Hazard Identification and Risk Assessment

Road Safety At Work website content

In order for an organization to take well-targeted actions that prevent motor vehicle incidents (MVI) and safeguard employees, it must first understand how employees can get hurt while driving for work. Identifying the hazards they encounter, understanding the factors that contribute to crashes and evaluating the associated risks are key steps in an effective road safety program.

Overview

This section explains hazard identification and risk assessment processes from a road safety perspective. It provides tools that will help you identify and categorize the hazards your drivers encounter, systematically evaluate the risks and establish priorities to control those risks. There are four parts.

1. The Basics – definitions and explanations of terms
2. Hazard Identification – steps to systematically identify hazards, linked to a hazard inventory and classification tool
3. Risk Assessment – two methods for assessing MVI risks plus examples that demonstrate both
   a) Method One: A Simple Risk Matrix
   b) Method Two: The Quantified Risk Scale
4. Resources – tools you can use to identify hazards and assess risks, and templates you can modify to fit your organization

The Basics

Understanding key terms will help you apply processes and tools in this section.

A **hazard** is a thing or condition that can expose a person to risk of injury or occupational disease. It's any potential source of harm, damage or adverse health effects. However, MVIs have sweeping consequences beyond personal injury. For road safety purposes, we also need to think of hazards in terms of exposing people and organizations to other significant losses – property damage, business interruption and reputation damage, and environmental harm.

Our approach to driving-related hazards

Using a somewhat narrow traditional approach, the primary *hazard* or source of harm that we seek to eliminate, is the motor vehicle incident. Certainly, there are driving-related hazards that do not involve a crash. Improper seating positions that cause musculo-skeletal injuries, the mental toll of intensely challenging road conditions, physical violence by a passenger, or being stranded by a vehicle break-down in extreme weather are a few. These are surely hazards to address. However, the greatest single source of harm associated with driving is the energy unleashed during a crash.

Unfortunately, applying a traditional understanding of *hazard* does not work very well for motor vehicle incidents. It is difficult to complete a meaningful risk assessment of a singular, yet vastly complex, hazard such as a crash. To get risk assessment results that you can readily use to build your action plan, you need to dig a little deeper and look closely at the things, conditions, circumstances, actions and inactions – the factors - that can cause or contribute to a crash.

Therefore, our approach to driving-related hazards includes conditions and circumstances that a traditional approach would classify as *contributing factors* or *risk factors*.

Types of driving-related hazards include:

1. **Physical**
   - objects - a sharp rock, wildlife, worn tire or faulty brake
   - substances - carbon monoxide, drugs, alcohol, fuel and hazardous fluids in or on a vehicle
   - materials - gravel road surface, ice
   - temperature – extreme weather temperatures, contacting a hot surface
2. **Energy**
   - kinetic - an oncoming vehicle, the speed of the vehicle you are in
   - gravity - car falling off jack during tire change
   - electrical – shock from an incorrect jumper cable connection
   - noise - prolonged exposure to a loud exhaust system
   - pressure - compressed air or hydraulic fluid

3. **Conditions, processes and practices**
   - conditions – fatigued driver, poor traction, insufficient lighting or visibility, stressful driving circumstances such as heavy traffic or aggressive drivers,
   - processes - insufficient driver training, lack of vehicle inspections or maintenance
   - practices – overloading vehicle; high-risk driving behaviours such as speeding, following too close or texting while driving; poor ergonomics such as improperly adjusted seat.

Risk is the possibility or potential for loss. Losses incurred by MVIs can include physical and psychological injuries to workers and others, costs of repairing or replacing damaged property, and impacts to business processes (e.g. lost productivity, reputation) and the environment. Three factors determine how much risk is associated with a given hazard:

- **Frequency of Exposure** – how often and for how long workers are exposed to the hazard.
- **Probability of Occurrence** – the likelihood that a MVI or other incident will occur.
- **Severity of Consequences** - the magnitude of loss, negative consequences or impacts.

