Human Factors Investigation Toolkit

Use tabs and embedded links to navigate this Toolkit.

5 Whys ›

Advanced Cause and Effect ›

5 Whys

Preparation | Evidence Gathering | Analysis | Findings | Recommendations | Report

Use the 5 Whys tool to identify factors that influenced behaviour

Tactics

Preparation	Evidence Gathering	Analysis	Findings	Recommendations
Refresh yourself on this toolkit to inform your plans	Get to know the accident site	Explore potential reasons for the behaviours	Explain any link between behaviours/ HF and underlying management system causes	Address HF issues, with HF recommendations
	Interview witnesses with HF in mind	Identify fresh lines of enquiry		
	Identify Behaviours for analysis			

Tools

Preparation	Evidence Gathering	Analysis
Use the investigation team top tips tool	Use the HF Evidence Gathering Checklist to help you collect HF evidence	Use Basic HF tool to help you understand the behaviour
		Use the Fatigue Tool to assess whether fatigue made a contribution to the incident

Gather Human Factors Evidence

- Usually, there are many people whose actions and decisions contributed to the incident over time. Identify these individuals and their actions.
- At the scene, reconstruct and walkthrough the incident sequences. Pay special attention to:
  - What people could/could not see from their locations
  - Body position
  - Equipment and people they interacted with
- Identify what people knew / did NOT know at the time of the incident and the goals they worked to.
- Review how this task was performed in the past. Was there anything different?
- Put yourself in the shoes of the people involved and ask why their behaviour made sense at the time.

Steps toward completing HF analysis

1. Identify the separate actions and decisions by different people over time that led to the incident.

2. Include the key behaviours in your 5 Whys and use the cause and effect relationships to understand the reasons for the behaviour. See examples.

3. Identify factors that influenced the behaviour*. Use the basic HF tool to help you understand the reasons for the behaviours and evidence needed to make the analysis. Add HF tool outputs to your 5 Whys.

4. Continue with your cause and effect analysis to identify the management system and organizational leadership and cultural factors that are responsible for the reasons for the behaviours identified in 2 and 3.

Remember:

*Investigate why the behaviour made sense to the person at that point in time.

Include factors that provoke or make an error more likely and factors that motivate people to behave in certain ways (e.g. immediate and certain consequences like time or effort saving).

Developing Human Factors Findings

- Write HF / behavioural findings so that the reader can recognise the human factors involved.
- In other words, the finding should clearly describe what the person did or did not do **and why**.
  - **Example 1:** The operator opened the wrong valve because it was the same colour and next to the correct valve. The valve design did not have HF review to identify potential for error.
  - **Example 2:**
    - The operator put his hand into a running pipe cutting machine because he believed lifting the guard would de-energise the machine (per his previous experience and training).
    - Procurement obtained the machine quickly and they did not identify that the machine purchased did not have a safety interlock because there was no procurement policy in place to require this.
- A finding should not denote blame.

Writing human factors related recommendations:

1. Your HF analysis and resulting findings should help you formulate a specific and targeted HF recommendation. See example of what good looks like
2. The recommendation should not be focused on preventing the individual's error at the time but on reliably preventing others getting into the same situation by tackling any underlying management system causes
3. The HF recommendation should seek to reduce the likelihood of error / non-compliance in the future
4. It should be sustainable over time
5. It should not introduce new HF risks in another area
6. Seek advice from an experienced investigator if you need help

When developing recommendations apply the Human Factors 'Hierarchy of Controls' and ask:

- Can the hazard be removed?
- Can the human element be eliminated, e.g. by automation?
- Can the consequences of the human failure be prevented, e.g. by additional barriers in the management system?
- Can human performance be assured by using interlocks or other engineered means?
- Can the factors that shape and motivate behaviour be optimised?

Reporting Dos

It is important to understand why actions and assessments being investigated, made sense to people at the time.

Get the HF in your report right:

- In plain language explain how the mindset unfolded in the situation leading to the incident and why it made sense at the time (see example).
- Clearly identify the human factors that shaped or motivated performance with the evidence to support.
- Identify the managerial and organizational leadership and cultural factors responsible for the human factors that shaped or motivated performance that you found.

Reporting Don'ts

Use labels and conclude the cause was:

- Human error
- Error type (e.g. decision error)
- Human behaviour (or its description, e.g. didn't follow a procedure)

Explaining behaviour by referring to personal characteristics

- Complacency
- Recklessness / Carelessness

Focusing on / stopping at what the person **Didn't Do** or **Should Have Done**

- Saying what people did not do does not explain why they did what they did.

Advanced Cause and Effect

Preparation	Evidence Gathering	Analysis	Findings	Recommendations	Report
Use the Logic Tree to identify factors that influenced behaviour and fresh lines of enquiry					
Tactics					
Refresh yourself on this toolkit to inform your plans	Get to know the accident site	Explore potential reasons for the behaviours	Explain any link between behaviours/ HF and underlying management system causes	Address HF issues, with HF recommendations	
	Interview witnesses with HF in mind	Identify fresh lines of enquiry			
	Identify Behaviours for analysis				
Tools					
Use the investigation team top tips tool	Use the HF Evidence Gathering Checklist to help you collect HF evidence	Use a HF analysis tool to help you understand the behaviour	Use HF Analysis Verification Tool (HFVT) to verify behaviour analysis		
		Use the Fatigue Tool to assess whether fatigue made a contribution to the incident			

Gather Human Factors Evidence

- Evidence gathering is supported by development of your cause and effect tool – keep looking for behaviours and HF evidence at every stage.
- Enhance your chances of making an effective investigation analysis by actively and systematically seeking human factors evidence and lines of enquiry.
- At the scene, put yourself in the shoes of the people involved and ask why their behaviour made sense at the time. A reconstruction or walkthrough of events usually helps understand the situation.
- Be systematic in preparing and completing interviews. Look for human factor evidence and fresh lines of enquiry.

Core Principles of HF Analysis

Use your cause and effect tool and the evidence collected to analyze the separate behaviours* of different people over time that led to the incident. For each behaviour:

- **Step 1** – Identify a single, well-defined behaviour which is represented in the cause and effect tool.
- **Step 2** - Explore the four potential error types:
  - Sensory (did they miss something?) Memory (did they forget?) Decision (Did they Misjudge?) or Action (did they do something inadvertently incorrect?)
  - Identify the Performance Shaping Factors (PSFs) that may have influenced the person to make the error. Include the potential errors and PSFs as potential causes in the cause and effect tool.
- **Step 3** - Explore potential Antecedents and expected Consequences that could have motivated the individual. Include these motivating factors as potential causes in the cause and effect tool.
- **Step 4** – Verify the HF potential causes and update the cause and effect tool based on the evidence to arrive at conclusions.
  - Continue with your cause and effect analysis to identify the management system and organizational leadership and cultural factors that are responsible for the reasons for the behaviours identified in steps 2 and 3.

