Problems

A new problem concerning reliability issues is posted on this web site periodically, and a solution is proposed. Use this page to select interesting problems by title.

67.	**Safety Integrity Levels (SIL) Standards Are Appropriate For Many Reliability Issues** SIL standards are about managing risks which is a subject for determining the amount of reliability required for making financial decisions using life cycle costs techniques.
66.	**A Few Profitable Processes vs Many Marginally Profitable Processes. Why?** Updated 07/17/11 How to tell where to search for the underlying causes for problems and how to go about fixing the problems with comparisons to 1st quartile processes.
65.	**Why Are A Few Profitable Processes Highly Reliable With Small Variations In Output And Many Marginally Profitable Process Are The Opposite?** Barringer process reliability plots help explain the difference when the processes are designed by the similar engineering companies using similar equipment and operated by competent people?
64.	**Effective Exception Reports For Special Causes** Barringer process reliability plots are effective tools for separating common cause problems from special cause problems. They become more effective when the exception reports for deviation of output is properly defined. Examples of effective reports are shown and also problem reports.
63.	**Cable Splice Failures** Electrical cable splices are causing major failures at a chemical plant. Each failure cost ~US$500,000. Weibull analysis shows the failure mode is wear-out and not chance failure modes expected by the local experts. Corrective actions, based on the wear-out failure mode, has avoided any failures in the time period of 1994 to 2010 with millions of $'s of cost avoided.
62.	**Shear Ram Blowout Preventer Forces Required** Updated 07/10/13 Shear ram test results and system requirements are presented to meet May 2010 USA Department Of The Interior requirements considering risk—this was originally presented as a case study in The New Weibull Handbook but extended here because of the BP blowout problem in the Gulf Of Mexico.
61.	**Can You Use Weibull Analysis On Repairable Items?** The short answer is yes. A longer answer is provided.
60.	**How To Calculate Maintainability Values** Updated 03/02/09 An example of repair data is show by hand calculation and by probability plot for finding maintainability values for use in reliability, availability, and maintainability (RAM) models.
59.	**Use Periods Of Low Production Output to Improve Process Reliability And Consistency**

	Improve process consistency during periods of low output when the problems stand out like a sore thumb to get prepared for larger production requirements and reduce costs.

58.	**Weibull Probability Paper for Hand Plots** Weibull probability paper with coaching notes for making a few quick hand plots

57.	**Compressors And Silent Root Causes For Failure** The number one **silent root cause** killer of compressors (both reciprocating and centrifugal) in chemical plants, refineries, and gas processing plants is inadequate knockout drum design.

56.	**Little r and Big R** Reliability strategic issues of big R and tactical issues of little r are described in relationship to Juran's explanation of quality with his big Q and little q details for making improvements.

55.	**Special Cause Variations, Common Cause Variations, and Process Reliability Plots** Barringer Process Reliability Plots Tell You The Problems And Skills Needed For Solutions

54.	**Summary Of Process Reliability** Question and comments about the technique

53.	**Reliability Programs: Successful or Failures?** Updated 12/10/07 Why are some programs successful and other failures along with what you must do to make reliability programs successful?

52.	**Reliability Tools** Updated 11/22/07 **What** reliability tools are available? **Why** should I use them? **When** should I use them? **Where** should I use them?

51.	**Weibull Analysis of Pump Seals** Updated 11/4/07 How to give the data a voice for business decisions

50.	**Reliability And Data** MTBF, MTTF, Weibull probability plots, and cost considerations—how to give your data a voice for making decisions.

49.	**Remaining Life In Pressure Relief Valves** Given you have pressure relief valves that have survived without failure for 24 months, how much longer can they survive to achieve the desired reliability of 95%?

48.	**Corrosion Problems, Inspection Data, And The Gumbel Lower Distribution** How to make sense of corrosion data taken from an operating pressure vessel and make a risk decision for run/don't-run using ASME and API fitness for service criteria.

47.	**PVE % A Goodness Of Fit Criteria** By Wes Fulton Updated 5/2/06

	Correlation coefficients and estimates of P-values for goodness of fit.

