

# The Cause and Effect Principle

By Dean L. Gano

In 1987, I began teaching root cause analysis and after teaching for about three years I discovered the cause and effect principle which led me to the Apollo Root Cause Analysis problem solving methodology. Unlike any causation model before it, it is based on a principle that holds true for every thing that happens. The Cause and Effect Principle provides four basic characteristics that allow us to understand reality in a simple structured way. These four characteristics are as follows:

## Cause and Effect Principle

1. Causes and effects are the same thing.
2. Causes and effects are part of an infinite continuum of causes.
3. Each effect has at least two causes in the form of actions and conditions.
4. An effect exists only if its causes exist at the same point in time and space.

## Cause and effect are the same

Knowing that cause and effect are the same thing only viewed from a different perspective in time helps us understand one reason why people can look at the same situation and see different problems. They are actually perceiving different time segments of the same event. If we treat each perspective as a different piece of a jigsaw puzzle, we can stop the usual arguing and work on putting the different pieces together. For example, in Figure 1 below, we see that the primary effect is the “Injury” and the first cause is a “Fall.” If we ask why “Fall,” this cause has to be seen as an effect. That is, we cannot ask why of a cause, only of an effect, so “Fall” changes from a cause to an effect. In a given event, we may each see the causes differently. You might see the “Fall” as the problem effect, while the next person sees the “Leaky Valve” as the problem effect. The reality is that cause and effect are the same thing, only viewed from a different point in time.

