An Overview of System Analysis

Different Type of Analysis

- Project or Business Level Analysis:
  - Is the project feasible
  - Are there other alternatives
  - Are there any business level risks involved? Do we require to conduct risk analysis?
- System Level Analysis:
  - Which system-level architecture to be used: Client-server, database, webserver, etc…
  - Are we aware of all possible alternative
  - Are there any system level risks involved
- Product Level Analysis
  - This is the lowest level of analysis and and involves lots of details. We will focus on this
    - Functional level
    - None functional level

Feasibility Analysis

Different Types of Costs and Benefits

- Tangible Benefits
  - Readily quantified as $ values
    - cost/error reductions
    - increased throughput/efficiency
    - more effective use of staff time
- Intangible benefits
  - Difficult to quantify, but maybe more important!
    - increased flexibility of operation
    - higher quality products/services
    - better customer relations
    - improved staff morale
- Development costs
    - Eg: Development team's wages and salary
- Operational costs (on-going)
    - Eg: system administrators, maintenance, etc..

Methods of Costs/Benefits Analysis

- There are different method of analyzing costs and benefits. There are also different indices to analyze and prioritize projects:
- A simple and common index is Return of Investment:
  - Identify costs and benefits
  - Determine Cash Flow
  - Calculate Net Present Value for all future costs/benefits
    - A dollar earned today is worth more than a potential dollar earned next year
    - Calculate Return on Investment:
      - Allows comparison of lifetime profitability of alternative solutions:

        ROI = (FVI – IVI)/IVI

        Where:

        FVI is future value of investment

        IVI is initial value of investment

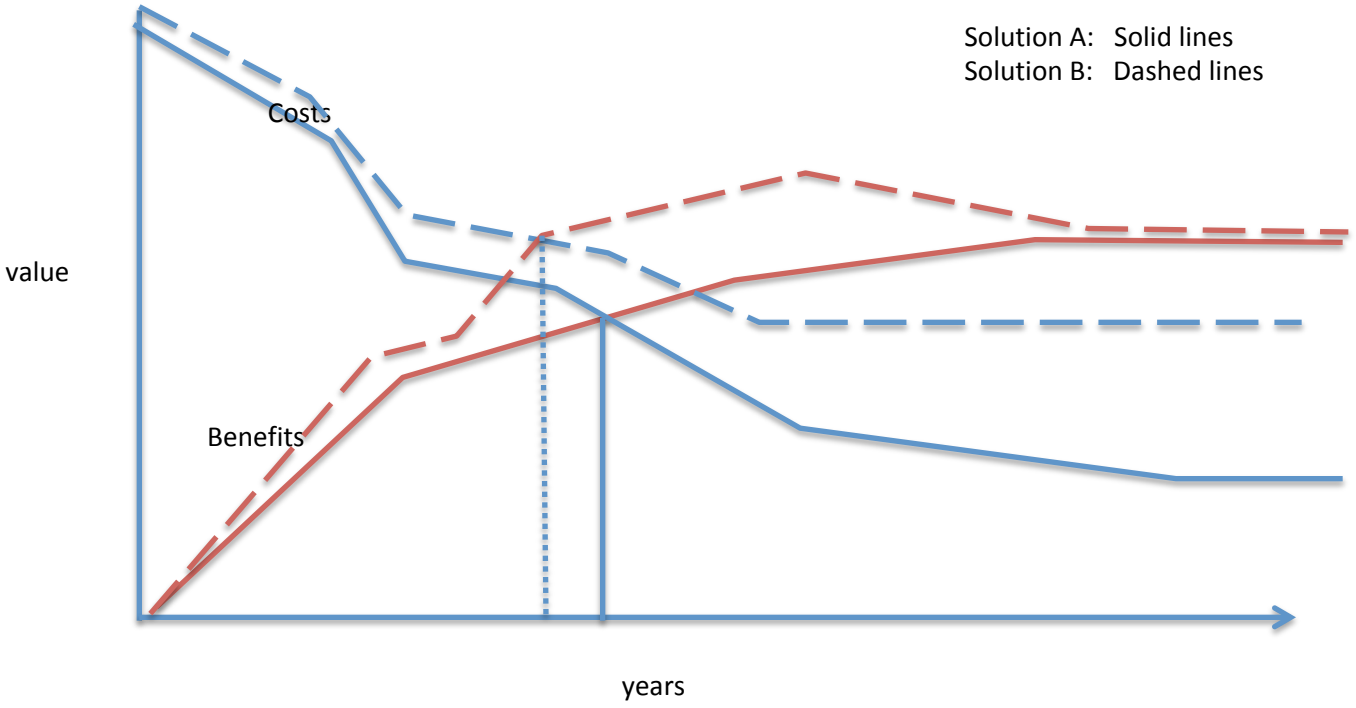
Net Present Value

To incorporate the impact of time on the ROI the net values can be converted to Net Present Value (NPV), using:

$$NPV = \sum_{t=1}^{n} \frac{Net\ Cash\ Flow}{(1+i)^t}$$

Methods of Costs/Benefits Analysis

- Calculate Break-Even point:
  - how long will it take (in years) to pay back the accrued costs:



Risk Analysis

What is Risk

- Risk is "the possibility of loss"
- Is it bad?
  - It is essential to progress
- Risk Analysis is a systematic activity:
  - Should continue throughout a project.
  - Risk analysis can uncover new requirements.
  - The challenge is to manage the amount of risk
- Risk management consists of two parts:
  - Risk Assessment
  - Risk Control
- Risk can be at the different levels (business, project, product)
  - RE Engineers only deal with project and product level

Risk Analysis Challenges

- Anticipation:
  - What can go wrong with the entity under study.
  - What are the initiator events
- Severity:
  - What and how severe are the potential detriments?
- How likely are to happen?
- Techniques:
  - Quantitative Techniques
  - Qualitative Techniques

Quantitative Indices?

- Risk Exposure Index: A dollar value index:
  - An indication of level of severity and cost of the risk:

$$RE = p(risk) \times loss(risk)$$

- Risk Reduction Leverage Index (RRL)
  - An indication to choose better alternative to mitigate the risk
  - For each mitigation action we can use the following simple calculation:

$$RRL = (RE_{before} - RE_{after}) / \text{cost of countermeasure}$$

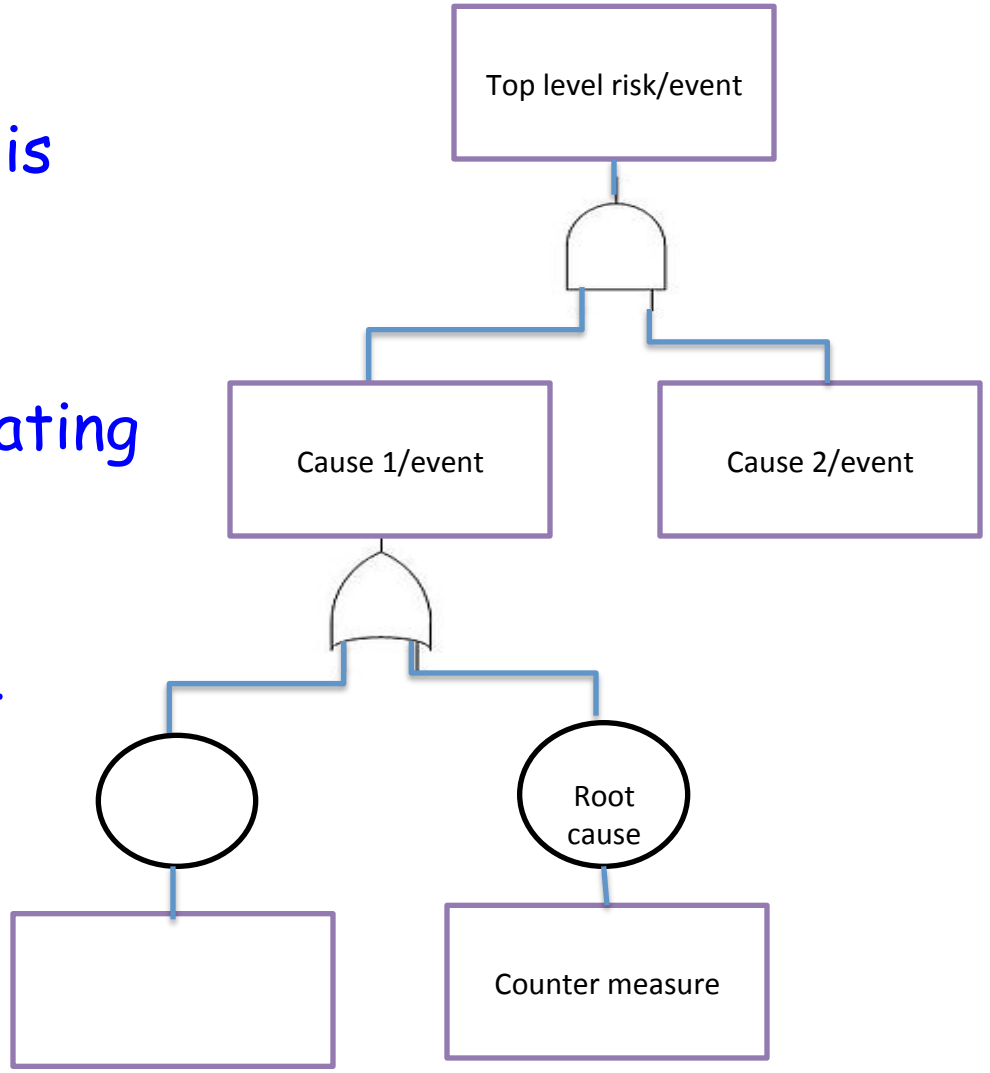
Qualitative Techniques

Fault Tree Analysis (FTA)

- FTA uses Boolean Logic to understand how system can fail or to identify the best method of mitigating risk. It is a deductive failure analysis technique.
- Initially, this method was used in safety and reliability engineering for the purpose:
  - Risk analysis assessment
  - discovering product failure.
  - engineering design failure
    - Sometime is used combine hardware failure and human or software failure.
    - helps to identify corrective actions to correct or mitigate problems.

Risk Assessment

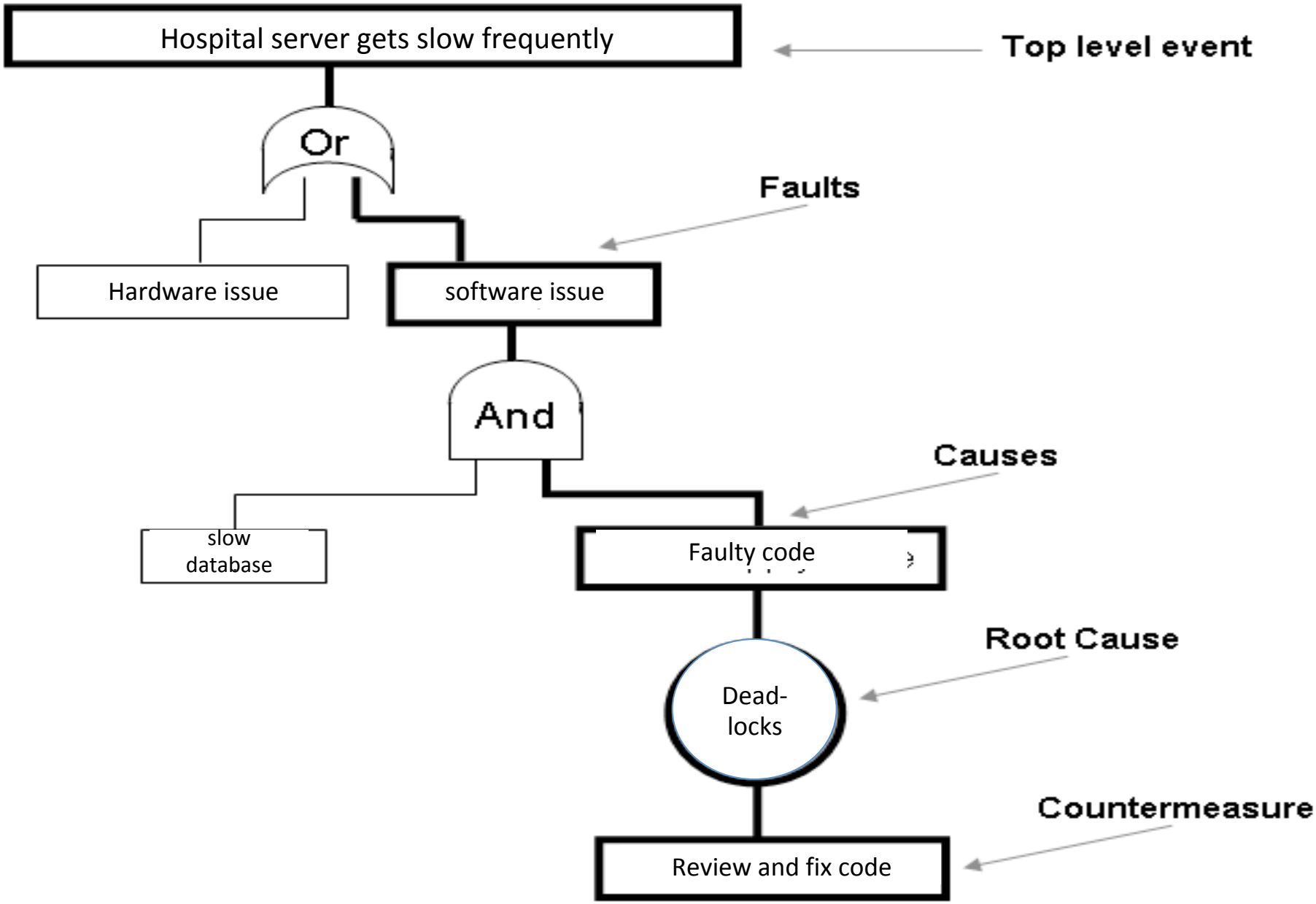
- The most serious outcome is selected as the Top Event.
- Tree is constructed by relating the sequences of events.
- AND and OR are the most common logic gates used..



