ISSUE LIFE CYCLE ANALYSIS DIAGRAM
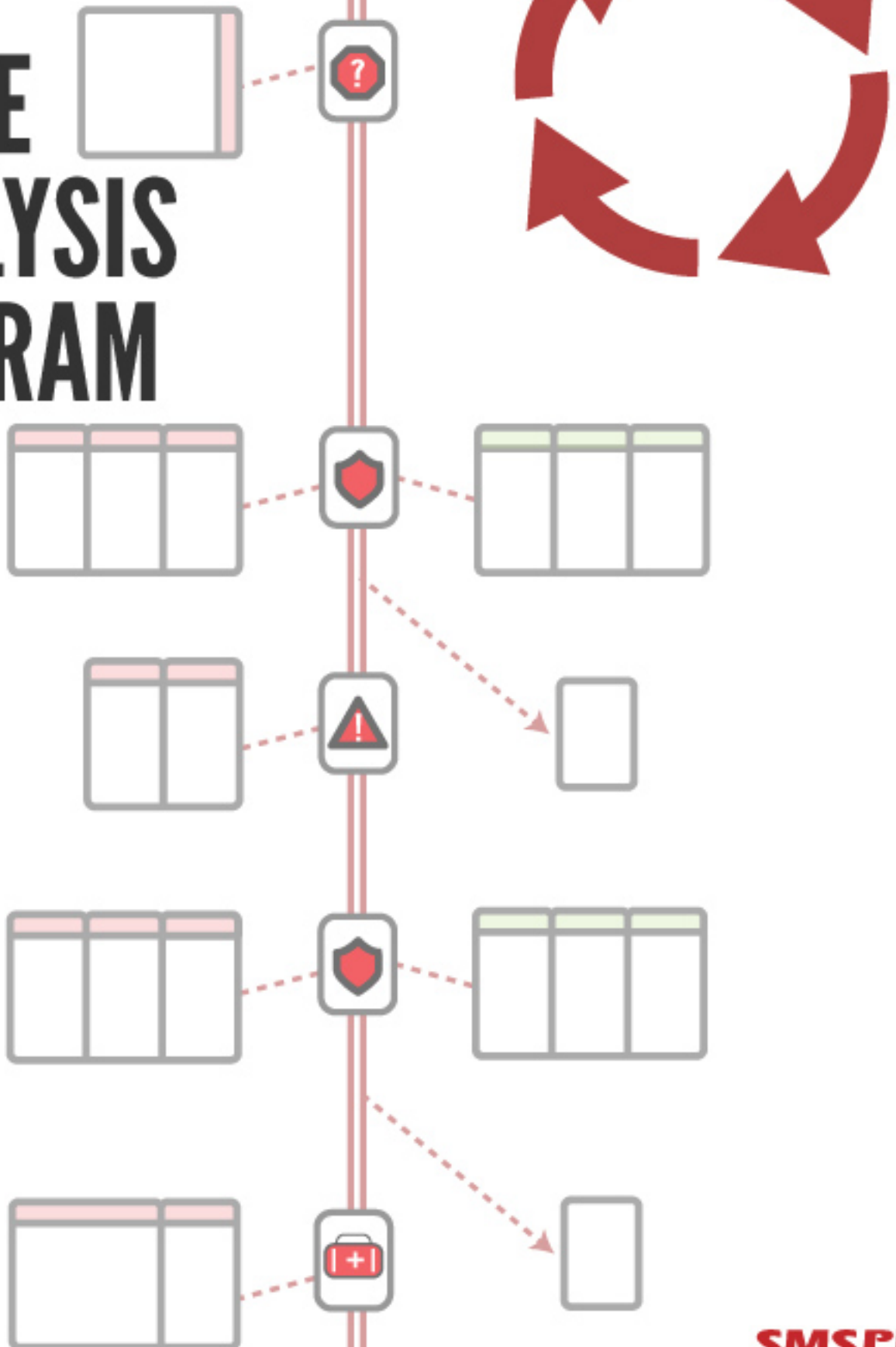
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What are Issue Life Cycle Analysis Diagrams

The life cycle of hazard and risk occurrence is the entirety of an adverse event that happens in your company, from underlying precursors to final consequences. This cycle has distinct "stages" that you can identify and perform risk analysis upon.