The following formula explains risk.

Risk = Exposure x Probability x Severity

Tip: In the risk equation, implementing measures that make any one of the variables zero also makes the risk zero. For example, if no worker is exposed to a hazard, exposure equals zero and risk is zero.

Find other helpful terms and definitions in our Glossary.

Hazard Identification

Hazard identification involves looking for things, conditions and practices in your employees' driving environments that have potential to cause or contribute to a crash, and identifying the people who may be exposed to those hazards.

Hints for Identifying Hazards

If you are not familiar with all the hazards your drivers face, try the following.

1. Speak with the drivers. What practices, locations or situations do they consider "dangerous"?
2. Go for a ride-along. Experience the conditions and circumstances your drivers encounter.
3. Check vehicle inspection reports. What mechanical issues do you see or hear about?
4. Review near-miss reports and incident investigations. What caused or contributed to those events?
5. Check a vehicle owner's manual. Review the operating instructions and watch for "Caution" labels and "Hazard" symbols.
6. Think about non-routine and high-risk driving circumstances. What dangers are there?
7. Talk with other employers. What are their biggest road safety challenges?
8. Who could be harmed? Usually, we think about injuries to the driver. Who else could be harmed – their passenger(s), other motorists, pedestrians or cyclists?

Tip: Effective hazard identification is a team effort. Involve your employees – supervisors, managers and especially the employees that drive for work. They know the hazards they face, and which ones are of greatest concern. They also have good ideas on how to manage the risks.

Use a Systematic Approach

Driving is complex. Drivers operate vehicles in a wide range of circumstances and conditions. Environments change, so do the drivers, vehicles and hazards. Use a step-by-step approach to identify and keep track of hazards.

Tip: It's effective to identify and organize hazards in terms of the driver, the vehicle and the journey.

The Road Hazard Inventory

Your organization might already have an effective method to identify and classify workplace hazards. If you do, apply it to road safety. If not, have a look at the Road Hazard Inventory. This worksheet lists many of the road safety hazards and categorizes them by driver, vehicle and journey.

To build your own Road Hazard Inventory, select the hazards that apply to your workplaces and drivers. Modify descriptions so they accurately reflect hazards in the driving environments your employees encounter. Add hazards or factors that aren't there. Rather than deleting hazards that don't apply, simply strike through them. Even though that hazard may not currently be present in your workplace, it might be the next time you review your hazard inventory.

Risk Assessment

Once you have an inventory of driving-related hazards, the next step is a risk assessment in which you estimate or calculate how much risk each hazard presents. There are two common approaches.

Qualitative methods classify risks based on descriptions of frequency and severity criteria. Qualitative methods are subjective and usually assign relative risk rankings such as low, medium, high or extreme.

Quantitative methods are objective and place greater reliance on numerical data and statistics or records to "score" frequency of exposure, probability of occurrence and severity of impacts and calculate individual risk scores.

Risk assessments using either method should take full advantage of relevant direct observations and records – how often certain types of crashes have occurred, how frequently specific hazards have contributed to crashes, which vehicle types, which drivers, which locations, as well as the nature and magnitude of consequences. However, because risk assessments are forward-looking procedures seeking to *anticipate* risks and prevent MVIs, many organizations don't have enough data to use purely quantitative methods to assess road safety risks.

Even when your risk assessment incorporates industry data or incident information from employers engaged in the same type of work, it can be difficult to gather reliable, representative numbers for each hazard. Usually, evaluating road safety risks requires that assessors also apply their qualified estimate or *informed best guess* in a combination of qualitative and quantitative methods.

Sections below demonstrate two such hybrid methods.

- **Simple Risk Matrix** is a 3 x 3 matrix that uses qualitative descriptions and comparative ranges of values to rank risks as high, medium or low.
- **Quantified Risk Scale** has three risk variables and applies more precise qualitative criteria as well as specific values to calculate individual risk scores.

