Example - Case Study

A Root Cause Analysis of the Titanic - Simple to Detailed
Investigating and preventing complex problems in your business.

How a Simple 5-Whys can Turn Into a Complete and Thorough Analysis

Root Cause Analysis - Cause Mapping Method

Step 1. Define the Problem

Step 2. Conduct a Cause-and-Effect Analysis (visual, simple to detailed)

Step 3. Identify Solution Options to Mitigate Risk (select the best ones)
### Root Cause Analysis - Cause Mapping Method

#### Step 1. Define the Problem

<table>
<thead>
<tr>
<th>What</th>
<th>Problem(s)</th>
<th>Titanic sank, ship hit iceberg, people died, weak rivets</th>
</tr>
</thead>
<tbody>
<tr>
<td>When</td>
<td>Date, time</td>
<td>April 14th, 1912, ~11:40 pm</td>
</tr>
<tr>
<td></td>
<td>Different, unusual</td>
<td>Maiden voyage, five ice warnings, nighttime</td>
</tr>
<tr>
<td>Where</td>
<td>Geographic location</td>
<td>North Atlantic</td>
</tr>
<tr>
<td></td>
<td>Company</td>
<td>White Star Line</td>
</tr>
<tr>
<td></td>
<td>Equipment, unit, area</td>
<td>RMS Titanic, starboard bow</td>
</tr>
<tr>
<td></td>
<td>Task (work process)</td>
<td>Transporting passengers from UK to US</td>
</tr>
</tbody>
</table>

#### Impact to the Overall Goals

<table>
<thead>
<tr>
<th>Safety</th>
<th>1500 Fatalities (705 survivors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Service</td>
<td>Major ?</td>
</tr>
<tr>
<td>Operations, Schedule</td>
<td>Major ?</td>
</tr>
<tr>
<td>Property, Equip.</td>
<td>Lost entire ship $7,500,000</td>
</tr>
<tr>
<td>Frequency</td>
<td>1x</td>
</tr>
</tbody>
</table>
Step 2. Analysis

Titanic Sank

Cause Map
Step 2. Analysis

Titanic Sank

Cause Map
Step 2. Analysis

Titanic Sank

Cause Map

- Impact to Safety Goal
- Loss of 1500 lives
- Titanic sank
- Ship hit iceberg

Basic Cause-and-Effect Relationship
Step 2. Analysis

Titanic Sank

Cause Map

- Impact to Safety Goal
- Loss of 1500 lives
- Titanic sank
- Ship hit iceberg

Basic Cause-and-Effect Relationship
Step 2. Analysis

Titanic Sank

Cause Map

- Ship hit iceberg
- Water filled hull
- Titanic sank
- Loss of 1500 lives
- Impact to Safety Goal
Step 2. Analysis

Titanic Sank

Cause Map
Step 2. Analysis

Titanic Sank

Cause Map

5-Whys is simply a Cause Map with 5-Why questions, but there are more....
Step 2. Analysis

Titanic Sank

Cause Map
Step 2. Analysis

Titanic Sank

Cause Map

- Impact to Safety Goal
- Loss of 1500 lives
- Titanic sank
- Water filled hull
- Opening in hull
- Steel plates pulled apart on hull
- Ship hit iceberg
- Ship didn't turn sufficiently

Basic Cause-and-Effect Relationship
Step 2. Analysis

Titanic Sank

Cause Map
Step 2. Analysis

Titanic Sank

Cause Map

<table>
<thead>
<tr>
<th>Effect</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening in hull</td>
<td>Steel plates pulled apart on hull</td>
</tr>
<tr>
<td>Ship hit iceberg</td>
<td>Ship didn't turn sufficiently</td>
</tr>
<tr>
<td>Saw iceberg late</td>
<td>Nighttime</td>
</tr>
<tr>
<td>Lost entire ship</td>
<td>Impact to Property Goal</td>
</tr>
<tr>
<td>Loss of 1500 lives</td>
<td>Impact to Safety Goal</td>
</tr>
</tbody>
</table>

Cause-and-Effect Relationship:
- Titanic sank
- Water filled hull
- Steel plates pulled apart on hull
- Ship hit iceberg
- Ship didn't turn sufficiently
- Saw iceberg late
- Nighttime
Step 2. Analysis