Remember:

*You're not just anazlying the person who turned the valve or pressed the button. You might be analysing the person who wrote the procedure, approved the job or designed the hardware.

Developing human factors findings

- Write HF / behavioural findings so that the reader can recognise the human factors involved. The Human Factors Verification Tool can help with that.
- The finding should make the link between:
  - Behaviour
  - Assumptions / decisions / mindset
  - External Factors that influenced behaviour (PSFs)
  - Management system causes / organizational leadership and cultural factors
  - For example – operator opened the wrong valve (**behaviour**) because it was the same colour and next to the correct valve (**PSF**). The valve design did not have HF review to identify potential for error (**Management system** cause).
- In other words, the finding should clearly describe what the person did or did not do **and why**.
- A finding should not denote blame.

A finding should describe a causal or contributory factor

The operator did not stop filling the storage tank (behaviour) because he was unaware (mind set) of the high level due to an incorrect level indication from the level instrument (PSF) and failure of the independent high-high level alarm to activate.

And describe the reason (s) it occurred

Writing human factors related recommendations:

1. Your HF analysis and resulting findings should help you formulate a specific and targeted HF recommendation. See example of what good looks like
2. The recommendation should not be focused on preventing the individual's error at the time but on reliably preventing others getting into the same situation by tackling any underlying management system causes
3. The HF recommendation should seek to reduce the likelihood of error / non-compliance in the future
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When developing recommendations apply the Human Factors 'Hierarchy of Controls' and ask:

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Use labels and conclude the cause was:

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- Complacency
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Use the 5 Whys to

Refresh yourself on this toolkit to inform your plans

Use the investigation team top tips tool

Use the Fatigue Tool to assess whether fatigue made a contribution to the incident

Tactics

Tools

Key points to remember:

- The human mind has a tendency to unconsciously oversimplify what has happened. Being aware of this tendency can help investigators to avoid this potential issue.
- Apply the investigation methods you were trained on and use the tools and tactics in this HF Toolkit.
- It might sound obvious, but remember to think like a human. Put yourself in the shoes of the people involved and establish why their actions and assessments made sense at the time.

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Tactics

Tools

Preparing yourself and your team:

- As you make preparations for the investigation refresh your memory on HF by reviewing this Toolkit and the Quick Links.
- Make sure you have this toolkit to hand.
- Use the “investigation team top tips” tool to refresh yourself and brief your team to set up the investigation team for success. Be vigilant and take steps to build on experience from previous investigations, as these can enhance the quality of your investigation.

Investigation team top tips

Pitfall	Solution
Does your team believe that the event was predictable if only people involved knew what you know now?	**If Yes, you may be at risk of missing how the situation and context influenced people's thinking and decisions contributing to the incident.** • Avoid cherry picking data that 'prove' a condition you have identified in hindsight • ALWAYS put people's behaviour back into the situation that produced and accompanied the behaviour
Does your team focus on proving what they thought were the causes of the incident?	**If Yes, you may be at risk of failing to identify important contributing factors.** • Apply the investigation methods rigorously and be systematic in collecting evidence
Does your team easily agree on the causes and avoid an ongoing challenge of what really could have happened?	**If Yes, you may be at risk of failing to identify important contributing factors.** • Identify your assumptions and test them – seek disagreement! • Keep asking questions – make use of independent checks and challenge
Does your team assign causes of incidents to human error, inattention, complacency or procedural non-conformance?	**If Yes, you are at risk of missing factors that created human error or attracted attention at the time.** • Put conscious effort into identifying factors that created error or non-conformance

Advanced Cause and Effect

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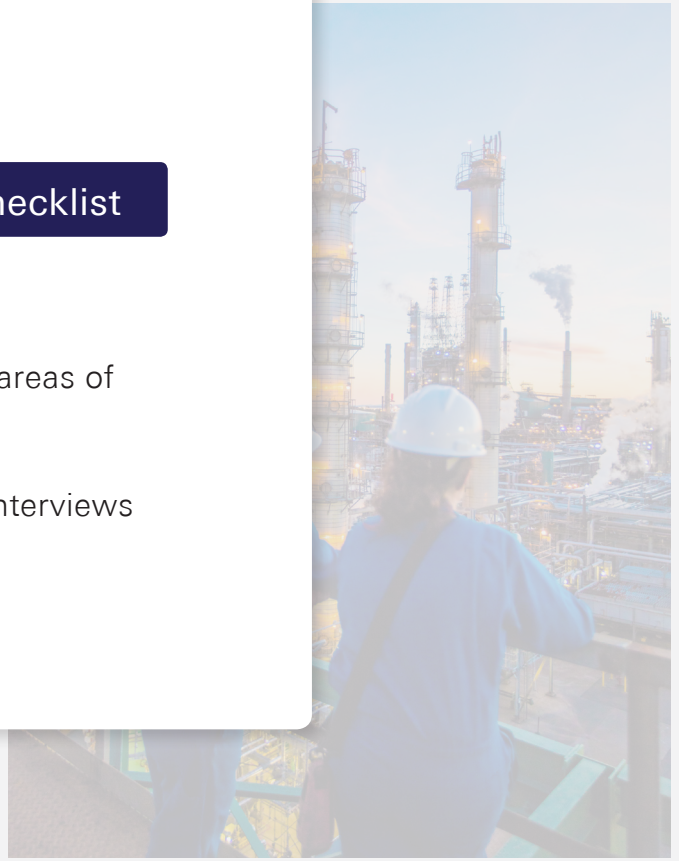

A checklist tool to help you gather HF evidence:

How to use this tool: HF evidence checklist

- Open the tool

- Use the checklist to help you identify and keep track of areas of interest during evidence gathering
- Use the checklist alongside interview methods
- DO NOT use the tool as a ready made question set for interviews
- The aim is to avoid the need to re-interview witnesses