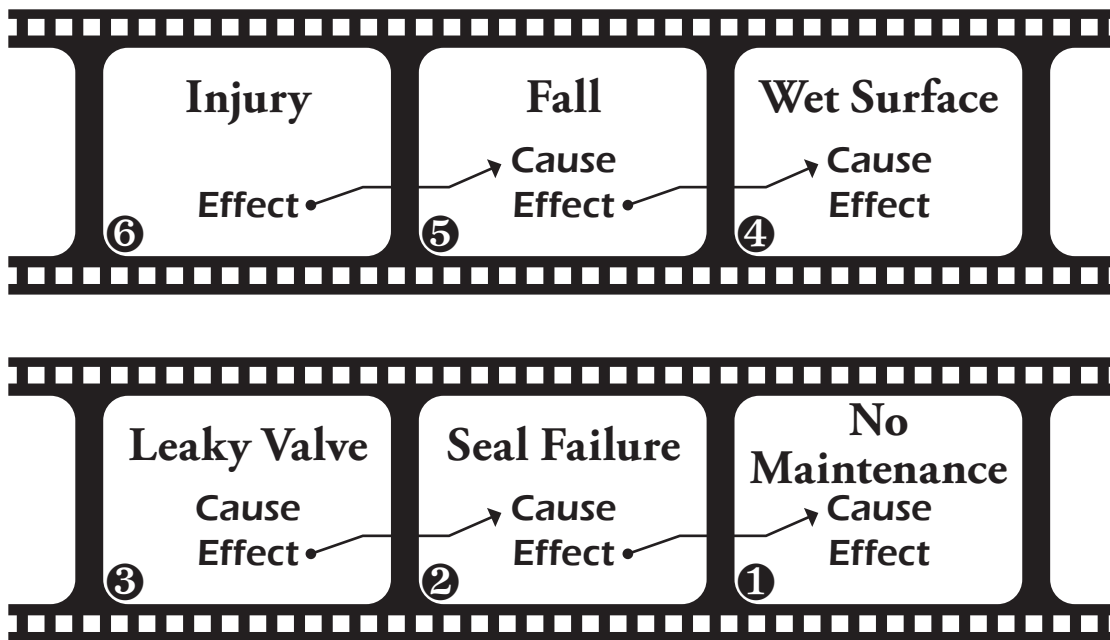


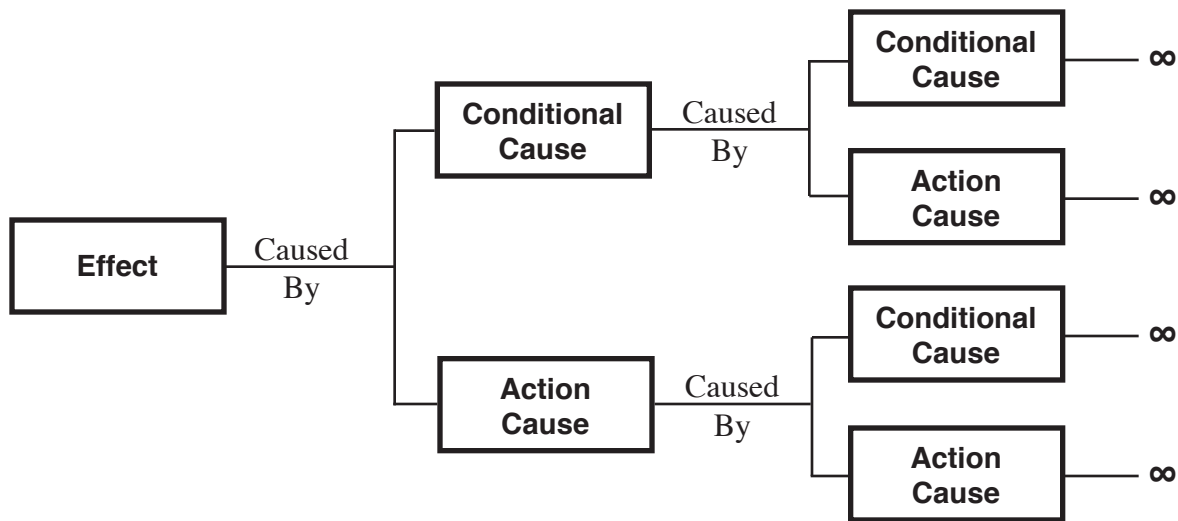
Figure 1. Simple Cause Chain

### Infinite continuum

Knowing that causes and effects are part of an infinite continuum of causes helps us understand that no matter where we start our problem analysis, we are always in the middle of a chain of causes. This helps us understand that there is no right place to start. Again, just like the jigsaw puzzle, we can start the problem solving process anywhere and still end up with a complete picture. This avoids the usual arguments over who is right and allows us to focus on finding causes. Again, in Figure 1, someone may be focused on the injury while another is focused on the leaky valve. Instead of arguing over what the problem is, like we normally do, we can know that all causes are connected somehow in time and we just need to figure out what those connections are.

### Each effect has two causes

Probably the most profound characteristic of the Cause and Effect Principle is that each effect has at least two causes in the form of actions and conditions. This teaches us that every time we ask “why,” we should find at least two causes and because of the infinite continuum, for each of these causes we should find at least two more causes resulting in four causes, and from each of these four causes we should find two causes resulting in at least 8, and on to 16, 32, etc. See Figure 2.



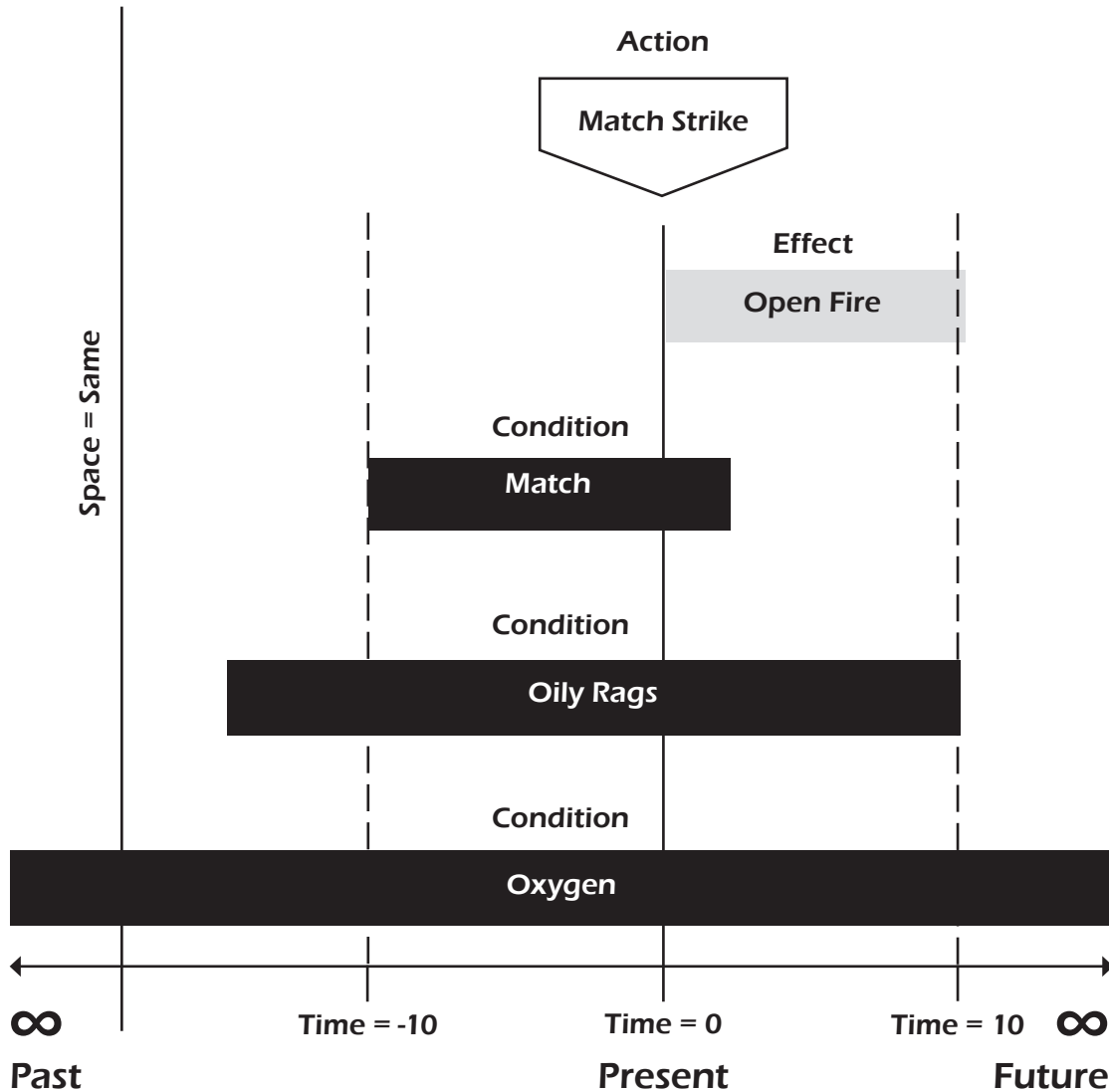
**Figure 2. The Infinite Set of Causes**