Titanic Sank

Cause Map

Impact to Safety Goal: Loss of 1500 lives

Insufficient lifeboats

Titanic sunk

Water filled hull

Opening in hull

Steel plates pulled apart on hull

Ship hit iceberg

Ship didn’t turn sufficiently

Saw iceberg late

Nighttime

Impact to Property Goal: Lost entire ship
Step 2. Analysis

Titanic Sank

Cause Map

Effect → Why? → Cause

Opening in hull → Steel plates pulled apart on hull

Ship hit iceberg → Saw iceberg late → Nighttime

Ship didn't turn sufficiently

Strength of Hull

Strength of Rivets

AND

Insufficient lifeboats

Loss of 1500 lives → Titanic sank → Water filled hull

Lost entire ship

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Step 2. Analysis

Titanic Sank

Cause Map

Impact to Safety Goal
- Loss of 1500 lives
- Titanic sank
- Water filled hull

Insufficient lifeboats

Impact to Property Goal
- Lost entire ship
- Bulkheads open at top
- Ship hit iceberg
- Saw iceberg late
- Nighttime

Why?
- Steel plates pulled apart on hull
- Opening in hull

Basic Cause-and-Effect Relationship

Cause
- Strength of Hull
- Strength of Rivets

Effect
- Insufficient lifeboats
- AND
- Strength of Hull
- AND
- Nighttime
Titanic Sank

Cause Map

Effect | Cause
--- | ---
Opening in hull | Steel plates pulled apart on hull
Steel plates pulled apart on hull | Strength of Hull
Strength of Hull | Strength of Rivets
Strength of Rivets | Nighttime

Why?

Insufficient lifeboats | Loss of 1500 lives
Loss of 1500 lives | Titanic sank
Titanic sank | Water filled hull
Water filled hull | Bulkheads open at top
Bulkheads open at top | Speed of ship
Speed of ship | Saw iceberg late
Saw iceberg late | Saw iceberg late
Nighttime | Nighttime

Impact to Safety Goal

Impact to Property Goal

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Titanic Sank

Cause Map

Impact to Safety Goal

- Loss of 1500 lives
- Titanic sank
- Water filled hull
- Insufficient lifeboats

Solution: Add 20 more lifeboats.

Impact to Property Goal

- Lost entire ship
- Ship hit iceberg
- Ship didn’t turn sufficiently
- Bulkheads open at top
- Saw iceberg late
- Nighttime
- Speed of ship
- Strength of Hull
- Strength of Rivets
- Insufficient lifeboats

Solution: Add two more lookouts to the bow.
Solution: Improve bow watch hazard recognition process.
Solution: Slow down with known icebergs in area.
Solution: Run bulkheads to the top deck.
Solution: Change steel hull design, materials.

Basic Cause-and-Effect Relationship

Why?

Effect

Cause

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Click here to get a Titanic Root Cause Analysis Poster

http://www.shopthinkreliability.com/
Titanic Cause Map with “Broken” Work Processes Identified

- **Safety Goal Impacted**: Loss of 1500+ lives
- **Property Goal Impacted**: Lost entire ship

**Solution**:
- Change steel hull design, materials.
- Add 20 more lifeboats.
- Improve bow watch process.
- Idle outside propellers instead of reversing.
- Ensure each lookout has binoculars available.
- Add two more lookouts to the bow.
- Run bulkheads to the top deck.
- Run bulkheads not sealed.
- Solution: Titanic sank.
- Solution: Ship filled with water.
- Solution: No splash on iceberg.
- Solution: Bulkheads not sealed.
- Solution: Steel seams opened on hull.
- Solution: Openings in hull.
- Solution: Iceberg in path.
- Solution: Ship hit iceberg.
- Solution: Dark, nighttime.
- Solution: Lookout process ineffective.
- Solution: Speed (18-22 knots).
- Solution: Maneuver.
- Solution: Iceberg hazard identification.

**NOTES**
- A Cause Map shows the causes that produced a particular incident (the Analysis).
- Each causal path reveals specific work processes that broke down (Pinpoints Necessary Changes).
- Solutions are implemented as changes within those particular work processes (Best Practices going Forward).
- Every cause and every work process does not need to be solved (Lowest Acceptable Risk).