- Sometimes this lifecycle ends before hazard occurrence, such as in the case that danger was identified before the occurrence.
- Sometimes this life cycle ends in an adverse event (risk occurrence) and entails several negative consequences.

The point of the risk life cycle analysis diagram is to:

- "Capture" the most important positive/negative "data" (behaviors, decisions, conditions, etc.) from each stage of the life cycle
- Thoroughly analyze an *entire* event
- Visualize the entire event in any easy to read flow diagram
- Understand what positive/negative factors influence outcomes in every stage of an event

Risk Life Cycle Analysis Diagram Goals

The ultimate goal of this diagram is to drive continuous improvement by answering questions like:

- How did existing behaviors contribute to this event positively/negatively?
- How did this event escalate?
- What mechanisms caused this issue to escalate?
- If a hazard occurred, when did the hazard occur and what was it?
- If a hazard/risk occurred, how did our SMS fail to mitigate this occurrence?

These should be the primary questions in most safety events, and the issue life cycle analysis diagram.

Benefits of Using Risk Life Cycle Analysis Diagrams

There are few risk analysis tools that allow you to see an entire safety event, including all important SMS factors. The first one that probably comes to mind, Bowtie analysis, is complex and requires training to adequately use.

Other forms of risk analysis are "point analysis", which means they look at specific stages of a safety issue. For example, root cause analysis only looks as what generates root causes (see "Initiating Mechanisms", "Precursors", and "Hazardous Sources" in Definition of terms).

Performing Life Cycle Analysis solves both of the above problems:

- It's designed to be straightforward and easy to use; and
- It provides an analysis for all applicable stages of the safety issue.

IMPORTANT: Definition of Terms

Terms and definitions are very important. Different safety professionals use different language and terms to describe similar things. It's important that we establish how this template is designed, and what the terms in different stages mean within the context of the diagram. See this link to test your understanding of these concepts.

Hazardous Sources

Otherwise harmless things in the environment from which the adverse flow of events start. Some examples are: birds, mountains, buildings, chemicals. **Hazardous sources become hazards through some kind of interaction**. It's the different between:

- (Hazardous Source) tall building
- (Hazard) tall building in flight path

Precursors

Existing Norms, attitudes, behaviors, businesses practices, and other underlying mechanisms that currently exist in your company. To put it another way, precursors are the positive/negative states of your company right now. Some examples are:

- "Showing up to work at all costs, despite being sick or tired"
- "Only reporting concerns if it seems absolutely necessary"
- "Report all potential concerns immediately"

Initiating Mechanisms

Also called Root Causes, these are the events, interactions, and conditions that start the adverse flow of events. **Initiating mechanisms always involve the hazardous sources**, and are often motivated by existing conditions. Examples of initiating mechanisms are:

- Faulty equipment (condition)
- Behaviors and choices (interaction)
- Changes in environment (event)
- Breakdown in a particular process/procedure/task (event)

Contributory Factors

Contributory factors are Human Factors, risk control factors, or other conditions that effect threat level:

- Negatively: increasing the threat/danger/exposure level that *leads to hazard occurrence*

- Positively: decreasing the threat/danger/exposure level and *preventing hazard occurrence*

In most situations, there will be factors that contribute both positively and negatively, but whichever side (positive/negative) has more contributing factors will decide whether or not a hazard occurs.

Hazard and Hazard Occurrence

A hazard is a condition, such as an object, situation, or circumstance, that poses an **unacceptable level of danger**. A hazard occurrence is when a hazard "actualizes," or becomes real, in your operational environment. Upon hazard occurrence, immediate steps must be taken (by humans or risk controls) to mitigate the situation and prevent risk occurrence (adverse event).

