

# *Safety Management*

Damage Tolerance and Maintenance Workshop

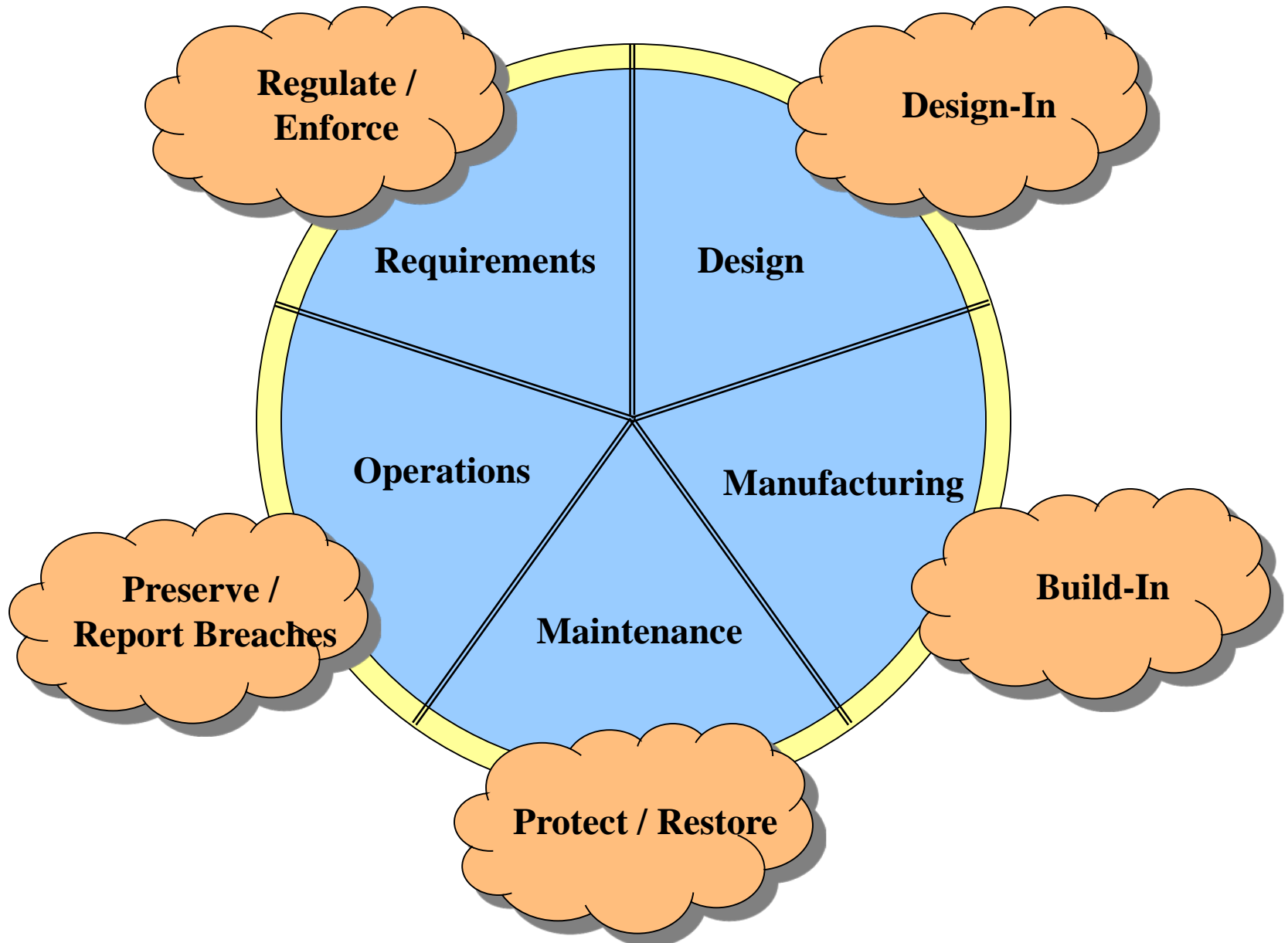
Chicago, IL  
July 19, 2006

Bjorn Backman – Structured Research

# Why is Safety the Challenge for Composites?

- A Steady Stream of New Materials, New Processes and New Structure;
- Slow Accumulation of Production Experience;
- Scant Service Experience;
- Many Damage Threats;
- Metal Design Rules are Obsolete;