How to construct FTA

- Identify the top level failure/condition
- Determine possible reasons for the top level failure, using logic gates
- Breakdown the each lower level cause/event/ condition, using logic gates as applies.
- Review the fault tree and make sure the leaf nodes are basic human, hardware, or software faults.
- If applies add probability of occurrence for each of the lower level nodes.

Example of Fault Tree Analysis for

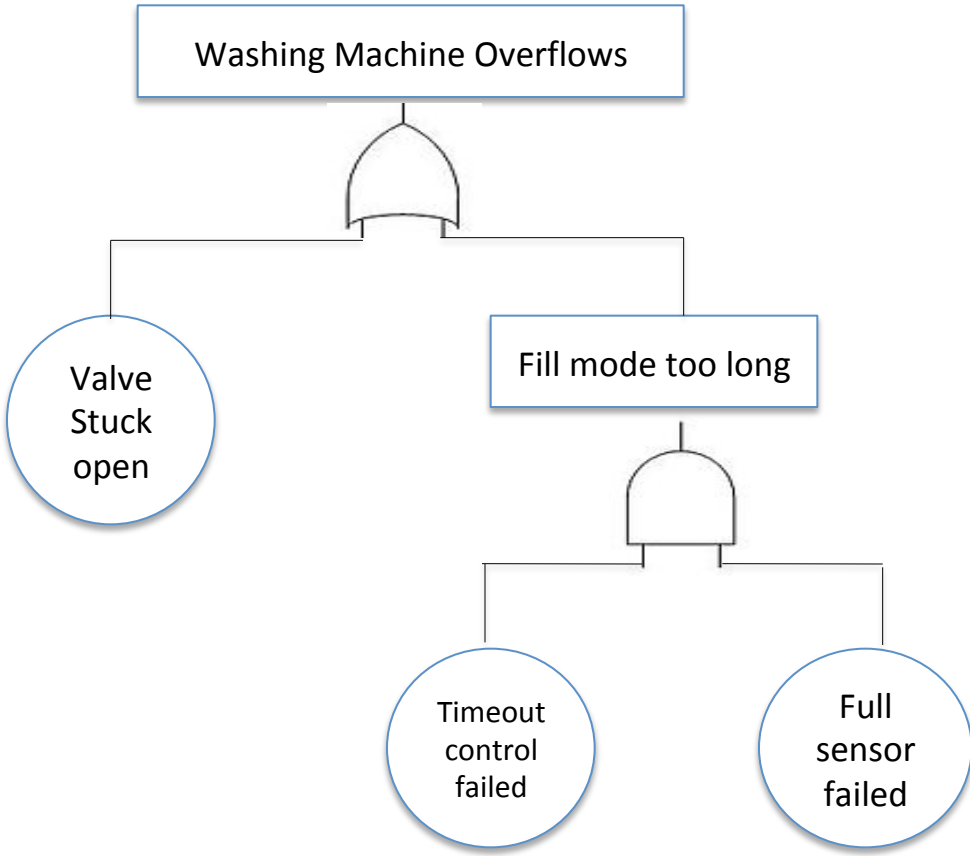


Adding Probability Measures

Example

What is the probability of a Washing Machine Overflows if all event are independent and:

- P(value stuck open) = 0.01
- P(timeout control failure) = 0.05
- P(Full sensor failure) = 0.07
- 0.05 * 0.07 = 0.0035
- 0.0035 + 0.01 = 0.0135



Risk Analysis Matrix

Risk Analysis Matrix

- Another qualitative method to assess possible risk.
- What are the risk measures for following events in an it system:
  - The server room on the 7th floor, flooded due to rain
  - Servers go down due to power outage (Power outage)
  - Servers go down due to application error (Application Error)
  - Servers get slow during pick demand (Slow server)
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		Likelihood of Occurrence		
		Very likely	**Possible**	**Unlikely**
Sevirity	**(4) Catastrophic**			Flood
	(3) Critical		Power outage	
	(2) Marginal	Application Error		
	(1) Negligible	Slow server		