

國立臺北大學自然資源與環境管理研究所

106 學年度第二學期『環境災害與風險管理』

課程講義 (12)：危害分析、系統可靠度與模擬工具軟體

I Hazard Analysis, Systems Reliability and Simulation Software

● INTRODUCTION

□ Risk Assessment Steps

- ⇒ Identification of hazards likely to result in disasters: What hazardous events may occur?
- ⇒ Estimation of the risks of such events: What is the probability of each event?
- ⇒ Evaluation of the consequences of the derived risk: What is the likely loss created by each event?

□ Risk Analysis Techniques related to Safety or Reliability

Dhillon, B.S. (2013) *Safety and Human Error in Engineering Systems*, CRC Press.

- ⇒ Fault Tree Analysis
- ⇒ Failure Modes and Effect Analysis (FMEA)
- ⇒ Failure Mode Effects and Criticality Analysis (FMECA)
- ⇒ Hazard and Operability Analysis (HAZOP)

● FAULT TREE ANALYSIS (FTA)

- Event Tree, Decision Tree, and Fault Tree
- Safety, Reliability, Risk, and Industrial Hazards
- Components: Result, Gates (and/or), Fault Events (input/output)
- Examples; Advantages/Disadvantages

● FMEA, FMECA AND HAZOP

- An Overview of FMEA and FMECA (<http://www.weibull.com/basics/fmea.htm>)
- Failure Modes and Effect Analysis (FMEA) 失效模式與效應分析
- Failure Mode Effects and Criticality Analysis (FMECA) 失效模式效應與關鍵性分析
- Hazard and Operability Analysis (HAZOP) 危害及可操作性分析
(http://158.132.155.107/posh97/private/accident-prevention/HAZOP_Technique.pdf)

● RISK ANALYSIS SOFTWARE

- Statistics and Probability: Calculation, Fitting, and Visualization
- Event Tree, Value Tree, Fault Tree, and Decision Tree
- Reliability and Safety => Fault and Failure
 - ⇒ Fault Tree Analysis, FMEA, and FMECA
 - ⇒ Risk Priority Numbers (RPN) for Failures: Severity, Occurrence & Detectability
- Process and Operation => Hazard and Operability
 - ⇒ Process Hazards Analysis: HazOp, Job Safety Analysis, etc.
 - ⇒ Brainstorming, Countermeasures, and Cost Assessment

**POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
Front Door L.H.**

System <u>1 - Automobile</u>		FMEA Number <u>1450</u>
Subsystem <u>2 - Closures</u>		Page 1 of 1
X Component <u>3 - Front Door L.H.</u>	Process Responsibility <u>Body Engineering</u>	Prepared By <u>J. Ford - X6521 - Assy Ops</u>
Model Year(s)/Vehicle(s) <u>199X/Lion 4dr/Wagon</u>	Key Date <u>3/31/2003</u>	FMEA Date (Orig.) <u>3/10/2003</u> (Rev) <u>3/21/2003</u>
Core Team <u>A. Tate Body Engrg, J. Smith - OC, R. James - Production, J. Jones - Maintenance</u>		

Item	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s) / Mechanism(s) of Failure	Occur	Current Process Controls Prevention	Current Process Controls Detection	Detect	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Actions Taken				
													Actions Taken	Sev	Occ	Det	RPN
Process Function/Requirements																	
3 - Front Door L.H.																	
Manual application of wax inside door. To cover inner door, lower surfaces at minimum wax thickness to retard corrosion.	Insufficient wax coverage over specified surface.	Deteriorated life of door leading to: - Unsatisfactory appearance due to rust through paint over time. - Impaired function of interior door hardware.	7		Manually inserted spray head not inserted far enough.	8		Visual check each hour - 1/shift for film thickness (depth meter) and coverage.	5	280	Add positive depth stop to sprayer.		Stop added, sprayer checked on line.	7	2	5	70
					Spray head clogged - Viscosity too high - Temperature too low - Pressure too low.	5		Test spray pattern at start-up and after idle periods, and preventive maintenance program to clean heads.	3	105			7	1	3	21	
					Spray head deformed due to impact.	2		Preventive maintenance program to maintain heads.	2	28			7	2	2	28	
					Spray time insufficient.	8		Operator instructions and lot sampling (10 doors/shift) to check for coverage of critical areas.	7	392				7	1	7	49

https://www.reliasoft.com/images/documents/xfmea_dfmea.pdf

■ **Risk Priority Numbers:** $RPN = Severity \times Occurrence \times Detection$

■ **Criticality Analysis**

Mode Criticality = Expected Failures \times Mode Ratio of Unreliability \times Probability of Loss

Item Criticality = SUM of Mode Criticalities