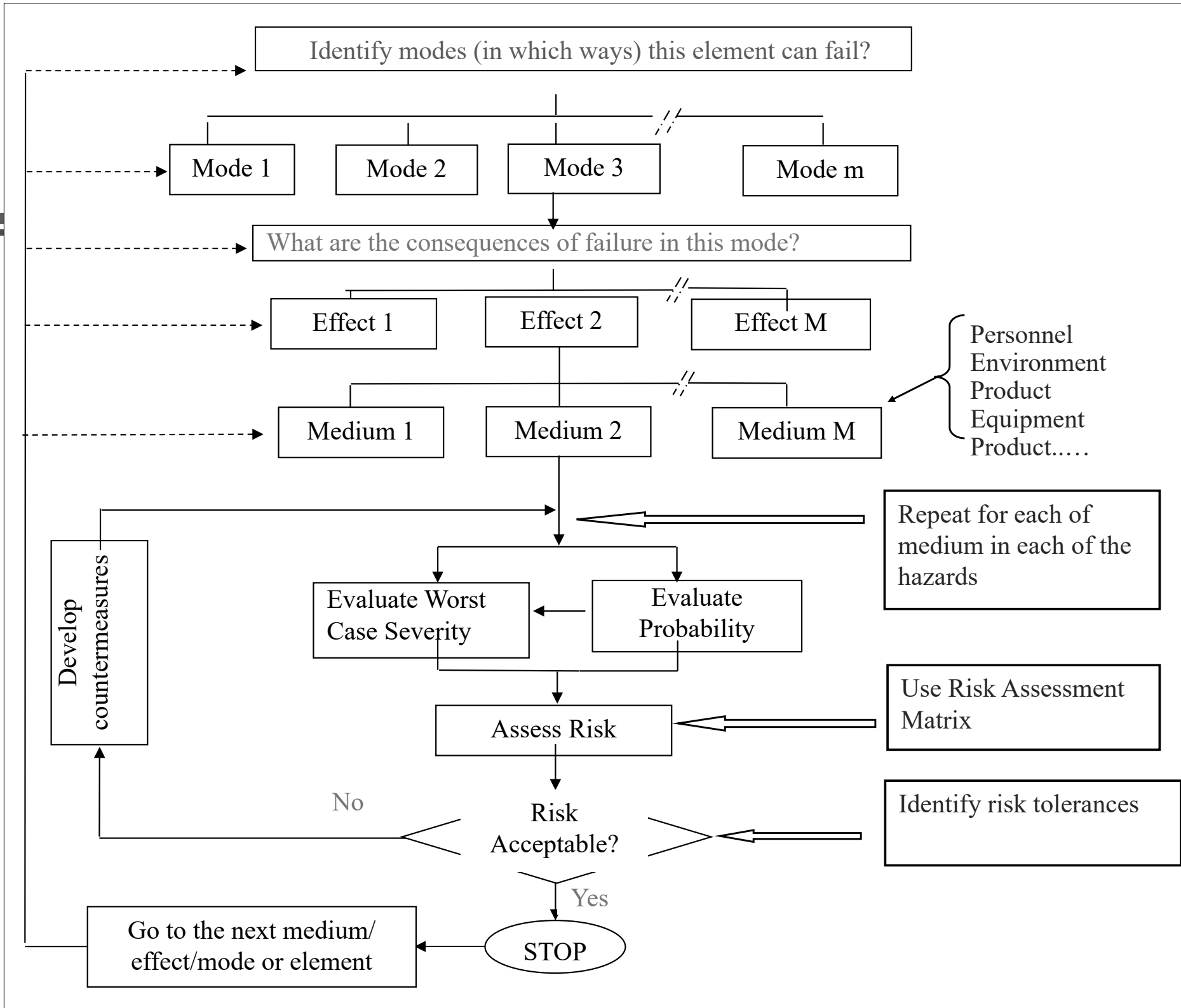


```

graph TD
    Start([Start]) --> Q1{Identify modes (in which ways) this element can fail?}
    Q1 --> M1[Mode 1]
    Q1 --> M2[Mode 2]
    Q1 --> M3[Mode 3]
    Q1 --> Mm[Mode m]
    M1 --> Q2{What are the consequences of failure in this mode?}
    M2 --> Q2
    M3 --> Q2
    Mm --> Q2
    Q2 --> E1[Effect 1]
    Q2 --> E2[Effect 2]
    Q2 --> Em[Effect M]
    E1 --> Med1[Medium 1]
    E2 --> Med2[Medium 2]
    Em --> MedM[Medium M]
    Med1 --> Q3{Risk Acceptable?}
    Med2 --> Q3
    MedM --> Q3
    Q3 -- Yes --> Stop([STOP])
    Q3 -- No --> Dev[Develop countermeasures]
    Dev --> Q1
    Q3 --> Q4{Go to the next medium/effect/mode or element}
    Q4 --> Q1
    Q3 --> Q5{Repeat for each of medium in each of the hazards}
    Q5 --> Q1
    Q3 --> Q6{Use Risk Assessment Matrix}
    Q6 --> Q3
    Q3 --> Q7{Identify risk tolerances}
    Q7 --> Q3
  