Gather H

- Evidence gatherin
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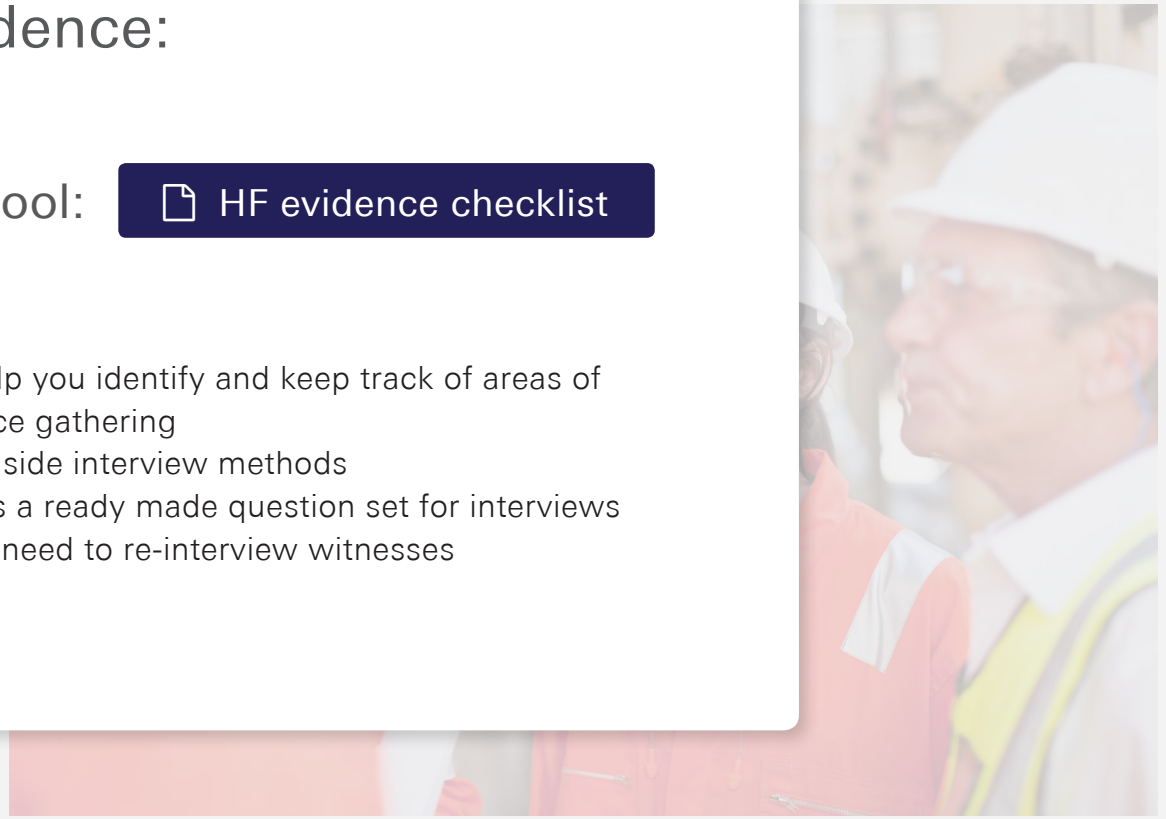

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The deeper the analysis the better the recommendation

Incident Description Example:

An operator using a new pipe cutting machine trapped and badly injured their hand whilst reaching in to retrieve the pipe. Note, machinery guarding and interlocks were installed on the machine as part of site's initial response

ANALYSIS — **MORE EFFECTIVE DEPTH**

Level 1	Level 2	Level 3	Level 4	Level 5
Operator is to blame for reaching into the machine whilst still switched on. ✗	Operator believed that lifting the guard would disable the machine. ✓	Operator had already received training; the machine used in training was interlocked. ✓	The machine was not fully tested before being put to use. ✓	The machine was needed quickly; the procurement process did not require the machine purchased to have a safety interlock. ✓

FOCUS OF RECOMMENDATIONS — **MORE EFFECTIVE IN PREVENTING REOCCURRENCE**

Discipline the operator. ✗	Re-train the operator in all aspects of operating the machine. ✗	Operator training should be completed on the specific machine they will be expected to use on site. ✓	Amend the procedure for introducing new equipment into the workplace to include provision for pre use testing and safety checks. ✓	Amend the procurement procedure to include a thorough risk assessment process for equipment selected for purchase. ✓

Analysing HF using 5 Whys

When studying how the actions and decisions of people contributed to an event, investigators build a 5 Whys branch:

- Describes how the behaviour contributed to the undesired event.
- Describes causes of that behaviour, including motivations and external factors which made the behaviour likely to occur.
- Goes on to describe the organizational leadership and cultural factors responsible for these causes of the behaviour.

Factors that shaped or influenced the behaviour could include:

- Motivating factors like time or effort saving, keeping plant running, avoiding supervisor disproval etc.
- The physical environment – lighting, line of sight
- The task – layout, design, supervision or procedures
- The person – training, knowledge, skill, experience

An operator using a new pipe cutting machine injured their hand whilst reaching in to retrieve the cut pipe.

Description of a behaviour that contributed to an incident.

why?

Operator believed that lifting the guard would disable the machine.

A description of an assumption / decision made by a person.

why?

Machine normally used by the operator has an interlock on the guard and the machine in use was different.

Explanation of the reasons leading to the assumption.

Explanation why it made sense to the person to do X.

why?

The machine in use was obtained quickly and did not come equipped with an interlock.