Method One: Simple Risk Matrix

The simple risk matrix in Table One relies on probability and severity scores of high, medium or low to assign relative risk rankings. The color-coding in the matrix provides you with a visual sense of the relative priority attached to that hazard.

Table Two provides comparative criteria or descriptors to help determine the probability and severity associated with each hazard. The outputs of Table Two are the inputs for Table One.

Table One: Simple Risk Matrix

Severity	HIGH			
	MEDIUM			
	LOW			
		LOW	MEDIUM	HIGH
		Probability		

Table Two: Simple Risk Matrix Assessment Descriptors

Rating	Probability	Severity
High	• Frequent or repeated event • Occurs at least once a year in the organization • Occurs several times during a project • Occurs often in similar circumstances (e.g. in another company that does work similar to yours) • Greater than 50% chance of occurring	• Serious or disabling personal injury, permanent disability or fatality • Costs to repair / replace property damage greater than $100,000 • Loss of business function for extended period, substantial consequences for business
Medium	• Event is known to occur, but not frequently • Occurs less than once a year in organization • Has occurred in similar circumstances (e.g. in another company that does work similar to yours) • 10% to 50% chance of occurring	• Injury requiring medical aid with or without lost time from work • Costs to repair / replace property damage $25,000 - $100,000 • Loss of business function for short period, modest consequences for business
Low	• Unlikely event, has not occurred in your company but could happen • May happen once in 10 years • Has never been observed, but possible • Less than 10% chance of occurring	• No injury or minor injury requiring first aid • Costs to repair / replace property damage less than $25,000 • Minor business interruption

Using the Simple Risk Matrix

Adapt Risk Assessment Criteria to Your Organization

Table Two (above) provides several descriptors with reasonable thresholds designed to yield appropriate probability and severity ratings for driving-related hazards in many workplace circumstances. However, you should review each descriptor, consider your company's business processes, values and risk tolerances, and revise the descriptors to fit your needs.

For example, for some larger employers, property damage costs of $25,000 have small impacts to their bottom line, and such a loss is properly scored as having low severity. For other organizations, $25,000 property damage costs can have a significant impact on their viability, and would therefore have medium or high severity. For some businesses, (such as self-employed contractors), even a short-term business interruption can have disastrous consequences, so would be scored as having high severity.

You may want to add environmental impacts (e.g., fuel spill, toxic release) or other consequences that could be associated with a crash, and are important for your organization.

Assign Scores for Probability and Severity

Once you have made those adjustments to the descriptors, the next step is to assign a probability score and a severity score to each of the hazards you want to assess (e.g. from the Road Hazard Inventory).

When scoring each hazard, keep the following questions in mind.

Probability – Collectively, how often are our employees exposed to this hazard? In our organization, or in other organizations like ours, how often does this occur? How likely is this to occur?

Severity – If this hazard causes a crash or other incident, what are the most likely outcomes? How much will it cost? How severe are the injuries and other losses likely to be? How will that impact our business?

Applying the Simple Risk Matrix

Example One

In the last two years, ABC Health Services has experienced two near crashes because their driver is distracted by a passenger or client. Based on what "just about" happened, ABC thinks such a crash would probably result in injuries to the driver and client (and perhaps an occupant of another vehicle) and it would cost about $50,000 to repair damaged vehicles. The ABC health and safety committee assign a medium severity and high probability to such outcomes, and ranks the priority of managing risks associated with passengers distracting their drivers as HIGH.

Example Two

XYZ Courier Services is working hard to win contracts. Recently, some drivers have adopted the practice of eating lunch "on the road" thinking it will improve productivity. Others are concerned this added task reduces their ability to pay attention to traffic, and drive. Yesterday, a driver damaged his van when he backed into a loading dock while trying to eat a sandwich. Today, XYZ has hired a contractor to fix their

client's loading dock, and is trying to repair its damaged business reputation and keep that client. XYZ management assigned a high severity and high probability to such outcomes. They have made eliminating "driving lunches" a HIGH priority.