Hazards are listed in your hazard register, and are classified during issue management. A hazard that is classified helps qualify and summarize the hazard that actually occurred in the safety issue. Here's an example:

- Hazard: "Ground object in flight path"
- Hazard Occurrence: Near miss after aircraft flew close to unlit telephone tower

Mitigation Factors

Mitigation factors are Human Factors, risk control factors, or other conditions that effect the dangerous situation:

- Positively: threat level is brought back into an acceptable level of safety and *does not lead to risk occurrence (adverse event)*
- Negatively: threat level is NOT brought back into an acceptable level of safety and *leads to risk occurrence (adverse event)*

Mitigation factors are very similar to Contributory Factors, but it's extremely useful to make the distinction between things that come BEFORE the situation reaches an unacceptable level of safety (hazard occurrence) and things that come AFTER the situation reaches an unacceptable level of safety (mitigation factors).

Risk Occurrence

A risk occurrence is when an adverse event occurs after a hazard occurrence. An adverse event is one that causes damages to your company, such as:

- Injury/Death;
- Crash;
- Accident; or
- Damaged equipment.

A risk occurrence is the climax of situations that are not successfully mitigated.

Consequences

Consequences are the specific fallout from your risk occurrence, such as:

- Loss of reputation;
- Fines and legal action;
- Non-compliance fines;
- Financial loss.

The line between consequences and risk occurrence is often vague, but in general consequences are quantitative (they have specific numbers attached to them), whereas risk occurrences tend to be more qualitive (they are described in a narrative). As an example:

- (Risk Occurrence) Aircraft very hard landing causing damage to tail assembly;
- (Consequences) Stock shares fall by $12 million after nationwide media coverage of incident; tail damage cost of $1.2 million.

Risk Controls

Risk controls are resources you use to prevent, detect, and correct safety issues. These resources can be:

- **People**, such as by providing specific types of training
- **Technology**, such as by providing certain software
- **Bureaucracy**, such as with specific policies and procedures

Risk controls are implemented two places in the issue life cycle:

- To control root causes (usually with detective and preventative controls); or
- To control hazard occurrence by preventing or mitigating risk occurrence (usually corrective and preventative controls).

Human Factors

While the Human Factors "Dirty Dozen" are strictly associated with negative attitudes/behaviors, this diagram takes a broader look at Human Factors as simply being anything human related that effects outcomes of safety events.

This is because, while the Dirty Dozen are aptly named, it's important to remember that humans are also your first line of defense. For example, where:

- "Good communication" can help a dangerous situation,
- "Lack of communication" can hurt a dangerous situation.
- "Teamwork" can help a dangerous situation,
- "Lack of teamwork" can hurt a dangerous situation.

Basically, this diagram allows for both POSITIVE and standard (NEGATIVE) Human Factors.

Other Conditions

Other conditions are things that cannot be categorized as risk controls and human factors, but affect the safety issue. Generally (but not always) other conditions are factors outside of your control, such as:

- Weather;
- Compliance changes; or
- Machine malfunction.

