



FEDERAL TRANSIT ADMINISTRATION

Public Transportation Agency Safety Plan Implementation: Hazards and Consequences Self-Guided Learning Tool

Version 1, July 2019

Use the “advance” links within this document to advance a page or the “return” links to go back to a previous page.

[Advance](#)



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Overview

Understanding the difference between hazards and consequences is fundamental to effective Safety Risk Management (SRM) under a Safety Management System (SMS).

There is confusion about the two terms – sometimes a consequence is mistakenly identified as a hazard and vice versa!

Understanding the difference between hazards and consequences greatly improves the accuracy of safety risk assessments and therefore greatly improves the implementation of effective safety risk mitigations.

[Advance](#)

[Return](#)

Purpose of the Learning Tool

The Federal Transit Administration (FTA) developed this tool to help individuals distinguish between hazards and consequences as the terms apply to SRM.

Advance

Return

Learning Objectives

By the end of this course, participants will be able to:

- Correctly identify hazards and consequences; and
- Explain why understanding the difference between hazards and consequences is important for effective SRM under SMS.

[Advance](#)

[Return](#)

Knowledge Checks

We will check our learning with a brief knowledge check at the end of each section. You can take each check as many times as you like.

We will practice taking a knowledge check on the next page.

[Advance](#)

[Return](#)

Sample Knowledge Check

This training is designed to teach the participant to (*click “select” to choose the correct answer*):

- A. Tango. (select)
- B. Distinguish between hazards and consequences. (select)
- C. Distinguish between spaghetti and linguine. (select)

[Return](#)

Sample Knowledge Check Answer A

This training is designed to teach the participant to:

A. Tango

Whoops! While I am a great dancer, we won't be teaching that today.

[Click here](#) to take a second shot!

Sample Knowledge Check Answer B

This training is designed to teach the participant to:

B. Distinguish between hazards and consequences.

You got it – great job!

[Click here](#) to continue with the training.

Sample Knowledge Check Answer C

This training is designed to teach the participant to:

C. Distinguish between spaghetti and linguine.

Whoops! Although delicious, we won't learn about pasta in this training.

[Click here](#) to take a second shot!

Great Job!

Now we're ready to dive right in.

Advance

Return

FTA

FEDERAL TRANSIT ADMINISTRATION

Hazards and Consequences in an SMS

First, let's discuss the role the terms hazard and consequence play in SRM under SMS.

We will then look at their definitions and differences.

[Advance](#)

[Return](#)

A Little SMS Background

An SMS supports management decisions on how to prioritize the allocation (spending) of resources (money, time, etc.) to address safety concerns.

In SMS terms: the allocation of resources to address safety concerns is based on ***safety risk***.

How does this relate to hazards and consequences?

[Advance](#)

[Return](#)

A Little SMS Background

Likelihood and Severity

The 49 C.F.R. Part 673 defines ***safety risk*** as “the composite of predicted severity and likelihood of the potential effect of a hazard.”

In other words, we need to know how often (likelihood) and how badly (severity) a safety concern **might** impact people, our systems, or our environment.

[Advance](#)

[Return](#)

A Little SMS Background

Hazard Effects

The 49 C.F.R. Part 673 defines *safety risk* as “the composite of predicted severity and likelihood of the potential effect of a hazard.”

The second part of the definition is really important. Under SMS we allocate resources to address “the potential effect of a hazard.”

Can you guess what “the potential effect of a hazard” is?

[Advance](#)

[Return](#)

A Little SMS Background

Consequences

That's right! The potential effect of a hazard is a ***consequence***.

So, under SRM, when we allocate resources, we aim to mitigate the safety risk of the potential ***consequence*** or ***consequences*** of a ***hazard***.

Why is it important to understand this distinction?

[Advance](#)

[Return](#)

Why Distinguish Hazards from Consequences?

When a transit agency becomes aware of a safety concern, it is important to correctly identify the origin of the safety concern – that's the ***hazard!***

If we mistake a ***consequence*** for the ***hazard***, we might not fully understand the actual safety concern and its true potential (safety risk) and the condition could worsen.

[Advance](#)

[Return](#)

Why Distinguish Hazards from Consequences? – Resource Allocation

If we mistake a **consequence** for the **hazard**, we also might allocate resources to address only the single consequence and miss other consequences that could cause equal or greater harm.

Note: The hazard/consequence relationship is not **one-to-one** (one hazard holds the potential to generate one consequence) but **one-to-many** (one hazard holds the potential to generate multiple consequences).

[Advance](#)

[Return](#)

FTA's Definitions

Let's dig a little deeper into FTA's definitions of hazard and consequence.

We will then explore a few examples to make sure we understand the important distinction between them.