Example Three

QST Construction is expanding its resource road construction business to highway projects. They are proactive about safety issues, but don't have experience to know how severe or probable MVIs will be in their new highway work. They can't afford a new fleet of pickups, so will have to rely on their "old" fleet. QST is hiring new drivers for the projects. Management is unsure whether they should first pay attention to vehicle inspection and maintenance procedures, or improve their driver orientation process.

QST estimates potential consequences of a crash due to either a mechanical failure or deficient driver orientation are about the same - lost time injuries and repair costs less than $100,000. Over the last 15 years, QST has had two vehicle mishaps due to mechanical failure; they estimate the likelihood of vehicle failure incidents as medium. However, because QST employees and supervisors have very little highway construction experience, QST feels the likelihood of a driver-related mishap is greater than the likelihood of a vehicle-related mishap. They have started building a better driver orientation process.

Example Four

Below is a snapshot of how A & R Taxi Ltd used a simple risk matrix to prioritize their action plans.

Hazard	**Probability**	**Severity**	**Priority**
Taxi won't start due to mechanical (battery) failure	High – happens at least once each year across fleet	Low – minor business delay; cost of repair = $100	Medium
Taxi collides with another vehicle at intersection	High – happens at least once per year across fleet	Medium – lost time due to injuries; cost to repair damaged property = $45,000	High
Taxi backs into pedestrian while parking	Medium – happened once before to this company; a few occurrences at other taxi companies	High – pedestrian receives serious injuries; liability costs greater than $100,000	High

For a more extensive example of how to apply the Simple Risk Matrix, download **Applying the Simple Risk Matrix - Top Notch Consultants**.

To access the working tool, download the **Simple Risk Matrix Assessment Tool**.

Advantages and Limitations of the Simple Risk Matrix

This section briefly describes some of the advantages and disadvantages of using a simple risk matrix. Reviewing these will help you appreciate some of its strengths and limitations, and see where its use best fits your organization.

Advantages

+ Intuitive – uses the assessor's perception of organizational driving risks
+ Can get reasonable risk rankings without extensive data or numbers
+ Adaptive – can adjust risk criteria to match company circumstances
+ Two rather than three variables to consider

One advantage of the simple matrix is that it is not necessary to have precise information or data about each hazard. Instead, it enables you to do a comparative analysis that, in some applications, can be sufficient. For example, you might not know how often a given hazard has contributed to crashes in the last five years. You might not have accurate reports on the severity of their consequences. As long as you have an informed sense that hazard A is more likely than hazard B to contribute to a crash, you can assign a greater probability to hazard A. If you know that MVIs that involve hazard A almost always have more severe consequences than MVIs involving hazard B, you can assign a comparatively greater severity ranking to hazard A. Applying those non-precise, qualitative inputs to the risk matrix enables you to assign priorities and start on your action plan.

Limitations

- Results are relative and therefore less precise then quantitative methods.
- When there are several risks to evaluate, all output rankings will fall into three rankings – low, medium and high. Certainly, hazards that get a "high" score are the first priority. However, if there are a dozen of more hazards that receive a "high" ranking, it is not obvious which three are your top priorities.
- To get reliable rankings from a simple matrix, assessors need a good sense of the frequency with which drivers are exposed to each hazard and the associated probable severity. That experience and knowledge can be difficult to come by.

Method Two: The Quantified Risk Scale

The Quantified Risk Scale uses three variables and applies more precise qualitative criteria as well as specific values to calculate individual risk scores. The three risk variables are:

- frequency of exposure,
- probability a crash or other loss will occur, and
- severity of impacts.

Table Three shows the scoring criteria used to rate each of the variables associated with a given hazard.