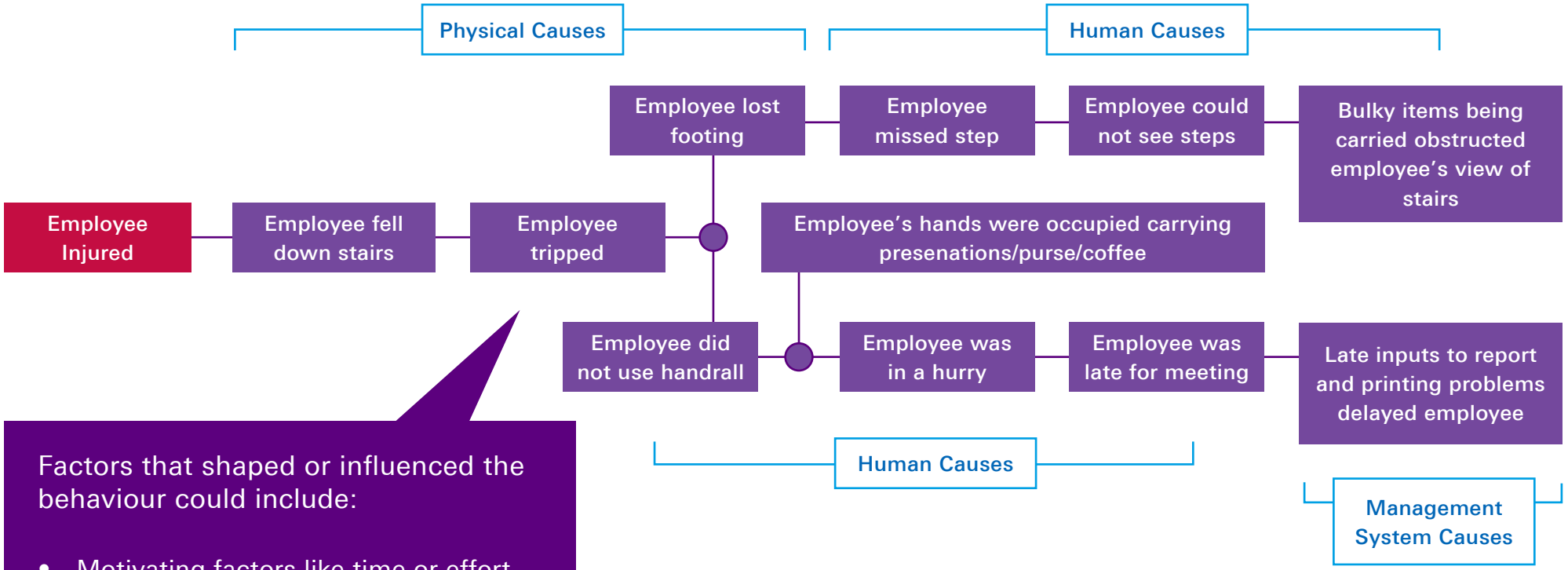
Explanation of the situation was created.

why?

The procurement process did not require the machine purchased to have a safety interlock.

Explanation of more distant factors that created the conditions which led to an assumption which led to a behaviour.

Analysing HF using 5 Whys



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Core Principles of HF Analysis

Use your cause and ...dents and collected to analyze ...ld have motivated different people over ...vating factors as For each behaviour: ...effect tool.

- **Step 1** – Identify ...auses and update which is represen... ...n the evidence to

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*You're not just anazlying the person who turned the valve or pressed the button. You might be analysing the person who wrote the procedure, approved the job or designed the hardware.

Help with the 4 step process

If you are unable to conclude the analysis of the behaviour using the 4 steps approach:

- Re-define the behaviour, and/or
- Collect more evidence
- And re-analyse
- Seek support from an SME or apply the analysis tools on this page

HF Analysis Tools

Remember:

Investigate why the behaviour made sense to the person at that point in time. These Tools can help you understand and verify the factors that influenced behaviour (Step 2 and 3).

Basic Analysis Tool

A simple HF analysis tool.

Fatigue Tool

A tool to enable the contribution of fatigue in the incident to be assessed. Recommended to use this to Verify or Rule Out Fatigue.

Verification Tool

A tool to help investigators verify their HF analysis

4 Steps Overview

This overview shows how the 4 step process can fit into an advanced cause and effect analysis tool. It can be used as a visual support as you facilitate a cause and effect analysis.

Instructions:

1. Open the file
2. Print the document
3. Use the content to help you to facilitate the HF analysis using the 4 step approach
4. Refer to the case studies for further help

Note, If you use a template for your cause and effect analysis tool (e.g. in a mind mapping package) the text in the overview can be added to this to support the investigators in the process of analysing HF / behaviours.

4 Steps Overview

Core Principles of HF Analysis

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incorrect?)

  - Identify the Performance Shaping Factors (PSFs) that may have influenced the person to make the error. Include the potential errors and PSFs as potential causes in the cause and effect tool.

Performance Shaping Factors (PSF)

These are conditions external to the person (e.g. noise, difficult procedures, equipment design) or internal to the person (e.g. personal problems, team relationships) that can affect how the person performs on the day, and therefore how likely they are to make an unintentional error.

Remember:

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Antecedents

These are factors that come before, or triggers a behaviour (e.g. signs, training, other people's expectations). It prompts the person to perform a behaviour one time, but does not guarantee that the person will continue to behave in that way.

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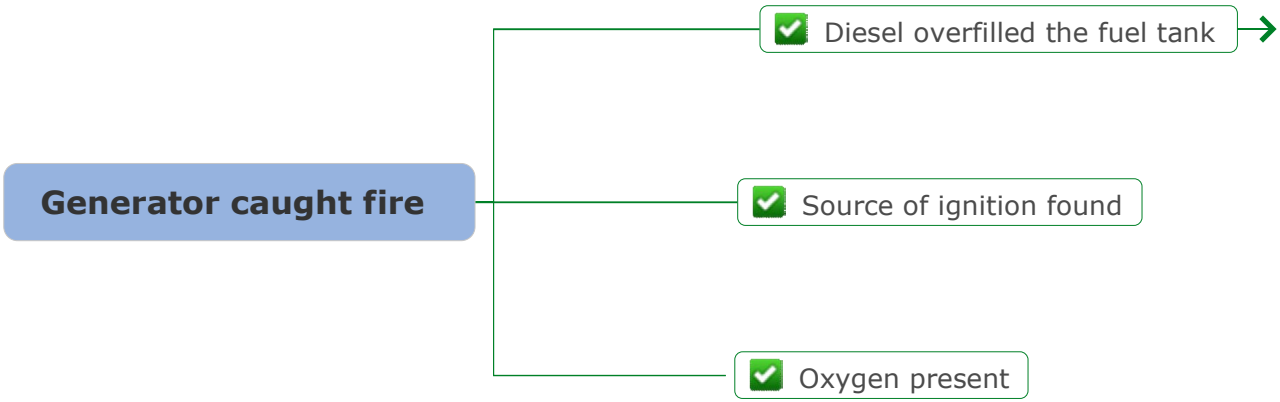
Consequences

Are motivating factors that occur after the behaviour (e.g. time or effort saving, keep plan running, gain approval from supervisor or peers). Consequences that reliably happen at or shortly after the behaviour are more powerful. Positive consequences to the individual can be particularly powerful in motivating them to use that behaviour again.