[Advance](#)

[Return](#)

The Regulation

49 C.F.R. Part 673 requires transit agencies to “establish methods or processes to identify hazards and consequences of hazards.”

[Advance](#)

[Return](#)

The Definition of a Hazard

49 C.F.R. Part 673 defines a **hazard** as “any real or potential condition that can cause injury, illness, or death; damage to or loss of the facilities, equipment, rolling stock, or infrastructure of a public transportation system; or damage to the environment.”

Note: “... that can cause injury, illness, or death; damage to or loss of the facilities, equipment, rolling stock, or infrastructure of a public transportation system; or damage to the environment.” ***These are consequences!***

Note: “... any real or potential condition...” ***That’s a hazard!***

[Advance](#)

[Return](#)

Hazards 101

But what exactly is a hazard?

A hazard is a ***real*** or ***potential*** condition that can cause consequences.

- A real hazard is observable and present; it exists within the system as we speak.
(For example, worn brakes or a cracked rail fastener.)
- A potential hazard does not currently exist but could develop unless we take action to prevent it.
(For example, designing a garage that will have sharp turns or designing buses with slippery floor material.)

[Advance](#)

[Return](#)

Hazards 101 – Putting it All Together

Let's put it all together! *A hazard:*

- Is a real or potential condition; and
- Can result in one or more consequences.

Spoiler alert!

- Hazards are not events; and conversely
- Safety events are not hazards – and consequences are not safety events (as defined by FTA) either!

[Advance](#)

[Return](#)

A Simplifying Convention

You might be thinking “wait, a consequence, such as a brake failure, *is* an event!”

Ok, technically, yes, a consequence could be an event. However, to simplify things and avoid confusion, FTA:

- Reserves the term “event” for reporting purposes as per Part 673; and
- Reserves the term “consequences” for SRM.

[Advance](#)

[Return](#)

A Simplifying Convention

What Could Happen

Why do we talk about events and consequences this way?

Because, when we look at safety risk, we want to allocate resources to address what **could** happen.

Events **have already** happened. Remember, SRM helps us look into the future!

This helps us avoid only looking at past events to determine consequences instead of considering all possibilities of what could happen.

[Advance](#)

[Return](#)

Consequences 101

Let's talk consequences. Recall the regulation states that a **consequence** is the effect or result of a hazard that could cause:

- Injury, illness, or death;
- Damage to or loss of the facilities, equipment, rolling stock, or infrastructure of a public transportation system; and/or
- Damage to the environment.

Note: A single hazard can have multiple consequences

[Advance](#)

[Return](#)

Consequences 101 – Putting it all Together

Let's put it all together! ***A consequence:***

- Is not a real or potential condition;
- Has not yet occurred, but could be similar to something that occurred previously; ***and***
- Is the result of a hazard.

Advance

Return

Hazards and Consequences 101

One last tip for distinguishing hazards from consequences. Under SRM:

- Hazards are (mostly) in the present; and
- Consequences are always in the future.

Advance

Return

Hazards and Consequences 101

Examples

Okay, now let's explore some examples.

A **hazard** is a condition that holds potential to trigger a consequence.

A **consequence** is what could occur when the potential is triggered.

Hazard: Bus brakes are worn out beyond manufacturer's tolerances.



Consequence: Collision with a pedestrian due to brake failure.

[Advance](#)

[Return](#)

Hazards and Consequences 101

More Examples

Let's explore some more examples.

Hazard: Heavy fog on a bus route.



Consequence: Collision with a pedestrian in the crosswalk.

Hazard: Procedure for handling hazardous waste is incomplete.



Consequence: Major oil spill.

[Advance](#)

[Return](#)

Hazards and Consequences 101

Missing Consequences

Did you notice something missing in those last three examples?

We identified just one consequence for each hazard, but we know that most hazards may generate more than one consequence.

[Advance](#)

[Return](#)

Hazards and Consequences 101

Additional Consequences

Let's explore some additional consequences for our example hazards.

Hazard: Bus brakes are worn out beyond manufacturer's tolerances.



Consequence: Collision with a pedestrian due to brake failure.



Consequence: A collision with another vehicle due to brake failure.

[Advance](#)

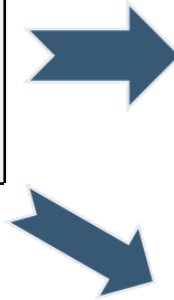
[Return](#)

Hazards and Consequences 101

Additional Examples

Let's explore some additional consequences for our example hazards.

Hazard: Heavy fog on a bus route.



Consequence: Collision with a pedestrian in the crosswalk.

Consequence: Passenger injury resulting from heavy braking to avoid a collision.

[Advance](#)

[Return](#)

Hazards and Consequences 101

Additional Examples 2

Let's explore some additional consequences for our example hazards.

