

it is not necessarily the failure itself that leads to dissatisfaction but often the organizations response to the breakdown

- Resilience
  - Understand what kind of failures can happen and how serious they are
  - Ways of how failures can be prevented
  - minimize negative consequences
  - Plans & procedures to recover from failure

**Risk and resilience**  
 Slack et al chapter 14 (2009)

3 Have failure mitigation measures been implemented?

- Failure mitigation actions
  - Decision tree and guide rules in case of failure --> What is to do (Mitigation planning)
  - insurances, hedging, spread financial risk (Economic mitigation)
  - stop the failure physically spreading (Containment (spatial))
  - spread of failure over time (Containment (temporal))
  - any action that reduces the catastrophic consequences of failure by removing the resources that are likely to suffer from failure (e.g. signs for evacuation) (Loss reduction)
  - like contingency planning --> provide other resources that can substitute (Substitution)

design out failing points with process maps

- Redundancy
  - Double or triple some parts of the operations
- Fail-safeing
  - poka-yoke = Prevent inadvertent errors
  - Principle = People make mistakes --> make sure that these mistakes can't become defects
  - e.g. Gauges, Digital counters, Checklists etc.

2 Have failure prevention measures been implemented?

- Maintenance
  - take care of physical assets
  - regular servicing (Preventive maintenance (PM))
  - only when facilities requires it (Condition based maintenance (CBM))

- 5 goals
  - examine all losses
  - autonomous maintenance --> people care about particular part
  - plan maintenance
  - train all staff in maintenance skills
  - avoid maintenance through maintenance prevention (design etc.)
- small maintenance groups --> Continuous improvement (Total productive maintenance (TPM))

1 Have potential failure points been assessed?

Often it is the failure to understand failure

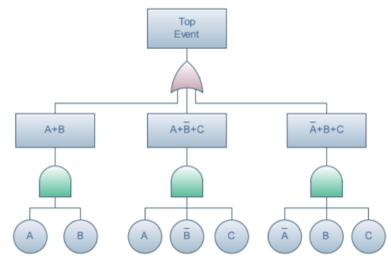
- Sources of potential failure
  - Supply failure: any failure in timing or quality of goods or services delivered by supplier
  - Human failure: Key personnel leave due to illness, death etc. (Mitigate through identification of these people); People make mistakes (errors in judgement, Violations)
  - Organizational failure: Failures of processes and procedures due to organizational structure and culture
  - Technology/facilities failure
  - Product / Service design failures: e.g. because of market pressure (TTM)
  - Customer failures: Customer is not always "right"
  - Environmental disruption: Disasters (fire, hurricane, floods etc)

Post failure analysis

- Accident investigation
- Failure traceability: traceability features of the product (RFID)
- Complaint analysis

Fault tree analysis

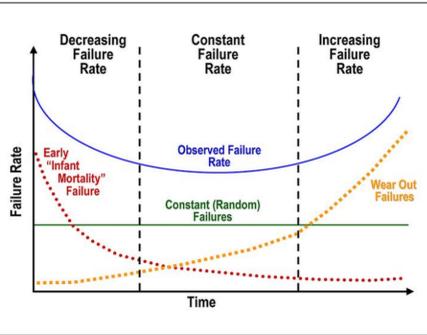
starts with issue and work backwards



Likelihood of failure

- Objective estimates
  - Failure rates = how often?
  - Reliability = chances of failure?
  - Availability = available operating time

Failure is often a function of time (bath tube curve (failure rate against time))



Failure mode and effect analysis (FMEA)

- What is the likelihood that failure will occur?
- What would the consequences of the failure will be?
- How likely is such a failure to be detected before it affects the customer?