# Structural Safety – A Joint Responsibility



# Safety Management



- Airplane Updates & New Derivatives
- Safety Improvements
- Risk Reduction
- Uncertainty Reduction



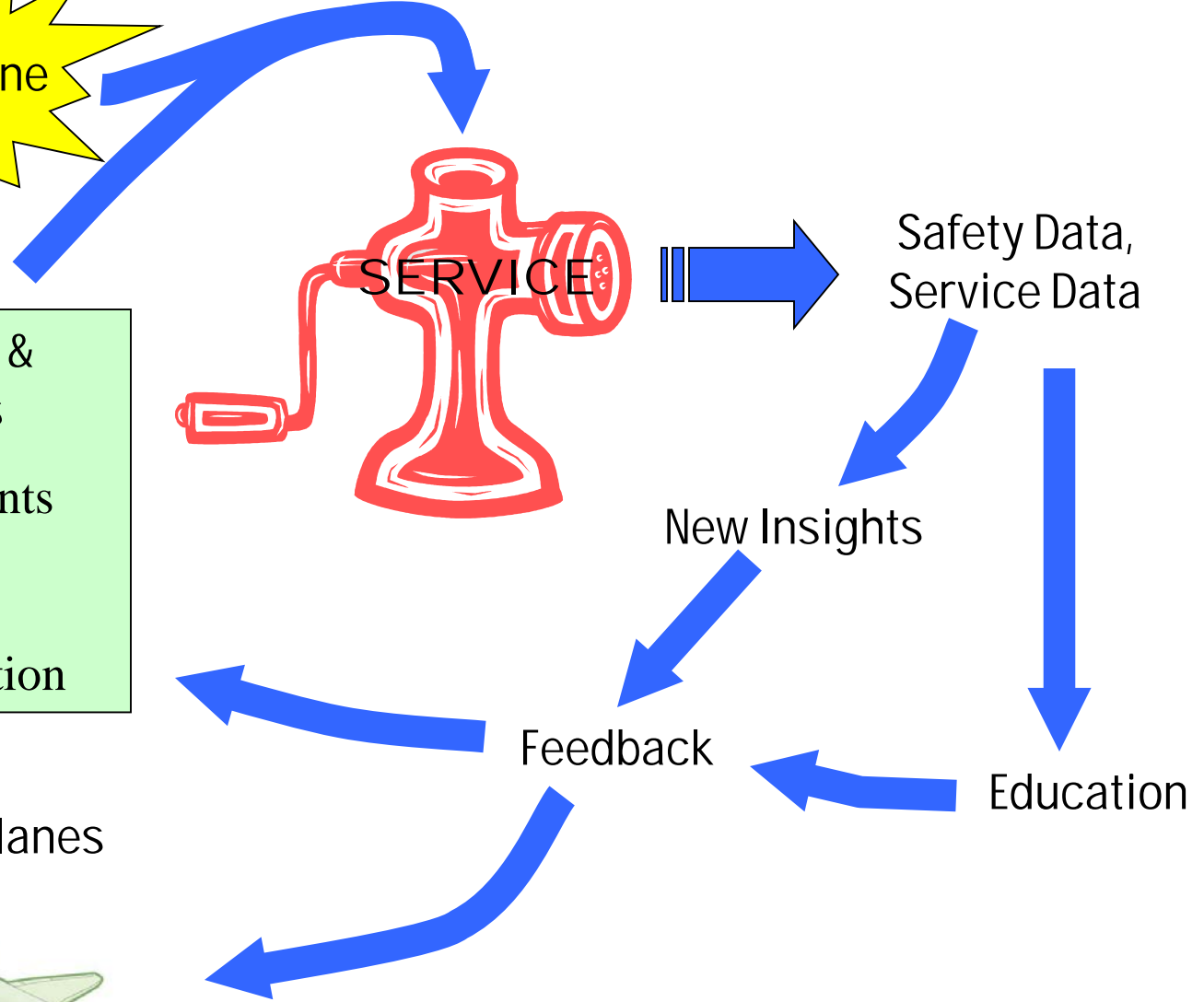
Safety Data,  
Service Data

New Insights

Feedback

Education

New Airplanes



# Probability of a Structurally Safe State

The probability of a structurally safe state is the joint probability of safe design, safe manufacturing, safe maintenance and inspection, safe operation, and safe requirements.