46.	**Benign Failures** Updated 1/16/05 Correct definition of failures and suspensions (censored data) is very important for a creditable reliability analysis—watch out for inspection euphemisms and the use of rubber rulers in defining failures

45.	**Process Reliability Punch List** Updated 5/2/05 How to show different product grades on a process reliability plot

44.	**Load-Strength Interference** Updated 1/11/07 How to calculate the reliability of products knowing a load distribution and a strength distribution

43.	**Find Annual Costs Using Life Cycle Cost Calculations With Planned Replacements** Updated 2/19/08 Monte Carlo simulation of Weibull life and costs with optimum replacements

42.	**Find Annual Costs For Life Cycle Cost Calculations** Updated 3/14/05 Monte Carlo simulation of Weibull life and costs with a fix when broken strategy

41.	**Risk Based Decisions** Updated 12/25/08 How to build a practical risk based decision matrix for everyday risk matrix decisions

40.	**Mean Time Between Stupid Events** Updated 10/15/07 A politically incorrect failure criteria that everyone understands

39.	**Failure Forecast For The World's Most Unsafe Railroad** Updated 5/18/05 Crow-AMSAA forecast of future failures and visual demonstration of failures avoided by corrective action programs

38.	**Forecast Of The Next Space Shuttle Failure** Updated 10/29/04 Carlo-AMSAA forecast of future space shuttle failures using data from the Challenger and Columbia failures

37.	**Fabled Mercedes Reliability Or Is Mercedes Reliability Just A Fable?** Updated 10/29/04 ML 320 SUV failure forecasts of future tow-in incidents based on my personal vehicle data using Crow-AMSAA methods to validate Mercedes reliability issues so you can decide if Mercedes vehicles are reliable or unreliable

36.	**Can Reliability Software Solve Other Statistical Problems?** updated 6/02/2004 WinSMITH Weibull and WinSMITH Visual reliability software is used to solve problems from the literature for 1) corrosion pit depths, 2) stress corrosion cracking (SCC) in aluminum, 3) stress corrosion cracking in stainless steel, 4) tank bottom pit depths, 5) tree diameters, and 6) pipe corrosion problems.

35.	**Use Data To Show You've Made A Maintenance Improvement With Crow-AMSAA Plots**

	Crow-AMSAA reliability growth plots graphically show improvements made and failures avoided by use of new methods to prove the changes were effective.

34.	**Process Reliability Line Segments** Process reliability Weibull plots often have a variety of line segments that provide useful information about hidden factories

33.	**How Many Heat Exchanger Tubes Should I Inspect?** updated 5/05/2004 How many tubes should be inspected to estimate the number of failures in the tube bundle

32.	**Are RCM Programs Justified?** updated 4/3/2005 Crow-AMSAA plots can demonstrate if your RCM has made improvements or are you just talking about making improvements

31.	**Death Of Soldiers In Iraq During Gulf War II with Crow-AMSAA Forecast** updated 12/25/2008 Crow-AMSAA plots are made from fatalities in the Iraq war to forecast future need for body bags and cusps on the curves show improvements/deterioration in combat deaths.

30.	**Make Repairs On Overtime?** updated 1/04/2004 How much risk can you tolerate for failures: $Risk = (probability of failures)*($Consequence for the failure)

29.	**Will It Last Until The Next Turnaround** Conditional reliability calculations define the probability of failure and $Risk are calculated

28.	**Reliability And Life Cycle Cost** updated 1/18/2003 Know when to accept the risk and when to reject the risk—finding the lowest long term cost of ownership

27.	**Crow-AMSAA Reliability Growth Plots** updated 5/22/2004 Show me, don't tell me, how failures are occurring with time

26.	**Waloddi Weibull's ASME Size Distribution Of Fly Ash Problem #2** Three parameter Weibull plots for fly ash data

25.	**Waloddi Weibull's ASME Yield Strength Problem #1** updated 10/2/2001 Three parameter Weibull plots for yield strength's to show the failure free zone

24.	**Maintainability** updated 02/17/2009 What is it and how do I find it?