With this understanding, we see that there is an infinite set of causes for each effect, limited primarily by our lack of knowledge. Presented with a reality that has a never-ending set of causes it is now easy to understand why we stop asking why at an early age and pursue simpler strategies like categorization, and storytelling. Designed to find the right answer, the human mind simply cannot deal with not knowing (Carter, 1999) so we create answers when there are none. This is particularly true in group settings because we don't want to be embarrassed. Embarrassment kills learning. (Goleman, 1995)

With this notion of the infinite set, it seems ridiculous to think we could just keep asking why forever. In practice however, the causal sets are rather short because we are not smart enough to know all the answers. Other natural limits come into play and the process is very manageable as long as we are humble and analyze the problem commensurate with its value.

### Effects exist at the same point in time & space

From observation, we see that an effect exists only if its causes exist at the same point in time and space. For example, in Figure 3, an open fire exists because conditional causes came together with an action cause at a particular point in time and space. As we can see from this example, three conditional causes: oxygen, oily rags, a match, AND one action cause, a Match Strike, occurred at the same point. If these four causes did not exist at the same time and space, the fire would not exist. For example, if the oily rags were stored in a closed can, or if the match was struck at a different time, a fire could not exist. Understanding this characteristic helps us determine the validity of causal relationships.



**Figure 3. Example of Time and Space Relationships**

By understanding these four characteristics, we can devise some simple tools that will enable us to tap the awesome power of the Cause and Effect Principle.

## Effective Problem Solving Tools – Apollo Root Cause Analysis

Using the cause and effect principle we can develop a simple problem solving method that can be used on any event-based problem. This method is called the Apollo Root Cause Analysis (ARCA) method.

The four steps of the Apollo method are as follows:

Step 1: Define the problem by writing the

What: Primary Effect (Noun-Verb)

When: Specific or Relative Time of the Primary Effect

Where: Location in System, Facility, or Component

Significance: Why you are working on this problem?

Step 2: Create a Realitychart

For each Primary Effect ask why

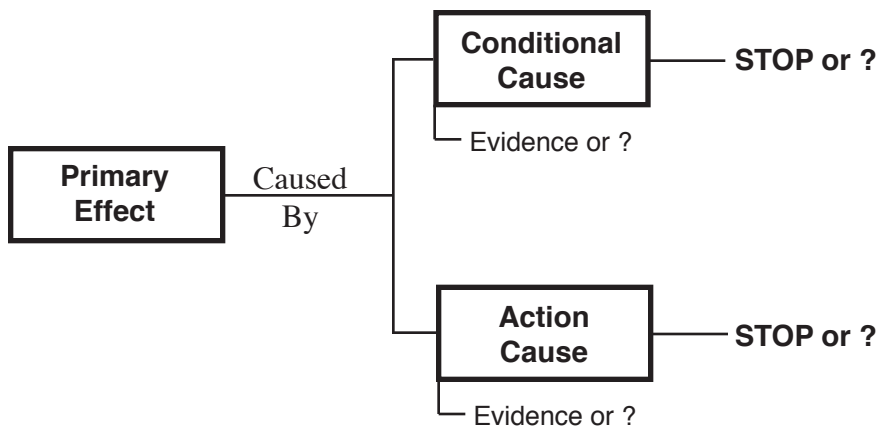
Look for causes in Actions and Conditions

Connect causes with “Caused By”

Support causes with evidence or use a “?”

