

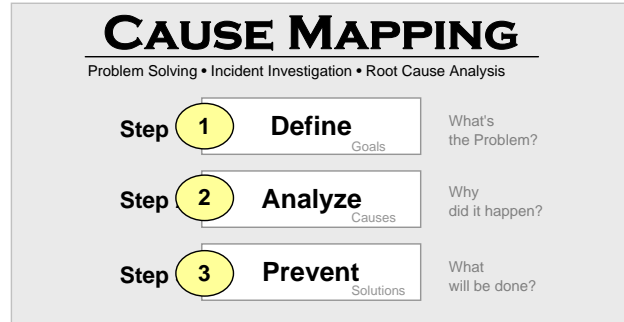
# Root Cause "Success" Analysis

Root cause analysis is an approach for identifying the underlying causes of why an incident occurred. It's typically used when something goes badly, but can also be used when something goes well. The investigation of US Airways Flight 1549 will include both why the aircraft ditched in the river and why all onboard survived.

## Cause Mapping Root Cause Analysis

In the Cause Mapping method, the word "root," refers to the causes that are beneath the surface. Most organizations mistakenly use the term "root cause" to identify the one, main cause. A Cause Map visually explains that all of the causes of an incident are required for the incident to occur. The "root" should be thought of as a system of causes to reveal the different options for solutions.

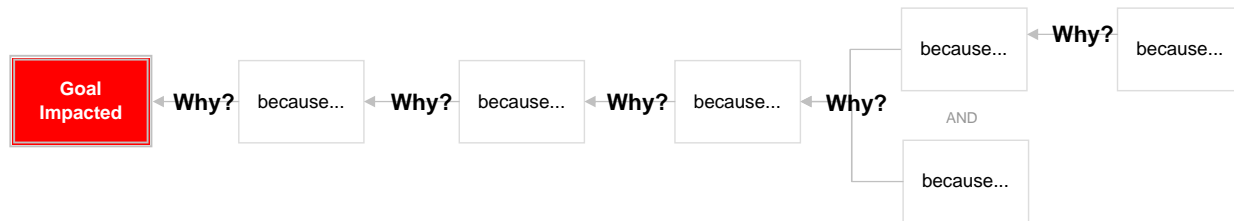
There are three basic steps to the Cause Mapping method: 1) define the issue by its impact to overall goals, 2) analyze the causes in a visual map, and 3) prevent or mitigate any negative impact to the goals by selecting the most effective solutions. For information about investigating and preventing a problem or attending a workshop visit our web site at [www.thinkreliability.com](http://www.thinkreliability.com) or call 281-412-7766.



## How to read a Cause Map

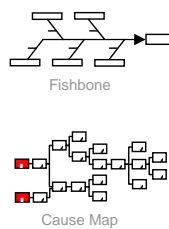
Start on the left. Read to the right saying "was caused by" in place of the arrows.

A Cause Map begins on the left with the impact to the overall goals. The questions begin, "Why did this effect happen?" The response to this question provides a cause (or causes), which is written down to the right. The next question is again, "Why did this effect happen?" The cause that was written down last becomes the effect for the next Why question. Anyone who's ever had a three-year-old in their life will immediately recognize how Why questions change a cause into an effect. This is fundamentally how causes and effects link together to create a *chain of events*. Writing down 5-Whys as a Cause Map, shown below, is a great way to start an investigation because it's so simple. In addition to the standard Why questions, which tend to create linear cause-and-effect relationships, the Cause Mapping method also asks "What was required to produce this effect?" Anything that is required to produce an effect is a cause of that effect. This question, "What was required?," builds a detailed Cause Map that provides a more complete representation of the actual issue.



## Read the Cause Map Left to Right

It should be noted that the popular fishbone cause-and-effect diagram starts with the problem on the right and builds the causes to the left. It was created by Kaoru Ishikawa (1915-1989) in Japan. The fishbone diagram builds from right to left because the Japanese language reads from right to left. The Cause Mapping method actually uses Ishikawa's convention by asking Why questions in the direction we read.