```

The flowchart illustrates the Risk Assessment Process, starting with identifying failure modes for an element. It then evaluates the consequences of failure in each mode, identifying effects and the media through which they occur. The process then assesses the risk by evaluating the worst-case severity and probability, using a risk assessment matrix and identifying risk tolerances. If the risk is acceptable, the process stops; otherwise, countermeasures are developed and the process loops back to the start.



FMEA Process, 1

- Define the subsystem, scope, and boundaries.
 - ⇒ Drawings, charts, descriptions, diagrams, components lists
- Break the system down into convenient and logical elements.
- System Breakdown
 - ⇒ Functional
 - * according to what the System Elements “do”
 - * Cooling System; Braking System; Steering System.....
 - * Engine Compartment; Passenger Compartment, Dashboard/Control Panel, Rear End,
 - ⇒ Geographic
 - * i.e., according to where the System Elements “are”)
 - ⇒ OR Both

Failure Mode & Effect

Failure Mode: The way in which the failure of an item occurs.

Element	Failure Mode Examples
Switch	open, partially open, closed, partially closed, chatter
Valve	open, partially open, closed, partially closed, wobble
Spring	stretch, compress/collapse, fracture
Cable	stretch, break, kink, fray
Operator	wrong operation to proper item, wrong operation to wrong item

Failure Effect: The consequence of a failure mode on an operation, function, status of a system.

Basic Failure Modes

- ❑ Open Circuit
- ❑ Short Circuit
- ❑ Out of Tolerance
- ❑ Leak
- ❑ Hot Surface
- ❑ Bent
- ❑ Warped
- ❑ Dirty
- ❑ Melted
- ❑ Omitted
- ❑ Oversize/undersize
- ❑ Cracked
- ❑ Brittle
- ❑ Misaligned
- ❑ Binding/Bound
- ❑ Corroded
- ❑ Rough

Typical General Failure Modes

- Premature operation
- Failure to operate at a prescribed time
- Intermittent operation
- Failure to cease operation at a prescribed time
- Loss of output or failure during operation
- Degraded output or operational capability
- Other unique failure conditions based on system features, operation requirements, and constraints, e.g., a switch

Causes of Failure

□ System Causes

- ⇒ Item does not work
- ⇒ Short Led to ground

□ Design Causes

- ⇒ Vibration
- ⇒ Shock Loads

□ Process Causes

- ⇒ Voltage Surge
- ⇒ Worn Bearings

□ Service Causes

- ⇒ Human Error
- ⇒ Poor Skills

Failure Effects

- ❑ Operations impaired
- ❑ Erratic Operation
- ❑ Intermittent Operation
- ❑ Quality Defects
- ❑ Customer expectation not met
- ❑ Unstable Process
- ❑ Inefficient Process
- ❑ Waste
- ❑ Excessive Wear/Tear
- ❑ Equipment damage
- ❑ Chemical Release
- ❑ Environmental Damage
- ❑ Personal Injury
- ❑ Loss of Life
- ❑ Catastrophic loss of system