End each cause path with a “?” or reason for stopping

The basic chart elements look like this:



Step 3: Identify effective solutions

Challenge the causes and offer solutions

Identify the best solutions — they must:

- Prevent recurrence
- Be within your control
- Meet your goals and objectives

Step 4: Implement the best solutions

## Final Product

The product of steps 1 and 2 is a Realitychart like Figure 4. The iterative process of step 3 identifies effective solutions. And while obvious, step 4 is often not performed, so it is included as a reminder.

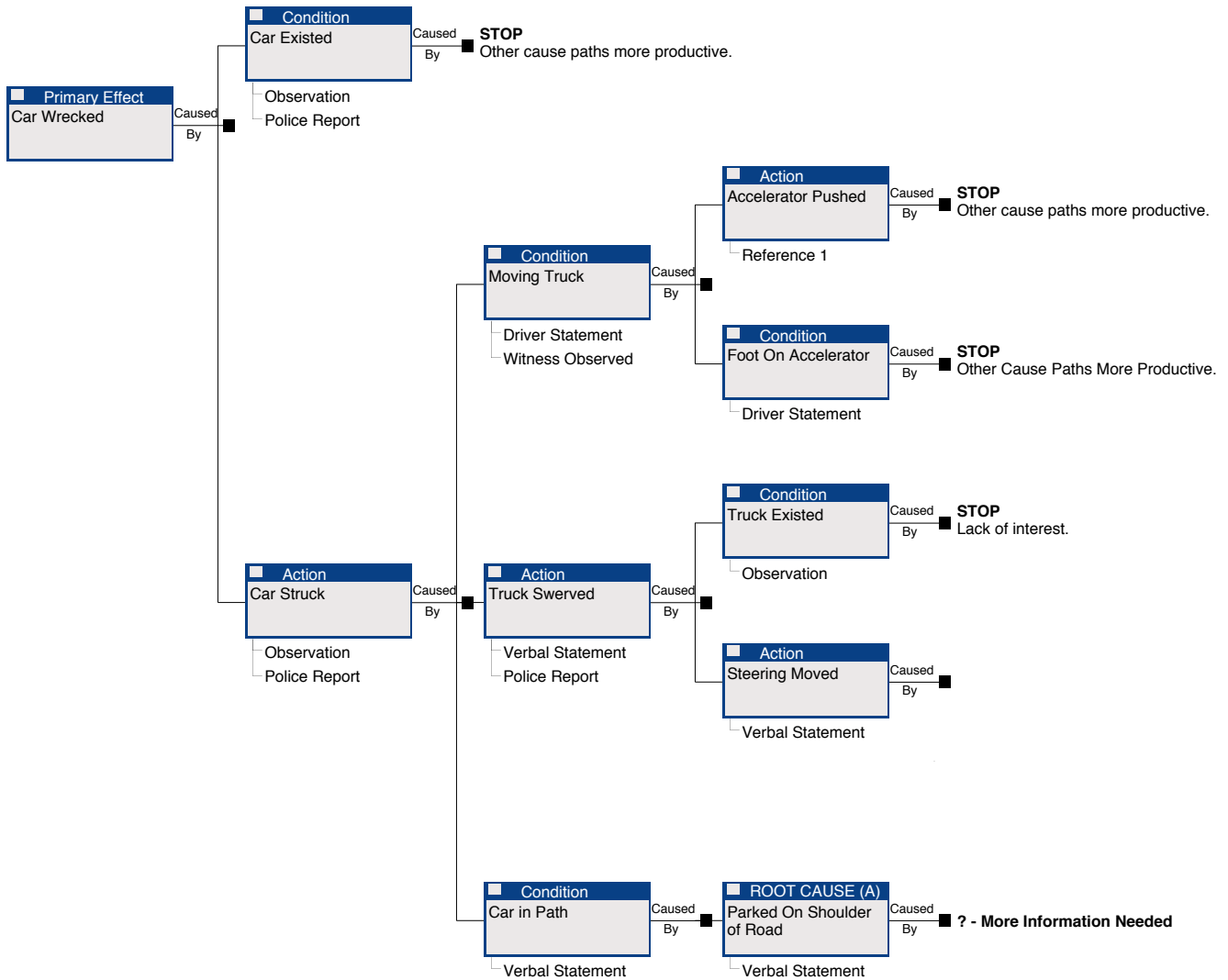


Figure 4. Example of a Realitychart