Listing other conditions is useful to assessing, from a high level, how much responsibility your SMS and employees had in outcomes.
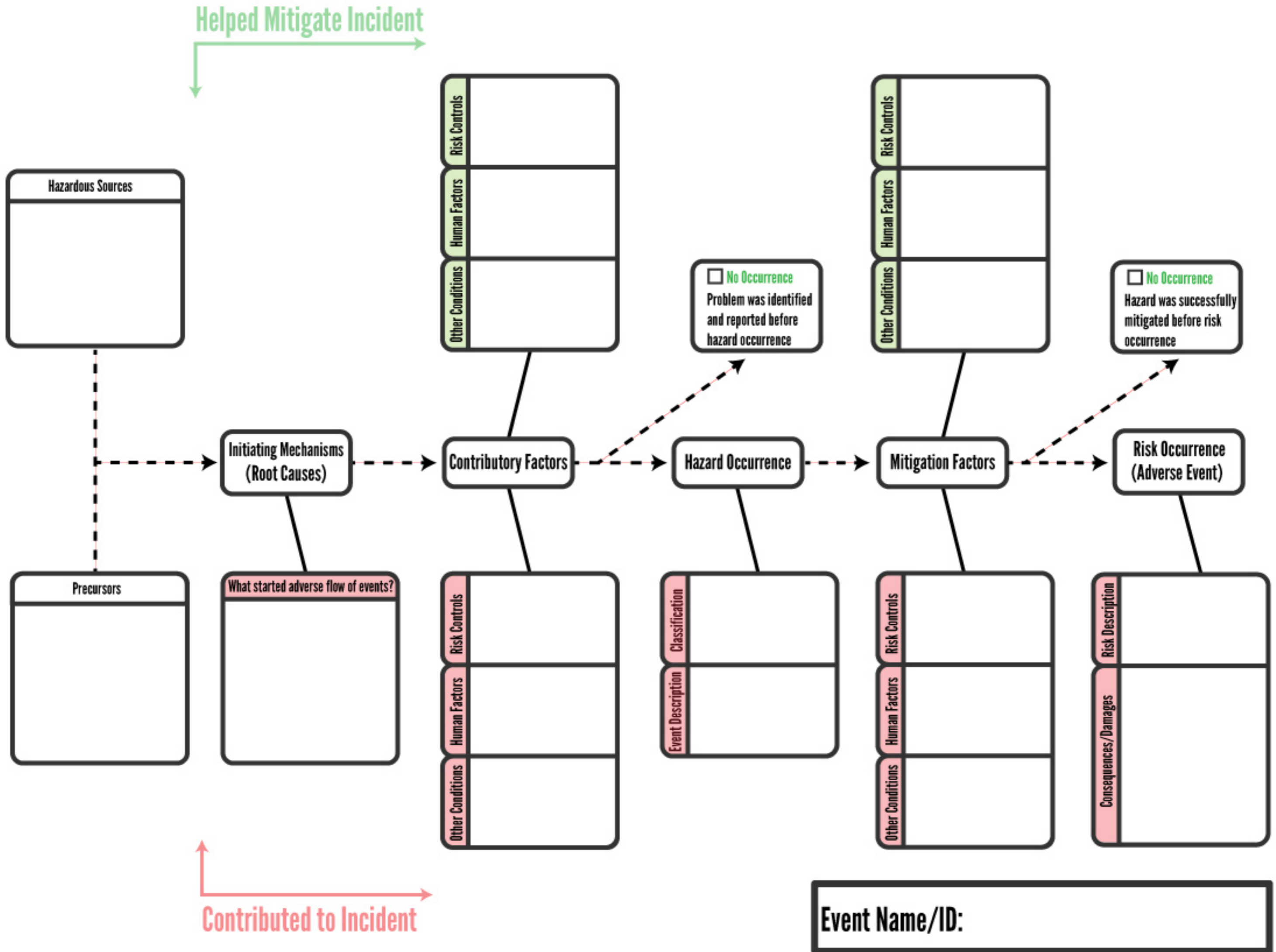
How to Use this Diagram

This diagram is designed to be as simple, quick, and straightforward as possible. The main steps are basically this:

1. First review all the details of your safety event, asking any questions to clarify details of what happened and why. Your goal is to gather as much information as possible on:
   - What decisions were made and why (behavior);
   - What things started the adverse flow;
   - What the sources of this problem are; and
   - What precursors your company had that may have contributed to the issue.
2. Second, list your sources and precursors; and
3. Third, walk through each step of the safety issue that happened, and fill in appropriate areas:
   - Any factor that positively helped mitigate the safety issue should be listed above the midline;
   - Any factor that negatively affected the safety issue should be listed below the midline;
   - If a hazard does not occur because it was identified early, you should check the box above Hazard Occurrence, and not fill out the rest of the diagram;

As discussed, safety issues will have both negative and positive factors. Even with negative hazard/risk occurrences, it's important to see in those situations what your SMS did right.

See the example templates to get a good understanding of what completed diagrams look like.

Helped Mitigate Incident

Hazardous Sources

Risk Controls
Human Factors
Other Conditions

☐ **No Occurrence**
Problem was identified and reported before hazard occurrence

Risk Controls
Human Factors
Other Conditions

☐ **No Occurrence**
Hazard was successfully mitigated before risk occurrence

Initiating Mechanisms (Root Causes)

Contributory Factors

Hazard Occurrence

Mitigation Factors

Risk Occurrence (Adverse Event)

Precursors

What started adverse flow of events?