Case Study 1: Analysing HF in a cause and effect tool

Generator caught fire during refuelling because it overfilled:

- A diesel generator needed to be refuelled twice a day
- Manual filling using a hose gravity fed from an IBC.
- The technician used a water bottle to hold open the trigger and then left to complete a pigging prep task.
- The plan was to come back and finish the refuelling but this step was forgotten.



When studying how the actions and decisions of people contributed to an event, investigators can build a cause and effect branch, which:

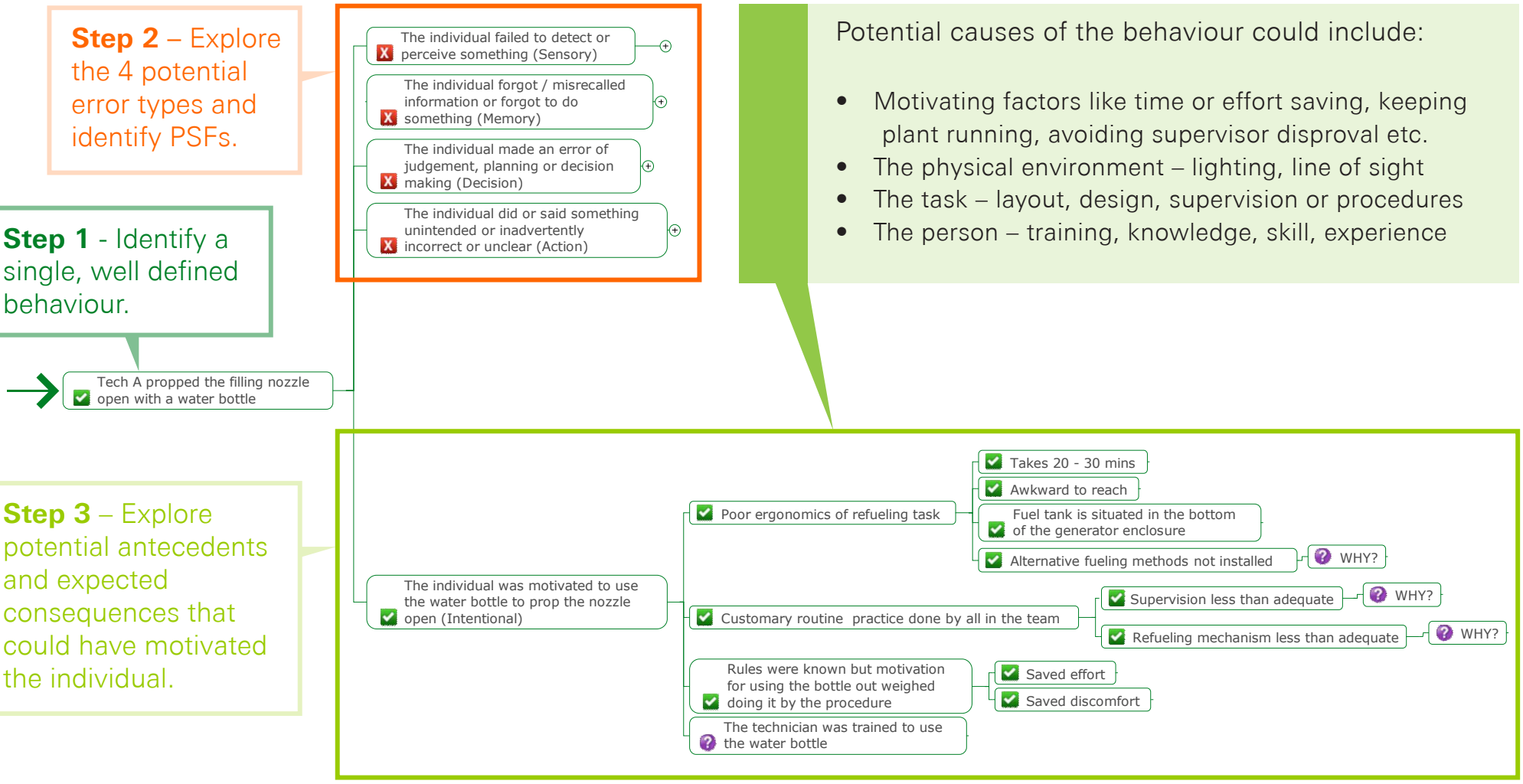
- Describes how the behaviour contributed to the undesired event.
- Describes causes of that behaviour, including motivations and external factors which made the behaviour likely to occur.
- Goes on to describe the organizational leadership and cultural factors responsible for these causes of the behaviour.

Case Study 1: Analysing HF in a cause and effect tool using the 4 step approach

Step 2 – Explore the 4 potential error types and identify PSFs.

Step 1 - Identify a single, well defined behaviour.

Step 3 – Explore potential antecedents and expected consequences that could have motivated the individual.



Potential causes of the behaviour could include:

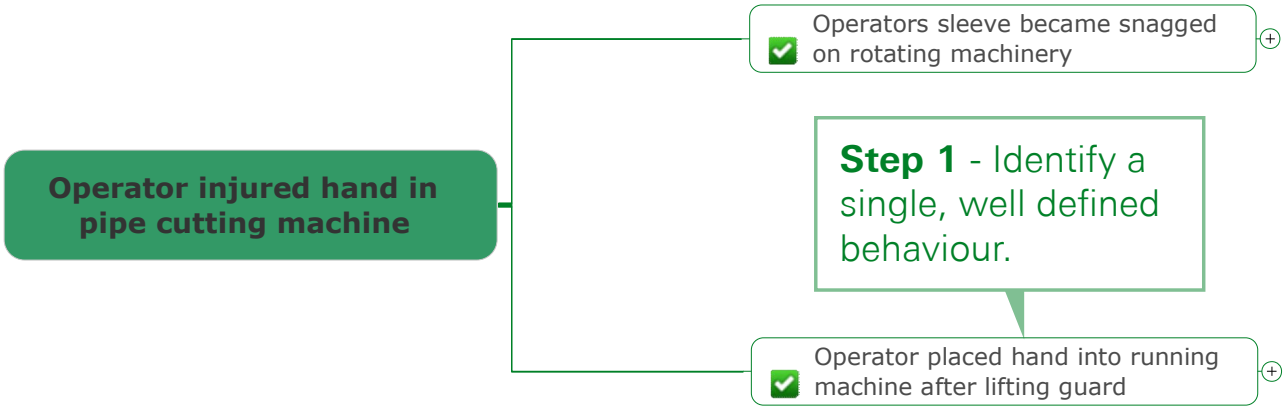
- Motivating factors like time or effort saving, keeping plant running, avoiding supervisor disproval etc.
- The physical environment – lighting, line of sight
- The task – layout, design, supervision or procedures
- The person – training, knowledge, skill, experience

Step 4 - Verify the HF conclusions and update the cause and effect tool based on the evidence.