$$P(S_T) = P(S_D S_M S_I S_O S_R)$$

where

$S_T$  = Safe Structural State

$S_D$  = Safe Design

$S_M$  = Safe Manufacturing

$S_I$  = Safe Maintenance and Inspection

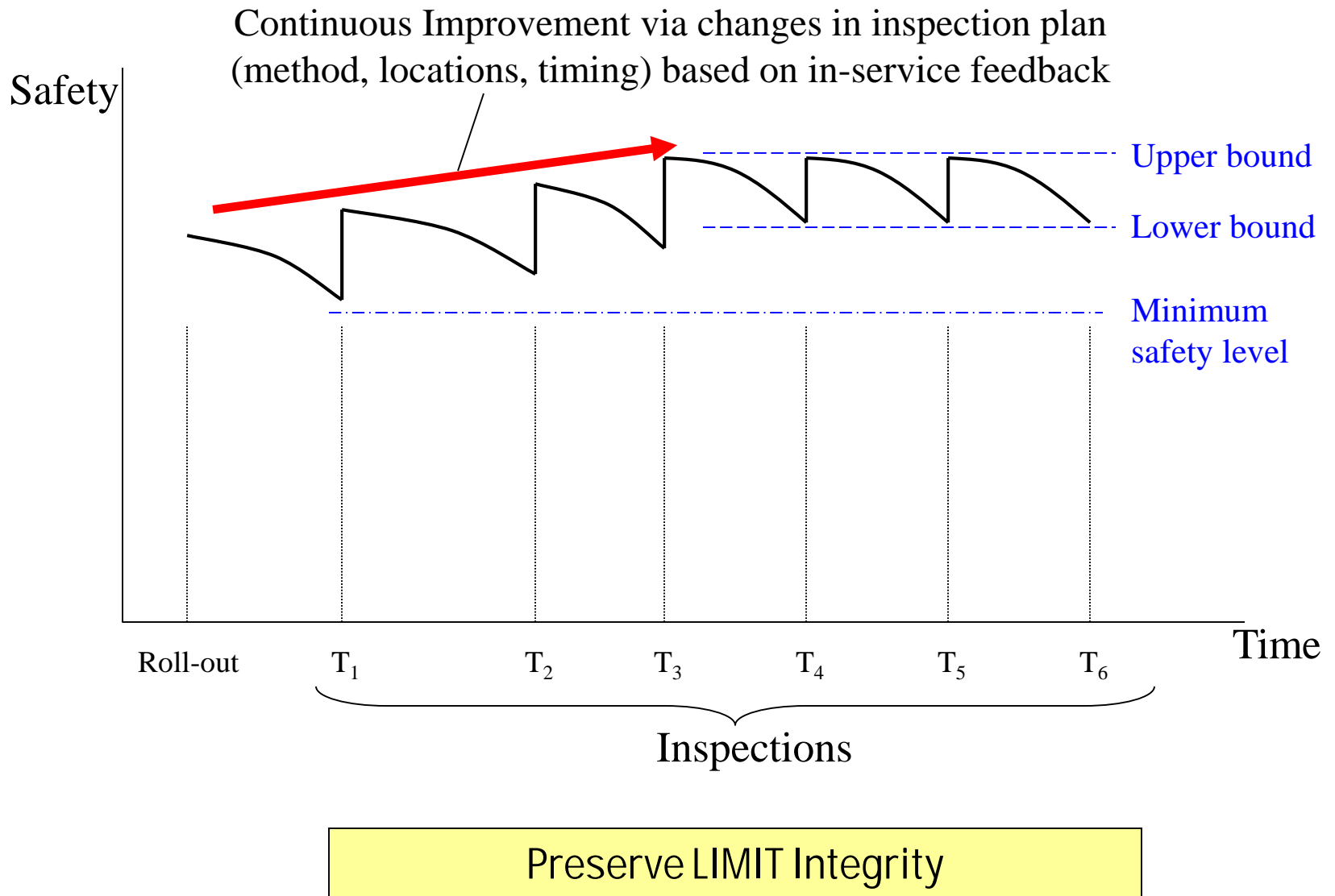
$S_O$  = Safe Operation

$S_R$  = Safe Requirements

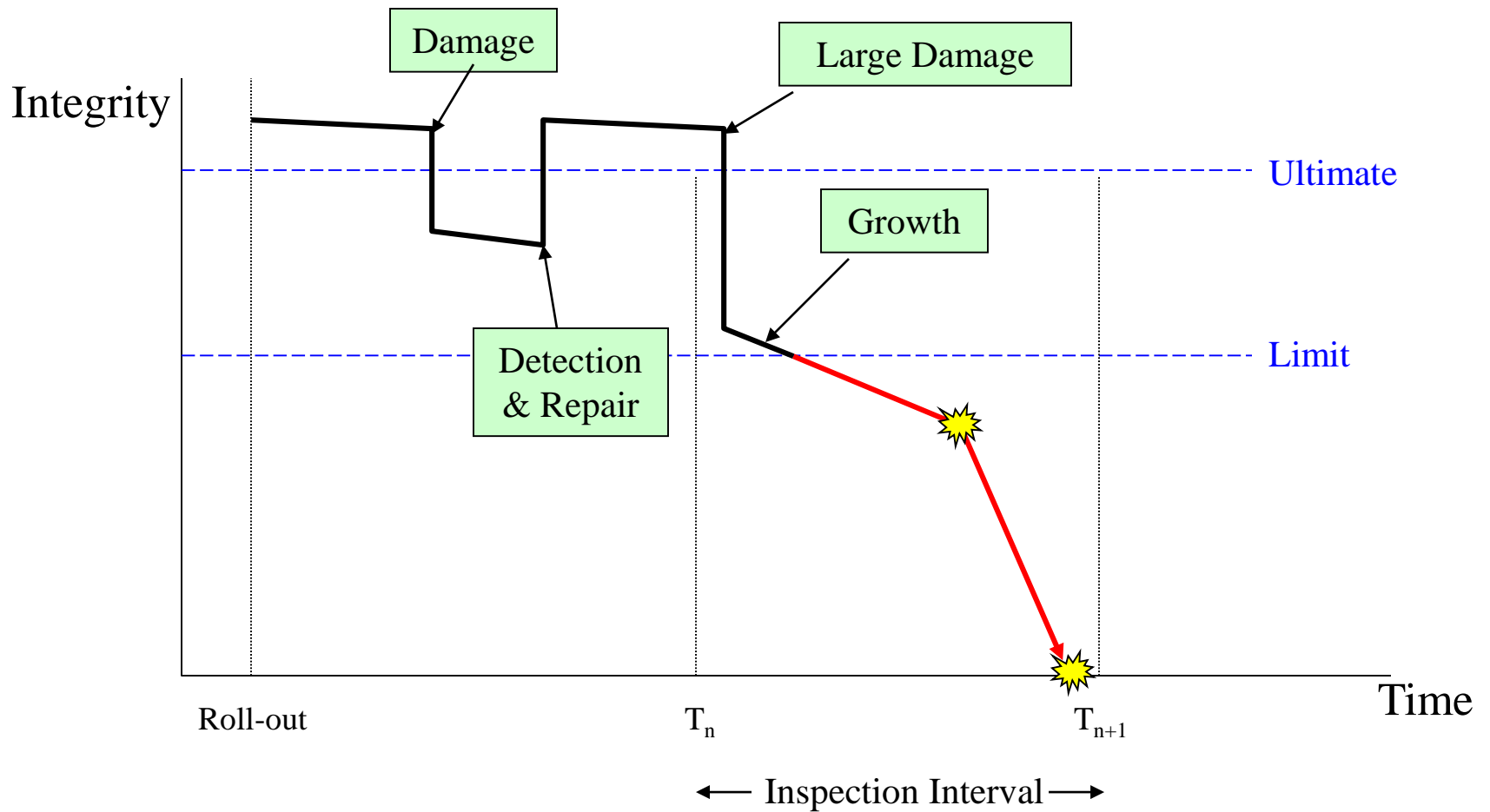
# Purpose

- A process that deals with Structural Safety as a function of time and manage the contributions of all the participants
  - *Design*
  - *Manufacturing*
  - *Maintenance and Inspection*
  - *Operation*
  - *Requirements*
- The process establishes, maintains and improves safety from Roll-out to continuous improvements for the fleet