Risk Controls
Human Factors
Other Conditions

Classification
Event Description

Risk Controls
Human Factors
Other Conditions

Risk Description
Consequences/Damages

Contributed to Incident

Event Name/ID:

Example Templates

See example templates on the following pages. They are based on real occurrences in real safety management systems. They demonstrate the usefulness of being able to see what helps and hurts the outcomes of incidents.

<u>Near miss due to runway light problem</u>

This situation resulted in both hazard and risk occurrence. You can see that leading up to the "Hazard Occurrence" section, the "Contributed to Incident" half of the diagram features many more factors. Likewise, from the "Hazard Occurrence" to the "Risk Occurrence" section, the same side of the diagram features more factors, resulting in risk occurrence as well.

Since both hazard and risk occurrence occurred, we do not check "No Occurrence" in either box. It's important to note however, that there were factors that helped mitigate the occurrence as well, that may have prevented further damages.

<u>Near Bird Strike</u>

In this diagram, you can see that many factors contributed to the hazard occurring. However, after the hazard occurred, more factors helped mitigate the incident, thus preventing a risk occurrence (bird strike). Since the risk occurrence was mitigated, we check "No Occurrence" in the "Risk Occurrence" section.

Hazardous Sources

Runway lights (brightness)

Map of runway

Headphones

Darkness

Risk Controls		
Human Factors		
Other Conditions		

Risk Controls	-Emergency maneuver -Aborted landing procedure
Human Factors	-Flying captain recognized incusion
Other Conditions	

☐ **No Occurrence**

Problem was identified and reported before hazard occurrence

☐ **No Occurrence**

Hazard was successfully mitigated before risk occurrence

Initiating Mechanisms (Root Causes) → **Contributory Factors** → **Hazard Occurrence** → **Mitigation Factors** → **Risk Occurrence (Adverse Event)**

Precursors

Over reliance on technology

High pilot turnover

Low budget for training

What started adverse flow of events?

-Miscalibrated runway lights
-Dated runway map
-Headphone static
-Runway monitoring software bug
-Cloudy, dark night

Risk Controls	-Runway map no hold short lines -Runway monitoring software failure
Human Factors	-No visual confirm of runway by ATC -No visual confirm of runway by captain
Other Conditions	-Aircraft moving too fast to stop quickly

Classification	-Runway incursion
Event Description	Aircraft crosses hold short line (incursion)

Risk Controls	-No training for runway incursion
Human Factors	-Incursion captain braked in center of runway and "froze"
Other Conditions	-Runway monitoring software did not alert of incursion

Risk Description	Near miss, aircraft passes within 200 meters of runway aircraft
Consequences/Damages	-Regulatory audit -Stock price drop 3% -Bad media coverage

Event Name/ID: Report ID 1086: Runway Incursion Results in Near Miss

Hazardous Sources

Birds

Fog

Risk Controls

Human Factors
-Pilot did visual check for wildlife on runway

Other Conditions
-Communication with nearby airports warned that flocks had been spotted

☐ **No Occurrence**
Problem was identified and reported before hazard occurrence

Risk Controls
-Emergency maneuver

Human Factors
-Captain identified bird during takeoff (awareness)

Other Conditions
-Aircraft radar alerted of bird flock

☒ **No Occurrence**
Hazard was successfully mitigated before risk occurrence

Precursors

Wildlife uncommon in area

All pilots live locally (and are thus not used to seeing much wildlife)

Initiating Mechanisms (Root Causes)

Contributory Factors

Hazard Occurrence

Mitigation Factors

Risk Occurrence (Adverse Event)

What started adverse flow of events?
-ATC gave okay for takeoff before verifying radar

Risk Controls
-No checklist for takeoff procedure

Human Factors
-ATC did not follow procedure

Other Conditions
-Ground radar did not recognize nearby flock
-Heavy fog hid white bird flock from pilot's view

Classification
-Near Bird Strike

Event Description
Flew into very close proximity of flock of birds

Risk Controls

Human Factors

Other Conditions
-Heavy fog causes pilot to initially hesitate after seeing (potential) flock

Risk Description

Consequences/Damages

Event Name/ID: Report ID 1087: Near-Bird Strike