a process for feedback on risk control actions, safety performance and safety audit results to employees</td>
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<td></td>
<td>• unsafe conditions not identified or corrected</td>
<td>• formal job briefings</td>
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<tr>
<td></td>
<td>• failure to identify, provide or use safety equipment</td>
<td>• safety awareness and promotion programs</td>
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<tr>
<td></td>
<td>• hazardous materials in workplace</td>
<td>• a workplace hazardous materials program meeting the Workplace Hazardous Materials Information System (WHIMIS) requirements</td>
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<td></td>
<td>Events;</td>
<td>• safety training, particularly with respect to new equipment, processes and procedures</td>
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<tr>
<td></td>
<td>• incidents (near misses)</td>
<td>• a recognition and rewards system that recognizes the right behaviours and safe working practices</td>
</tr>
<tr>
<td></td>
<td>• deaths</td>
<td>• a safety ombudsman</td>
</tr>
<tr>
<td></td>
<td>• injuries</td>
<td></td>
</tr>
<tr>
<td><strong>Dangerous Goods and Hazardous Materials Transportation</strong></td>
<td>Hazards;</td>
<td>• knowledge of and compliance with the applicable standards, rules and regulations</td>
</tr>
<tr>
<td></td>
<td>• receiving or delivering defective or leaking tank cars or containers Risks;</td>
<td>• procedures for identifying and feeding back containment failure data and maintenance deficiencies to the shippers of the dangerous goods</td>
</tr>
<tr>
<td></td>
<td>• risk to employees from spills, leaks and container failures</td>
<td>• procedures for integrating the organization into industry and community awareness and emergency response (CAER) programs</td>
</tr>
<tr>
<td></td>
<td>• risk to the public and communities from large-scale accidents and incidents</td>
<td>• criteria for identifying and activating external resources for dangerous occurrences</td>
</tr>
<tr>
<td></td>
<td>• negative public perceptions adversely affecting operations</td>
<td>• procedures for liaison with and management of external resources at dangerous occurrences</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• participation in the Canadian Chemical Producers Association “Responsible Care” initiative</td>
</tr>
<tr>
<td><strong>Environmental Impact</strong></td>
<td>Hazards;</td>
<td>• knowledge of and compliance with the applicable standards, rules and regulations</td>
</tr>
<tr>
<td></td>
<td>• noise and fumes</td>
<td></td>
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<tr>
<td></td>
<td>Risks;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• damage to the environment from</td>
<td></td>
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</tbody>
</table>
## Area

### Hazards, Risks, Events

- ongoing operations
  - damage to the environment from accidents, including dangerous goods and fuel spills

### Risk Control Strategies

- identification of risks (threat assessments) and development of security plans and procedures (with the appropriate confidentiality)
- staff training and familiarity with security risks and procedures
- security exercises
- links with security agencies

### Vandalism, Terrorism and Sabotage

#### Hazards:
- objects on right-of-way
- misaligned switches
- disabled signals and crossing protection
- thrown objects
- sabotaged equipment
- bomb/sabotage threats

#### Events:
- runaway equipment
- risk to employees and operations from deliberate malicious acts

### Emergencies

#### Hazards:
- dangerous goods involvement
- earthquakes
- proximity to other installations
  - dangerous goods processing or storage facilities
  - mining
  - pipelines
  - nuclear generating stations

#### Events:
- blocked crossings (emergency services unable to get through)

#### Risks:
- derailments
- collisions
- employee injuries
- passenger injury/evacuations
- fires (including right-of-way)
- spills into the environment

#### Emergency Preparedness and Response

- emergency preparedness and response procedures, including emergency response plans
- procedures for initial response, call out and on-site management
- procedures for notifying and liaising with other agencies, as required
- procedures for conducting drills and tests
- periodic review and revision of procedures, in particular after incidents
- awareness of and integration with community and site-specific emergency plans

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