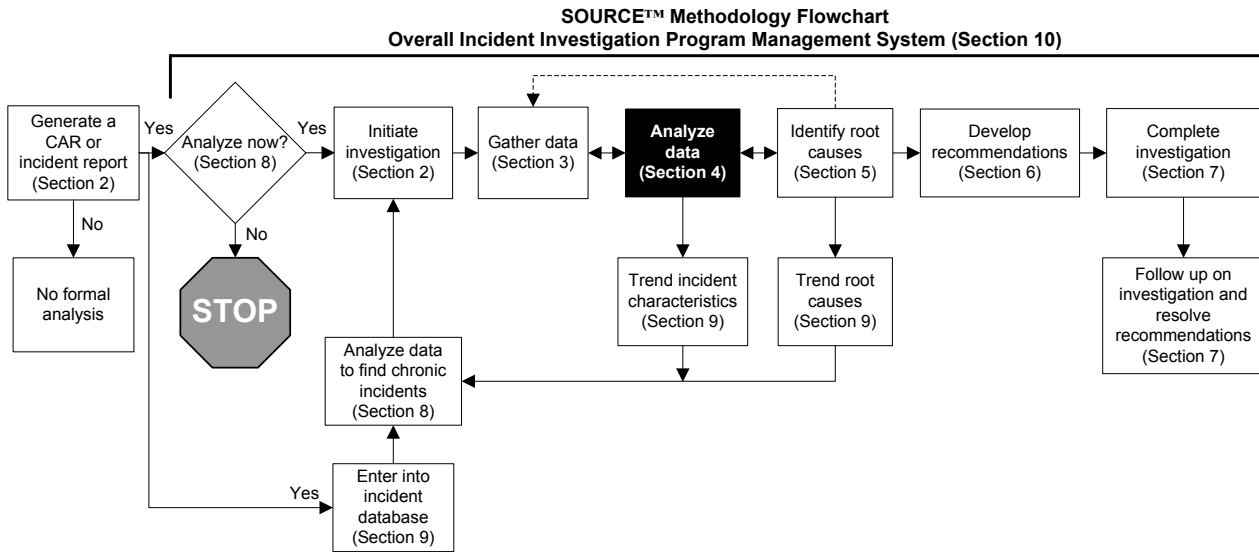**FIGURE 4.1: Analyzing Data Within the Context of the
Overall Incident Investigation Process**

4.2   Overview of Primary Techniques

There are three primary data analysis techniques: cause and effect tree analysis, timelines, and causal factor charting.

Cause and effect tree analysis is a structured approach for modeling the combinations of human errors, equipment failures, and external factors that can produce the type of incident or problem being evaluated. This type of analysis is used frequently to resolve gaps in causal factor charts and timelines, but it can also be used as a stand-alone tool. It is the best tool for analyzing equipment and software problems as well as chronic problems. It can also be described as a troubleshooting approach or a structured guessing approach. Hypotheses (guesses) are put forward as to what could have caused each event, then data are systematically gathered and analyzed to determine whether the potential cause is an actual cause of the event.

Causal factor charting arranges building blocks to graphically depict the timing of events and the cause-effect relationships between events and conditions. It has many of the attributes of a timeline, but it also has logic tests built into the process through "necessity" and "sufficiency" testing of data, which make causal factor charts much more powerful than a simple timeline. It is the best analysis method to use when timing of events is important. It is usually the best tool for incidents with safety and environmental impacts.

Table 4.1 summarizes the characteristics of the three analysis techniques addressed in this subsection. Table 4.2 provides guidance on when to apply each of the different techniques.

TABLE 4.1: Summary of Analysis Technique Characteristics

	Cause and Effect Tree Analysis	Timeline	Causal Factor Charting
Basic structure	Logic tree	Timeline	Timeline
Timing of events incorporated?	Very limited	Yes, explicitly	Yes, explicitly
Logic tests incorporated	Yes, explicit use of logic gates (AND and OR gates)	No	Yes, with necessity testing
Summary	A detailed logic tree	A simple timeline	An enhanced timeline

TABLE 4.2: Applicability of Analysis Techniques

	Cause and Effect Tree Analysis	Timeline	Causal Factor Charting
Acute incidents	Good	Good	Good
Chronic incidents	Good	Can only characterize typical incident	Can only characterize typical incident
Equipment hardware and software system problems	Best	Acceptable	Good
People-oriented problems	Acceptable	Good	Best
Incidents where timing is important	Not very useful	Good	Best
Typical types of incidents analyzed	Reliability, quality	Health, safety, environmental, security, reliability, quality	Health, safety, environmental, security

4.3   Cause and Effect Tree Analysis

Cause and effect tree analysis begins with a known event (referred to as the top event) and describes possible combinations of events and conditions that can lead to this event. The top event in the cause and effect tree can be the loss event under investigation or a specific event that is involved in the incident. In Figure 4.2 the top event (the main loss event) is defined as a "Spill from tank area."
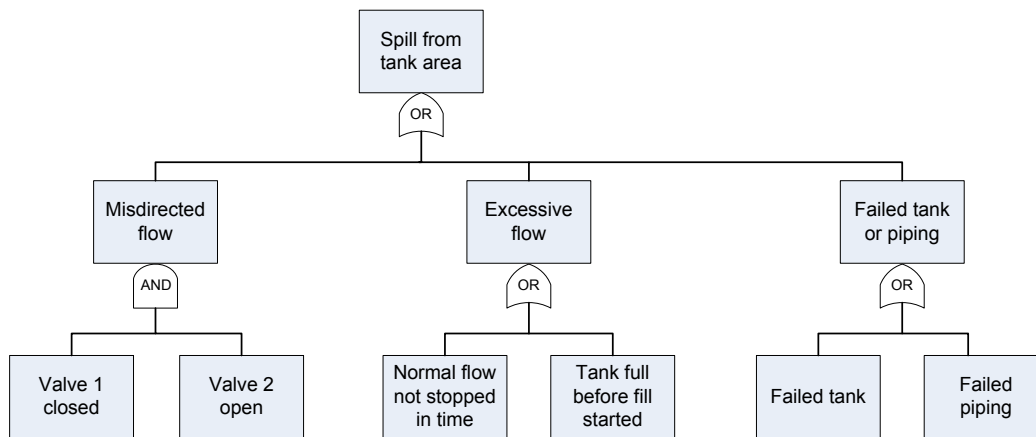

FIGURE 4.2: Example Cause and Effect Tree