23.	**Flood Data and Gumbel Largest Distributions** updated 6/19/2001 Houston, Texas flood data with prediction of 100 year flood depths at gaging station near downtown using a single maximum flood depth per year

22.	**Process Reliability Plots With Flat Line Slopes** updated 8/17/2002 A Monte Carlo simulation shows how small effects can destroy predicted output in a production processes
21.	**Weibull Beta Slopes For Ball Bearings** updated 7/11/2001 What's the "right" Weibull slope value, beta, to use for ball bearings
20.	**Heat Exchanger IRIS Wall Thickness and Gumbel Smallest Distributions** updated 1/07/2007 How to predict end of life from ultrasonic wall thickness inspection data with minimum wall thickness for each tube
19.	**Spare Equipment** updated 1/26/2001 How and why to add spare equipment
18.	**Timing of Maintenance Replacements** updated 1/26/2001 Gives replacement concepts and a Monte Carlo simulation is available for no-cost download to illustrate failure intervals
17.	**Screen Sizes For Pulverized Materials** updated 6/14/2002 WinSMITH Weibull makes a probability plot for sieve data
16.	**Automating Monthly Weibull Production Plots From Excel Spreadsheets** updated 8/14/2001 Batch processing using WinSMITH Weibull cuts time when many plots are required
15.	**Key Performance Indicators From Weibull Production Plots** updated 6/19/2001 Weibull production Monte Carlo simulation to find how KPI's relate to demonstrated production output
14.	**April 1998—Production Reliability Example With Nameplate Ratings** updated 6/19/2001 How to find reliability losses along with efficiency and utilization losses to quantify the hidden factory
13.	**March 1998—Nameplate Capacity** updated 6/19/2001 How to find the nameplate capacity of a production process using Weibull analysis
12.	**February 1998—Coefficient of Variation** updated 11/1/2002 Why is the coefficient of variation helpful for process reliability issues and Weibull plots
11.	**January 1998—Six Sigma** updated 8/14/2001 Six sigma—how is it calculated and used in manufacturing plus preliminary info for Weibull plots
10.	**Waste Disposal System Failures And Crow-AMSAA Plots** updated 1/20/03 Crow/AMSAA plots used for business decisions and for determining the turnaround period for an

	actual waste disposal system

9.	**Total Productive Maintenance Results** updated 1/9/03 Crow/AMSAA (formerly known as Duane AMSAA) plots for no-TPM and TPM programs show failures avoided

8.	**How Much Life Is Lost From Specific Pump Practices** updated 6/5/05 Losses for each pump practice are quantified

7.	**Demonstrated Life Of Pump Components From Pump Practices** updated 3/31/98 Inherent reliability of pump components are derated in a reliability model based on findings of from the pump practices survey

6.	**Pump Practices And Component Life Multipliers** updated 3/31/98 with more information Best practices, better practices, and good practices for pump installation and use based on a survey of expert users

5.	**Monte Carlo Reliability Model Of A Pressure Vessel** Log-normal plots of random stresses, S-N curves, Miner's rule to failure via Monte Carlo models, pressure vessel wall thickness versus age to failure

4.	**Pipe Wall Thickness & Risk Based Inspection** updated 5/31/2001 Weibull plots, characteristic life versus time plots, parameter as function of engineering variables

3.	**Production Output/Problems** updated 6/19/2001 Weibull plots of production data as a business tool to find the process reliability

2.	**Tank Bottom Corrosion** Weibull plots, log-normal plots, normal plots, and likelihood ratio confidence limit plots

1.	**Remaining Coke Drum Life** updated 5/31/2001 Weibull plots and likelihood ratio confidence limit plots

A few words of caution:

- These problems are not accompanied by complete solutions.
- They do not represent a solution to your problems.
- They are intended to stimulate your interest and comments.
- Use professional judgment in how you apply these items to your problems.
- Sometimes the solutions will be controversial to get your thinking process started.
- Maybe you also have a better idea on how to solve the problem as there are many ways to "skin the cat"--or maybe I've screwed-up the solution (heaven forbid) and you can point out my errors as you check my calculations.

E-mail comments, criticisms, and corrections to: Paul Barringer. Also, if you have a problem suitable for future listings, submit a problem statement for consideration. Problems include reliability issues and costs receive priority.

Technical tools are only interesting toys for engineers until results are converted into money and time for the business. Want to get the interest of your management team? Complete your analysis with a bottom line converted into $'s and time!

You can download a PDF file of these topics by clicking here.

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