Hazard: Procedure for handling hazardous waste is incomplete.



Consequence: Major oil spill.



Consequence: Collision between vehicles due to the spill.

[Advance](#)

[Return](#)

Bringing Hazards and Consequences to Life

Let's look at a few examples to make sure we understand the distinction between hazards and consequences.

Advance

Return

Knowledge Check 1

Select the photo caption that represents a hazard.

Car turning right in front of and colliding with a bus as the bus pulls out of a near-side bus stop.



A. (select)

Near-side bus stop.



B. (select)

[Return](#)

Knowledge Check Answer 1A

Select the photo caption that represents a **hazard**.

A. Car turning right in front of and colliding with a bus as the bus pulls out of a near-side bus stop.

*Whoops! That's not quite right. Remember that hazards are **conditions**.*

[Click here](#) to give it another try!

Knowledge Check Answer 1B

Select the photo caption that represents a **hazard**.

B. Near-side bus stop

*Great job! The near-side bus stop is the **hazard** with the potential to result in a **consequence**, such as a collision.*

[Click here](#) to continue with the training.

Knowledge Check 2

Employees report that pits in the maintenance bays are open and exposed when not in use. Which of the following is the ***hazard***?

- A. People may fall into the pit. (select)
- B. The unprotected pit. (select)
- C. Supervisors did not notice the open pits. (select)

[Return](#)

Knowledge Check Answer 2A

Employees report that pits in the maintenance bays are open and exposed when not in use. Which of the following is the *hazard*?

A. People may fall into the pit.

*Whoops! Remember that hazards are clear and present **conditions**.*

[Click here](#) to take a second shot!

Knowledge Check Answer 2B

Employees report that pits in the maintenance bays are open and exposed when not in use. Which of the following is the **hazard**?

B. The unprotected pit.

Great job! The clear and present condition that is the cause for concern is the open pit.

[Click here](#) to continue to the next knowledge check!

Knowledge Check Answer 2C

Employees report that pits in the maintenance bays are open and exposed when not in use. Which of the following is the **hazard**?

C. Supervisors did not notice the open pits.

*Whoops! Although we want supervisors to notice situations like these, it's not the hazard. Remember that hazards are a **condition**.*

[Click here](#) to take a second shot!

Knowledge Check 3

Select the ***consequence***.

- A. Electrical arcing. (select)
- B. Traction power cables submerged in standing water. (select)

[Return](#)

Knowledge Check Answer 3A

Select the **consequence**.

A. Electrical arcing.

*Great job! Electrical arcing and smoke are a potential **consequence** of submerged traction power cables.*

[Click here](#) to continue to the next Knowledge Check.

Knowledge Check Answer 3B

Select the **consequence**.

B. Traction power cables submerged in standing water.

*Whoops! This a **condition**.*

Submerged traction power cables have the potential to result in electrical arcing.

[Click here](#) to try again.

Knowledge Check 4

A bus operator reports that construction at a bus stop reduced the physical length of the stop. Normally, two buses can service the stop at once, but now only one can fit at a time. Which of the following is a **consequence**?

- A. Automobile strays across double yellow line to avoid bus partially in the street. (select)
- B. Construction engineers did not consult with the transit agency before changing the bus stop. (select)
- C. Construction reduced the length of the bus stop. (select)

[Return](#)

Knowledge Check Answer 4A

A bus operator reports that construction at a bus stop reduced the physical length of the stop. Normally, two buses can service the stop at once, but now only one can fit at a time. Which of the following is a **consequence**?

A. Automobile strays across double yellow line to avoid bus partially in the street.

Great job! Can you think of any other consequences?

[Click here](#) to continue!

Knowledge Check Answer 4B

A bus operator reports that construction at a bus stop reduced the physical length of the stop. Normally, two buses can service the stop at once, but now only one can fit at a time. Which of the following is a **consequence**?

B. Construction engineers did not consult with the transit agency before changing the bus stop.

Whoops! This is not a potential result of the bus stop being shortened. Remember that consequences are in the future and the consultation belongs in the past.

[Click here](#) to take a second shot!

Knowledge Check Answer 4C

A bus operator reports that construction at a bus stop reduced the physical length of the stop. Normally, two buses can service the stop at once, but now only one can fit at a time. Which of the following is a **consequence**?

C. Construction reduced the length of the bus stop.

Whoops! This is a condition, not the result of a condition. In fact, the reduced physical length of the bus stop is a clear and present condition – it's the hazard!

[Click here](#) to take a second shot!

Bringing Hazards and Consequences to Life

More Consequences

Great job! Did you think of any other potential consequences from our last Knowledge Check?