Table Three: Quantified Risk Scoring Guide

Rating	Frequency of Exposure	Probability of Occurrence	Severity of Consequences
10	Continuous - occurs many times per day.	It is **almost certain** that an incident will occur and cause the expected results; likelihood greater than 50%	Results in 2 or more fatalities, catastrophic property damage (more than $1 million) and/or business termination
8	Frequent - occurs several times each week, or daily	It's **quite possible** or probable the incident will occur; likelihood 10% to 50%	Results in single fatality, severe property damage (greater than $500,000) and/or lengthy business interruptions
6	Common - occurs about once each month	It's a possible occurrence, but it is **unusual**; 1% to 10% likelihood	Results in serious injury, loss of use of limb or long-term disability, property damage $100,000 to $500,000 and/or business interruptions up to one month
4	Occasional - occurs 3 - 5 times each year	It hasn't happened in this organization, but it is **remotely possible**; likelihood less than 1%	Results in injuries and short-term disability, property damage less than $100,000 and/or minor business delays
2	Unusual - occurs once a year	It's conceivable but **very unlikely**; not aware this has ever occurred, but it could; likelihood = 1 in 10,000.	Results in injuries requiring medical aid and incurring lost time, property damage less than $25,000 and/or minimal business inconvenience
1	Rare - possible, could occur once every 10 years	It's **practically impossible**; likelihood = 1 in 100,000	Results in negligible impacts to well-being of any person (employee or external), little or no property damage and no impacts on business processes

Applying the Quantified Risk Scale Approach

To help you use the Quantified Risk Scale (QRS) approach, we developed a QRS assessment tool. It has three (3) components: a road hazard inventory, the scoring criteria (the Quantified Risk Scoring Guide above), and the QRS Assessment Tool. The outputs of this method are individual risk scores that enable you to easily identify the hazards that deserve top priority.

Before seeing how the QRS is applied, it is helpful to re-visit the risk variables and to keep the following questions in mind.

- **Frequency of exposure** – How many and how often are drivers exposed to this hazard? Does frequency of exposure vary widely among drivers? If it does, you will need to group drivers by level of exposure and calculate a relative risk for each driver group.
- **Probability of occurrence** – If your drivers encounter a given hazard, how likely is it an incident will occur? Do you notice that some employees with different types of driving assignments have a greater or lesser probability of being involved in a crash that involves a given hazard?
- Severity of consequences– If an MVI incident occurs, what do you expect the impact will be? Will someone likely be injured? How severe will the injuries be? How much will it cost to repair or replace damaged property? How will it affect your business?

The ABC Trucking Ltd scenario applies the above scoring guide. Using a few of the hazards that ABC Trucking regional delivery drivers face, below is an explanation of why ABC Trucking scores risks the way they do.

Hazard / Contributing Factor	Frequency of Exposure	Probability of Occurrence	Severity of Consequences	Risk Score
distraction - texting or talking on cell phone while driving	6	6	4	**144**
distraction - conversation with or interference by passenger	1	2	6	**12**
distraction - responding to dispatcher call, 2-way radio	8	8	4	**256**
insufficient orientation or training, lacks necessary competencies; inexperienced	2	8	6	**96**
does not recognize driving hazards or hazardous conditions and/or adapt driving accordingly	6	8	6	**288**

Cell phone distraction – ABC issues each regional delivery driver a company cell phone for emergencies. ABC has strict procedures prohibiting phone use while driving, but phone records show that each month at least one of their drivers is on their phone while driving (frequency = 6). Although ABC has not yet experienced a crash due to cell phone distractions, they know other trucking companies have; it is quite possible ABC will experience such a crash if cell phone use continues (probability = 6). They also know that when those crashes occur, they typically result in lost time injuries to the driver and repair costs up to $100,000 (severity = 4).

Passenger distraction – ABC has a clear policy against drivers carrying non-employee passengers (exposure = 1). Even if a driver disobeys the policy and carries a passenger, ABC feels it would be very

unlikely to cause an incident (probability = 2). If a crash does occur, the expected consequences would be injuries and lost time plus property damage up to $100,000. However, because ABC would also be liable for health care costs of the passenger, the safety committee increases the severity rating one position (from 4 to 6).