Case Study 2: Analysing HF in a cause and effect tool – Step 1

A pipe fitter reached into a running pipe cutting machine and incurred a serious hand injury:

- The pipefitter was very experienced.
- The machine he was using worked differently to the machine he normally used.
- The expectation was lifting the guard would shut the machine off, he adopted a habitual behaviour (his mind-set was incorrect for the situation).
- The machine was not equipped with this type of interlock device.



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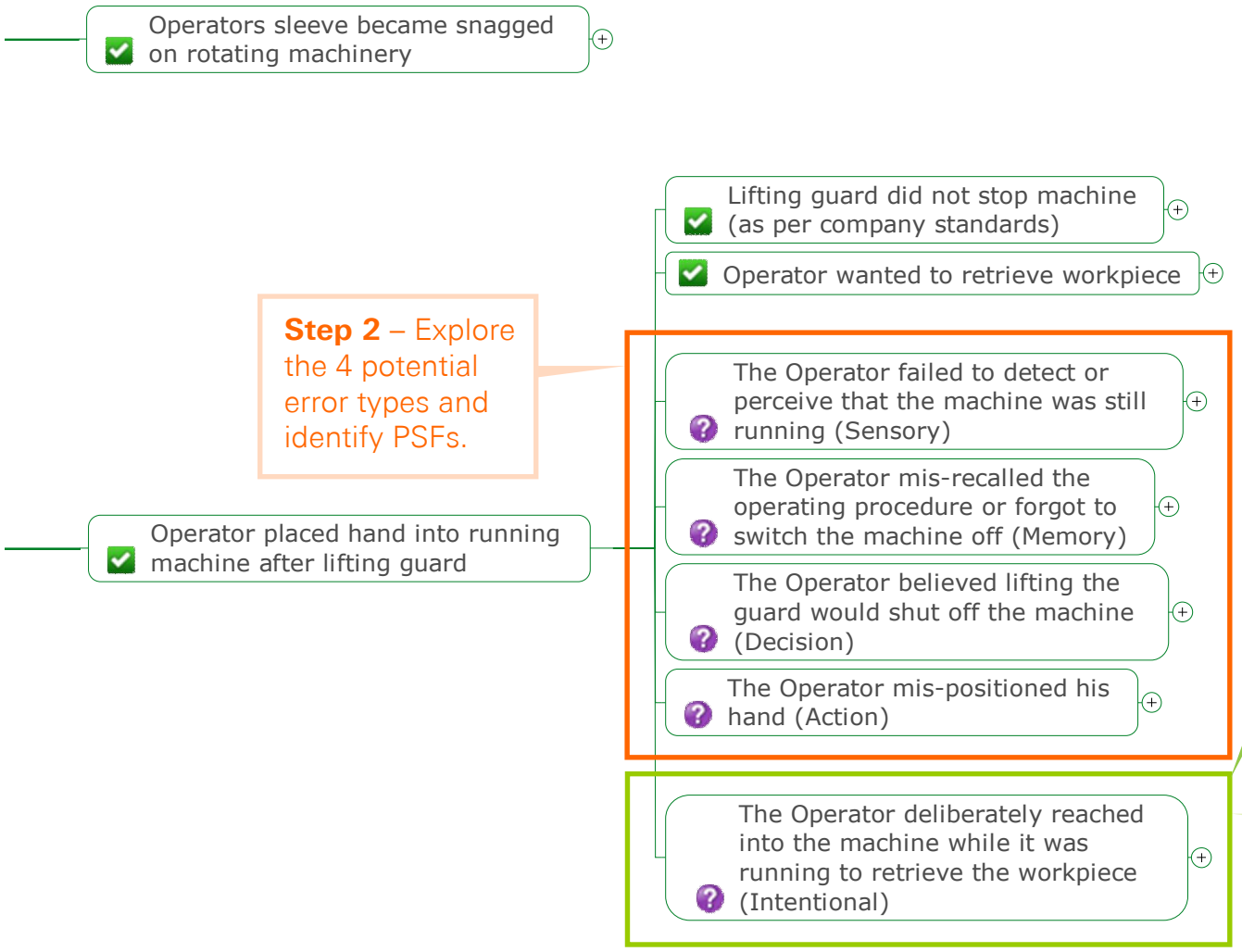
Case Study 2: Analysing HF in a cause and effect tool – Steps 2 & 3



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Potential causes of the behaviour could include:

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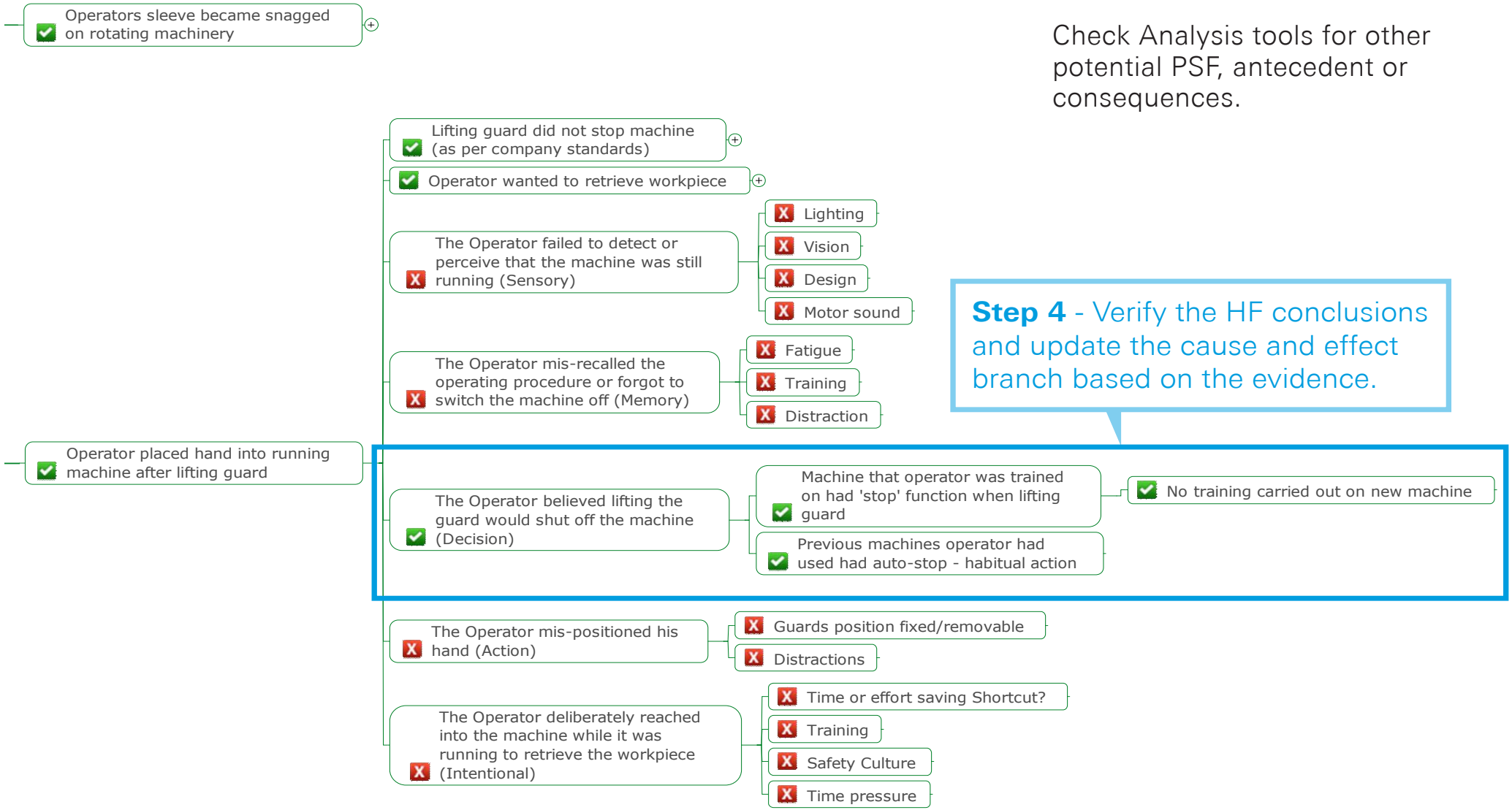
- The task – layout, design, supervision or procedures
- The person – training, knowledge, skill, experience

Step 3 – Explore potential antecedents and expected consequences that could have motivated the individual.

Case Study 2: Analysing HF in a cause and effect tool – Steps 3 & 4



Check Analysis tools for other potential PSF, antecedent or consequences.

Step 4 - Verify the HF conclusions and update the cause and effect branch based on the evidence.

How to report an unfolding mind-set

An incident:

An operator using a new pipe cutting machine trapped and badly injured their hand whilst reaching in to retrieve the pipe.

Narrative to avoid:

The operator failed to conduct a pre-check to identify if the machine had an interlock.

The operator ignored the sign placed in the coffee area to not put their hands close to moving machinery parts.

Narrative to consider:

The operator had 16 years of experience at the time of the incident.

Traditionally, the pipes were cut manually, however as the company grew and needed to process 4 times more pipes, 3 years ago the management decided to build a new production line with multiple working stations across the shop floor responsible for different stages of the manufacturing process.

As the new machines were installed on the shop floor, the operators were trained on the use of the machines. Training was delivered by a qualified trainer, and the participants had to demonstrate the 100% conformance to the operating procedures. The new machines had advanced mechanisms of protecting the users including proximity sensors and interlocked guards which switched off the machine if a hand was close to the moving part. The side effect of this solution was that due to the design of the machine it was quicker to use the interlocked guard than to switch the machine off, remove the pipe, and start it again.

6 months before the incident the incident, the manufacturer of the machine went bankrupt. 2 months before the incident the machine broke and could not be replaced by the same model. The company had to find a new supplier urgently due to a building order backlog. The newly identified machine had similar specification but no interlocks in place.

The operators were informed that they will be working on the same model of the machine as previously.

How to report an unfolding mind-set

An incident:

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The deeper the analysis the better the recommendation

Incident Description Example:

An operator using a new pipe cutting machine trapped and badly injured their hand whilst reaching in to retrieve the pipe. Note, machinery guarding and interlocks were installed on the machine as part of site's initial response

ANALYSIS — **MORE EFFECTIVE DEPTH**

Level 1	Level 2	Level 3	Level 4	Level 5
Operator is to blame for reaching into the machine whilst still switched on. ✗	Operator believed that lifting the guard would disable the machine. ✓	Operator had already received training; the machine used in training was interlocked. ✓	The machine was not fully tested before being put to use. ✓	The machine was needed quickly; the procurement process did not require the machine purchased to have a safety interlock. ✓

FOCUS OF RECOMMENDATIONS — **MORE EFFECTIVE IN PREVENTING REOCCURRENCE**

Discipline the operator. ✗	Re-train the operator in all aspects of operating the machine. ✗	Operator training should be completed on the specific machine they will be expected to use on site. ✓	Amend the procedure for introducing new equipment into the workplace to include provision for pre use testing and safety checks. ✓	Amend the procurement procedure to include a thorough risk assessment process for equipment selected for purchase. ✓

Analysing HF using 5 Whys

When studying how the actions and decisions of people contributed to an event, investigators build a 5 Whys branch:

- Describes how the behaviour contributed to the undesired event.
- Describes causes of that behaviour, including motivations and external factors which made the behaviour likely to occur.
- Goes on to describe the organizational leadership and cultural factors responsible for these causes of the behaviour.

An operator using a new pipe cutting machine injured their hand whilst reaching in to retrieve the cut pipe.

why?

Description of a behaviour that contributed to an incident.