# Safety and Time



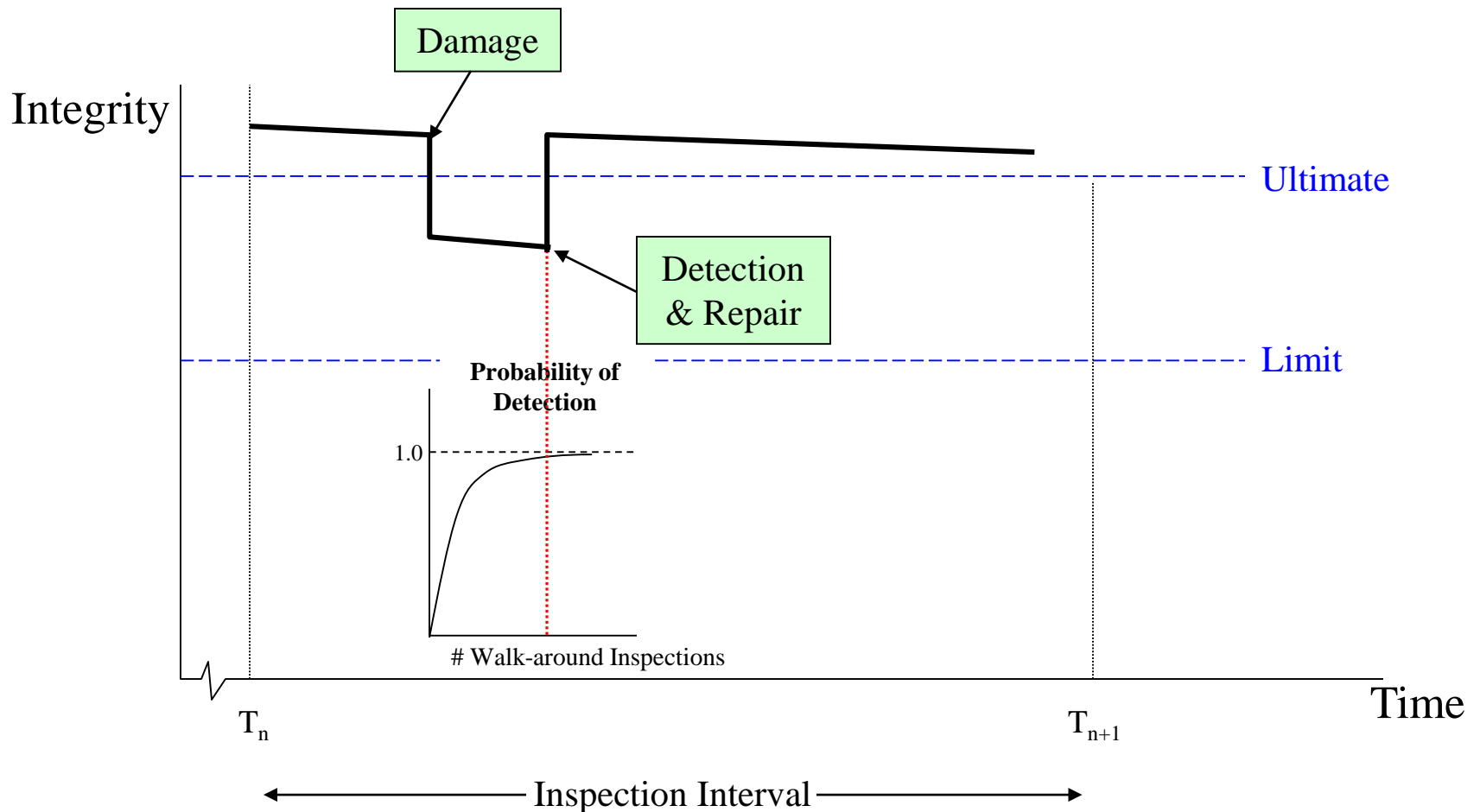
# Unsafe Scenario



Preserve LIMIT Integrity



# Walk-Around Detection

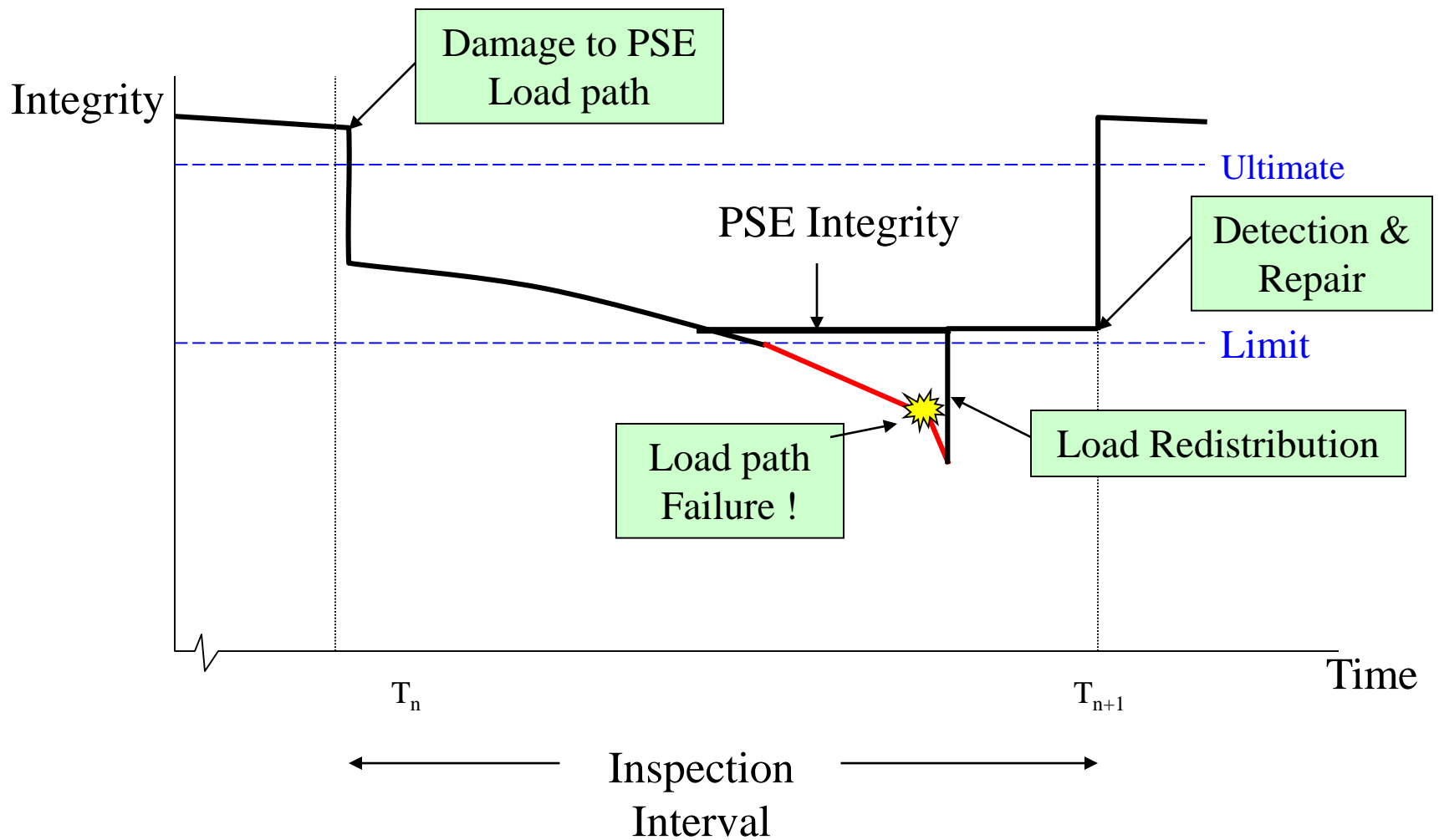


Example: 30 inspections @ 50% POD  $\approx$  99% POD

# What Would Be Nice!!

- “Cherry-pickers” for the walk-around inspections
- “Hand-held” detection devices for internal / hidden, large damage

# No Walk-Around ... Fail-Safe



# Safety Considerations

- Ultimate Integrity
- Limit Integrity
- Damage Tolerance
- Damage Resistance
- Testing
- Damage Growth
- Inspection
- Detection
- Repair
- Damage Reporting
- Quality Assurance
- Quality Control
- Preventive Maintenance
- Service Monitoring
- Degradation
- Process Control
- “Operations Reporting”
- Risk Management
- Safety Requirements
- Violation Reporting

# Safety Management Assures ...

- Limit Integrity
- Fail-Safety
- Damage Tolerance
- Damage Resistance
- Controlled Damage Growth
- Timely Detection
- Monitoring
- Risk Management