Here are two more consequences you might have come up with:

- Operators drop off and pick up passengers while stopped in the street; or
- Passengers walk around the construction and into the street to get onto the bus.

Advance

Return

Knowledge Check 5

Select the ***hazard***.

- A. Presence of trespassers or unauthorized personnel on the right-of-way leading to injuries. (select)
- B. Damaged right-of-way perimeter fence. (select)

[Return](#)

Knowledge Check Answer 5A

Select the ***hazard***.

A. Presence of trespassers or unauthorized personnel on the right-of-way leading to injuries.

Whoops! This is a potential result of a damaged fence along the right-of-way.

[Click here](#) to take a second shot!

Knowledge Check Answer 5B

Select the *hazard*.

B. Damaged right-of-way perimeter fence.

Great job! The damaged fence is a present condition that could result in consequences.

[Click here](#) to continue to the next Knowledge Check!

Knowledge Check 6

Select the *hazard*.

- A. Incomplete employee fatigue management policy. (select)
- B. Micro-sleep burst while operating transit vehicle. (select)

[Return](#)

Knowledge Check Answer 6A

Select the *hazard*.

A. Incomplete employee fatigue management policy.

Great job! The incomplete policy is a present condition that could lead to future consequences.

[Click here](#) to continue to the next Knowledge Check!

Knowledge Check Answer 6B

Select the *hazard*.

B. Micro-sleep burst while operating transit vehicle.

Whoops! Micro-sleep burst while operating transit vehicle may be a result of an incomplete employee fatigue management policy – it's a consequence.

[Click here](#) to take a second shot!

Knowledge Check 7

Operators must cross in front of the bus bays to get to the parking lot after completing their shifts.

Illumination outside the bays is poor and pedestrian pathways in the bus yard are faded. Which of the following is a **hazard**?

- A. Faded pedestrian pathways in the bus yard. (select)
- B. Poor lighting in the bus yard. (select)
- C. Both A and B. (select)

[Return](#)

Knowledge Check Answer 7A

Operators must cross in front of the bus bays to get to the parking lot after completing their shifts. Illumination outside the bays is poor and pedestrian pathways in the bus yard are faded. Which of the following is a hazard?

A. Faded pedestrian pathways in the bus yard.

Great job! The unmarked pathways are a clear and present condition. We played a little trick on you, so let's revisit the options again and see if you can spot it.

[Click here](#) to take a second shot!

Knowledge Check Answer 7B

Operators must cross in front of the bus bays to get to the parking lot after completing their shifts. Illumination outside the bays is poor and pedestrian pathways in the bus yard are faded. Which of the following is a hazard?

B. Poor lighting in the bus yard.

Great job! The poor lighting is a clear and present condition. We played a little trick on you, so let's revisit the options again and see if you can spot it. [Click here](#) to take a second shot!

Knowledge Check Answer 7C

Operators must cross in front of the bus bays to get to the parking lot after completing their shifts. Illumination outside the bays is poor and pedestrian pathways in the bus yard are faded. Which of the following is a hazard?

C. Both A and B.

Well done! Real life is rarely simple and most operational contexts and situations have more than one hazard.

[Click here](#) to continue to the next Knowledge Check!

Knowledge Check 8

Let's do one last Knowledge Check - select the ***consequence***.

- A. Placement of bus maintenance panels. (select)
- B. Strained back due to limited panel access. (select)

[Return](#)

Knowledge Check Answer 8A

Select the *consequence*.

A. Placement of bus maintenance panels.

Whoops! The placement of the bus maintenance panels is a present condition – it's the hazard.

[Click here](#) to take a second shot!

Knowledge Check Answer 8B

Select the **consequence**.

B. Strained back due to limited panel access.

Great job! The placement of the bus maintenance panels exists as we speak – it's the hazard. The difficulty of accessing the panels because of the placement could lead to an injury.

[Click here](#) to finish the training!

Bringing it Home

Hazards are conditions that hold potential for damaging effects.

Consequences are the potential damaging effects of hazards.

Hazards are (mostly) in the present and consequences are always in the future.

- Try the “snapshot” test! If you can’t go photograph it, it’s most likely not the hazard.

[Advance](#)

[Return](#)

Bringing it Home

“One-to-many” Relationship

There is a “one-to-many” relationship between hazards and consequences.

If we accidentally name the hazard as one of the consequences, we may miss out on identifying other consequences.

[Advance](#)

[Return](#)

Bringing it Home

SRM Building Blocks

Hazards and consequences are the building blocks of SRM under SMS.

We quantify the consequence(s) of a hazard using safety risk assessment under the terms “likelihood” and “severity.”

The bottom line of SRM is putting a safety risk number to the consequence(s) of a hazard to help us prioritize allocation of resources for mitigation.

Advance

Return

End of Training

[Return](#)