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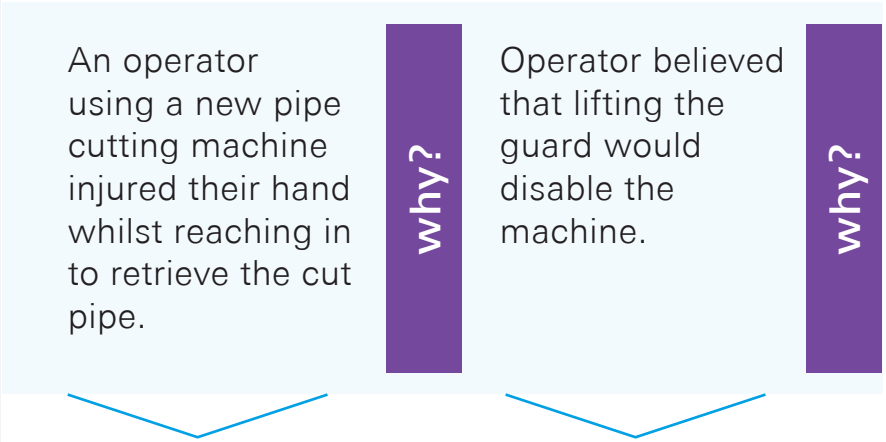
Factors that shaped or influenced the behaviour could include:

- Motivating factors like time or effort saving, keeping plant running, avoiding supervisor disproval etc.
- The physical environment – lighting, line of sight
- The task – layout, design, supervision or procedures
- The person – training, knowledge, skill, experience



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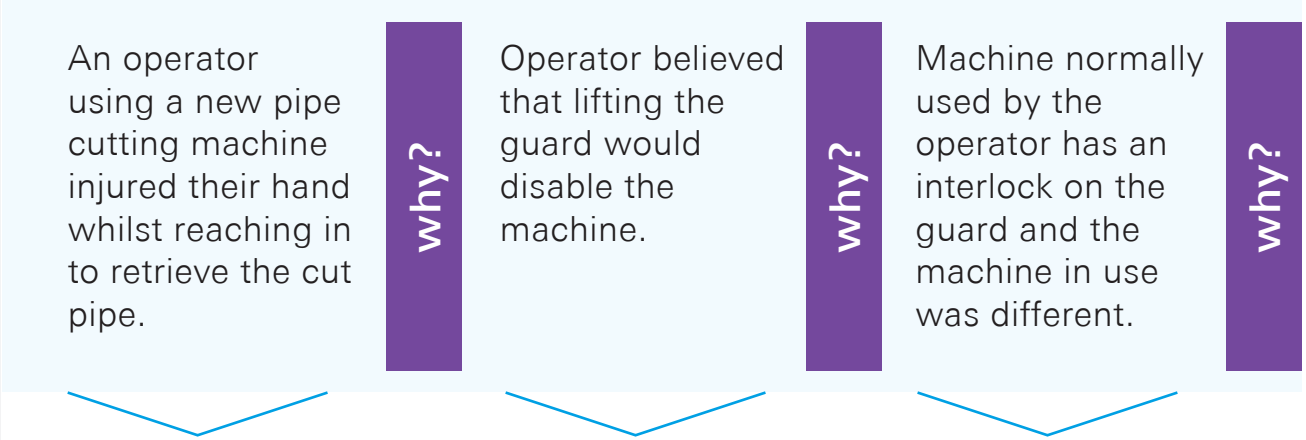

Description of a behaviour that contributed to an incident.

A description of an assumption / decision made by a person.

Explanation of the reasons leading to the assumption.

Explanation why it made sense to the person to do X.

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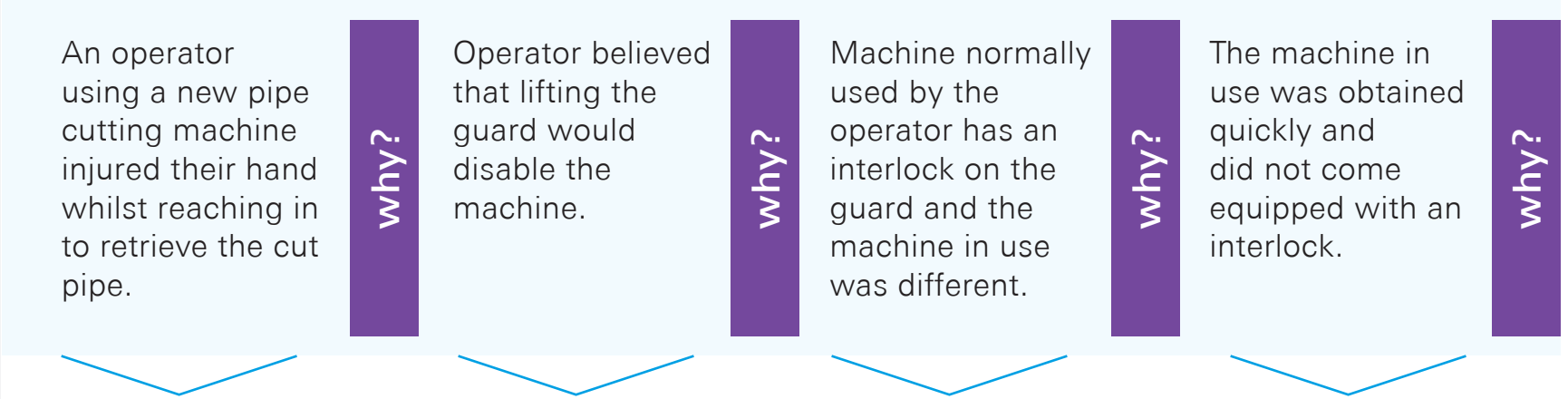

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Explanation of the situation was created.

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An operator using a new pipe cutting machine injured their hand whilst reaching in to retrieve the cut pipe.

why?

Operator believed that lifting the guard would disable the machine.

why?

Machine normally used by the operator has an interlock on the guard and the machine in use was different.

why?

The machine in use was obtained quickly and did not come equipped with an interlock.

why?

The procurement process did not require the machine purchased to have a safety interlock.

Description of a behaviour that contributed to an incident.

A description of an assumption / decision made by a person.

Explanation of the reasons leading to the assumption.

Explanation why it made sense to the person to do X.

Explanation of the situation was created.

Explanation of more distant factors that created the conditions which led to an assumption which led to a behaviour.

Preparation ... Report

Use the 5 Whys to

Refresh yourself on this toolkit to inform your plans

Use the investigation team top tips tool

Use the Fatigue Tool to assess whether fatigue made a contribution to the incident

Tactics

Tools

All tools

- Which HF Tool to use and when?
- HF evidence checklist
- Basic Analysis Tool
- Fatigue Tool

Advanced Cause and Effect

All tools

- Which HF Tool to use and when?
- HF evidence checklist
- 4 Steps Overview
- Basic Analysis Tool
- Fatigue Tool
- Verification Tool

Use the Logic Tree ... enquiry

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to the incident

Tactics

Tools