Dispatcher distraction – ABC dispatchers have a reputation of demanding that drivers respond to calls immediately. Several times each day, a driver is distracted from their driving duties by a dispatcher's call (exposure = 8). ABC drivers have reported 17 near misses (probability = 8) and one incident that resulted in lost time injuries and substantial repair costs (severity = 4).

Insufficient orientation – Most ABC regional delivery drivers are experienced veterans, but ABC has hired five new drivers in the last year to replace retiring drivers. Although they pair each new hire with a reliable mentor, ABC expects that new hires will sometimes encounter situations they don't know how to handle when their mentor is not available for guidance (exposure = 2). One such crash (probability = 8) resulted in serious injuries to another motorist (severity = 6).

Hazard recognition – About once a month (exposure = 6), an ABC driver reports a near miss or is involved in a MVI that is a consequence of the driver either failing to recognize a hazardous condition, or recognizing the hazardous condition but failing to adjust their driving to accommodate the condition. ABC has found that when that occurs, an incident is quite probable (probability = 8) and the consequences are costly (severity = 6).

Making Improvements and Reducing Risks

In their 2014 risk assessment, ABC recognized that their greatest risks came from drivers not recognizing hazards and hazardous conditions, or failing to adjust their driving accordingly (as per below).

Hazard	Frequency	Probability	Severity	**Risk Score**
Does not recognize driving hazards or hazardous conditions and/or adapt driving accordingly	6	8	6	**288**

Realizing it is not possible to eliminate those hazardous conditions, ABC enrolled drivers in training that explained how to actively look for and recognize hazards and showed them how to adjust their driving in anticipation of potentially hazardous conditions. In a recent risk review, ABC noticed that the frequency of near misses has declined, and drivers say they are less likely to be involved in a near miss or collision when they apply those techniques. The new risk assessment reflects the success of ABC's risk management actions.

Hazard	Frequency	Probability	Severity	**Risk Score**
Does not recognize driving hazards or hazardous conditions and/or adapt driving accordingly	4	6	6	**144**

Advantages and Limitations of the Quantified Risk Scale

Advantages

+ deals with frequency of exposure as a distinct variable. Users assign a frequency score based on their knowledge of how many and how often drivers are exposed to each hazard. This step provides more concise risk scores, and lets the user set priorities with greater confidence.
+ scoring descriptors are more precise and require less "guess work" or interpretation than the Simple Risk Matrix.
+ resulting risk scores provide better differentiation between competing hazards, making it is easier to see which ones are the highest priorities.

Limitations

– three rather than two variables to consider
– greater reliance on records, data and statistics; a plus if you can access those numbers, but a minus if you can't.

Rating the Risks and Applying Results

Because your risk scores set priorities for the real work of eliminating those hazards and managing risks, spend enough time on the risk assessment to get it right. The objective is to arrive at a well-reasoned relative ranking that will guide your safety efforts to deliver the "best bang for your safety bucks".

For either model above, there are at least a couple of approaches to scoring the variables.

- Work as a team to discuss each hazard and variable and agree upon each ranking or score.
- Have two or more knowledgeable people score the hazards independently, and then compare results. It's unlikely that both would have identical scores, but overall results should be similar. If two assessors come up with quite different scores, they apparently perceive the exposure, probability or severity quite differently. Look closely at why there is a difference, and determine the best answer.

Either way, when drivers look at the resulting ranking, they should agree that addressing those highest-ranked risks makes good sense. Managers should be able to see that investing in controls to address top-ranked risks should yield the greatest safety improvements and the best return on investment.

For a more extensive example of how to apply the Quantified Risk Score, download **Applying the Quantified Risk Scale ABC Trucking Ltd**. To access the working tool, download the **Quantified Risk Scale Assessment Tool**.

Taking Action

The key to making hazard identification and risk assessments work for you is to take action. Once you decide on priorities, the next step is to develop measures to control those hazards and minimize associated risks. To learn more about developing those controls and building safe work procedures look to the next section in this Tool Kit.