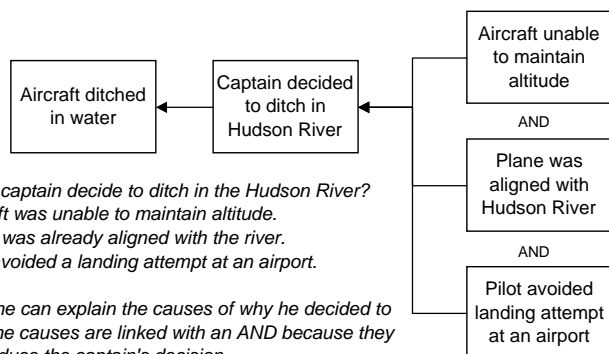
## 5-Whys on a Cause Map

The 5-Why approach is an excellent example of basic cause-and-effect analysis. Just as a journey of a thousand miles begins with the first step; every investigation, regardless of size, begins with one Why question. The Why questions then continue, passing through five, until enough Why questions have been asked (and answered) to sufficiently explain the incident. The 5-Why approach, created by Sakichi Toyoda (1867 - 1930), the founder of Toyota, is a simple way to begin any investigation. A Cause Map can start with just 1-Why and then expand to accommodate as many Why questions as necessary. Some refer to the Cause Mapping method as "5-Whys on Steroids."

## Some causes are linked with AND inbetween

ANDs show where more than one cause is required.

When an effect has more than one cause, both causes are placed on the Cause Map. Each cause is connected to the effect with an AND placed in between. These causes are independent of each other, but they are both required to produce that effect. An AND is needed when people provide different, yet valid, explanations of a cause. People think of cause-and-effect as a simple one-to-one relationship; an effect has a cause. In reality, every effect has causes.




Question: Why did the captain decide to ditch in the Hudson River?  
 - because the aircraft was unable to maintain altitude.  
 - because the plane was already aligned with the river.  
 - because the pilot avoided a landing attempt at an airport.

By asking the captain, he can explain the causes of why he decided to ditch in the Hudson. The causes are linked with an AND because they were all required to produce the captain's decision.

# 1 Define

## "Miracle on the Hudson" Flight 1549



<b>What</b>	Problem(s), Issue(s)	Aircraft ditched in Hudson River, Bird strike, Lost both engines	
<b>When</b>	Date, Time	January 15, 2009, ~3:31 PM est	
<b>Where</b>	Geographic location	Hudson River, west of Manhattan, near 48th street	
	Company identification	US Airways, Flight 1549	
	Process (task being done)	Passenger flight - New York City (LaGuardia) to Charlotte, NC	
<b>Impact to the Goals</b>			
<b>Safety</b>		No fatalities, 150 passengers, 5 crew members survived	
		Potential was for major loss of life on aircraft and ground	
<b>Property</b>		Loss of aircraft, write-off (estimated aircraft value)	\$ 70,000,000
		Loss of passenger belongings	?
		This incident	
<b>Frequency</b>		1x ditching for US Airways	

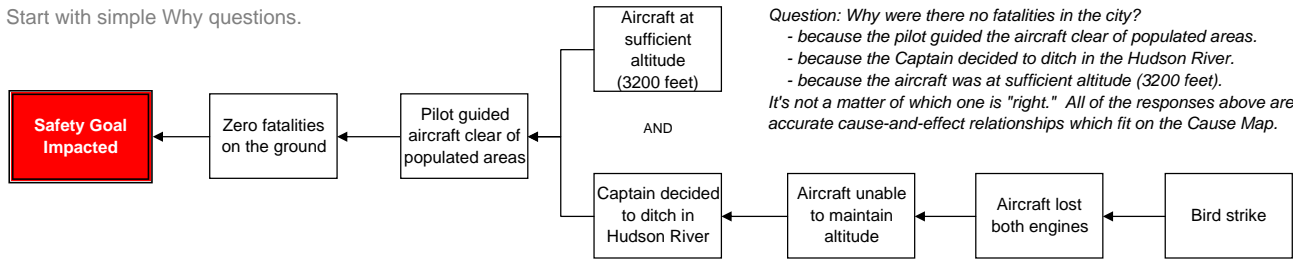
Step 1 is the Definition of the Problem. It's written in an outline format so that it's easy to capture and easy to read. The problem is always defined by the specific impact to the organization's overall goals (the deviation from the ideal state). In the case of Flight 1549 the impact to safety was a positive. All 155 people onboard survived, but it could have been catastrophic. There was also the loss of a \$70M aircraft.

# 2 Analyze

Step 2 is the Analysis of the incident. The cause-and-effect relationships are identified by asking "Why?" questions starting with the Goals that were impacted. While the Cause Map may start linearly, it will expand to provide a detailed view of the entire incident as more information is collected.

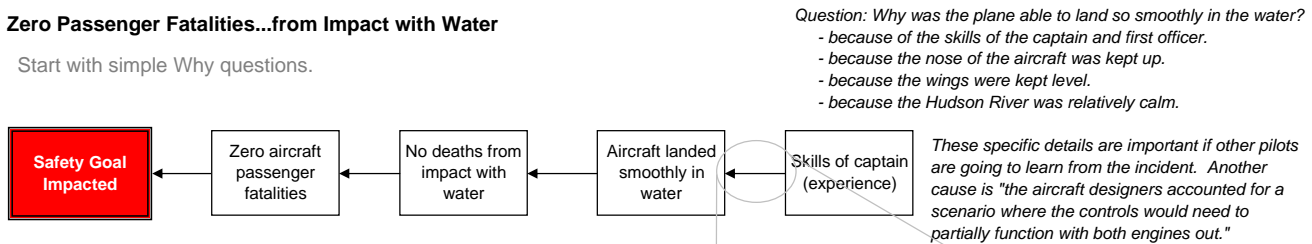
## Zero Fatalities on the Ground

Start with simple Why questions.

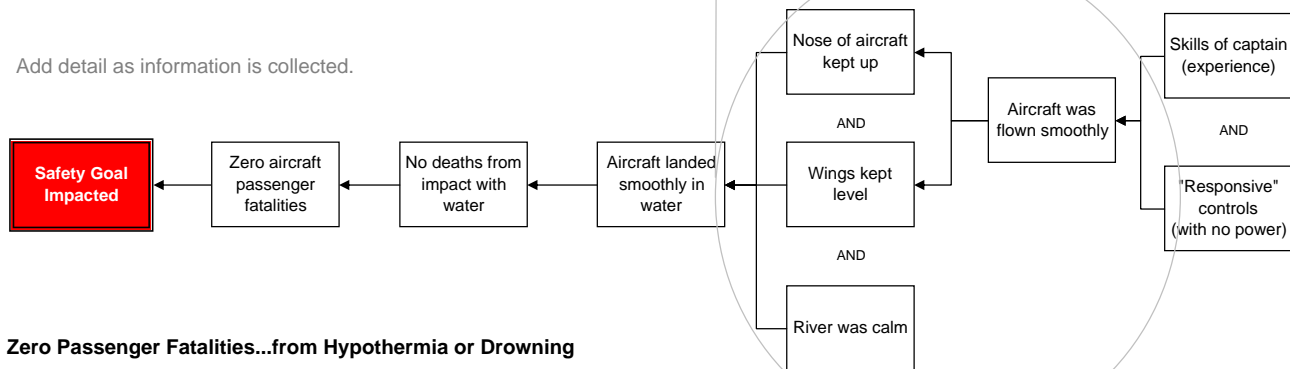


## Zero Passenger Fatalities...from Impact with Water

Start with simple Why questions.



Add detail as information is collected.

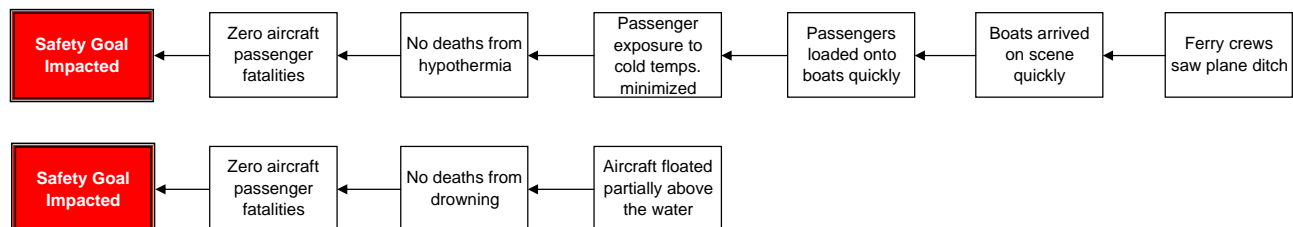


## Zero Passenger Fatalities...from Hypothermia or Drowning

Question: Why were there no passenger fatalities on the aircraft?

- because of how smoothly the aircraft impacted the water.
- because no one died of hypothermia or drowning.
- because no one died from fire.

These causes (and more) can be combined onto a Cause Map to accommodate as much detail as needed. See the Cause Map on the next page.



# 3 Prevent

Step 3 is the selection of specific action items to prevent the issue from occurring.

The recommendations and action items from the actual Flight 1549 incident will be included once they are made available.

**Cause Map**

Start with any one of the goals that have been impacted. Read the Cause Map from left to right using the phrase "was caused by" in place of the arrows.

