Use Crow-AMSAA Reliability Growth Plots To Forecast Future System Failures

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So, when do you forecast your next failure will occur?—Accept it?—Prevent it?

Reliability Is?

- Reliability is concerned with **avoiding failures** of equipment and **processes** by proper design and careful operation of the equipment by trained personnel in a specified environment for a given time interval.
- The ultimate aim of reliability is a **failure free environment**.

MIL-HDBK-338: Reliability- 1) The duration or probability of failure-free performance under stated conditions. 2) The probability that an item can perform its intended function for a specified interval under stated conditions.

Failures are?

- Failures terminate reliability.
- Is your organization:
  1) **Reliability-focused** (**abhor failures**)?
  or
  2) **Repair-focused** (**accept repairs**)?
- How do you prove your focus based on failure data from your plant?

MIL-HDBK-338: Failure- The event, or inoperable state, in which any item or part of an item does not, or would not, perform as previously specified.

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Treat Repairs As Failures

- **Management views repairs as failures!** Why? Repairs cost money and take equipment out of service
- Too many repairs occur from accelerated consumption of life due to errors from both omission and commission
- **You cannot repair yourself to happiness —avoiding failures brings happiness**

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Most Organizations say…

- ~2 out of 3 say "I'm reliability-focused" **but they demonstrate a repair-focus.** They reward fast repairs. No rewards occur for failure avoidance.
- Only ~1 out of 3 demonstrate a reliability-focus
- Line slopes on Crow-AMSAA plots tell you are:
  beta <1 → reliability-focus
  beta >1 → repair-focus
- What do your facts show:
  1) reliability-focus?
  2) repair focus?
- **Show me, don't tell me, how you're doing!**

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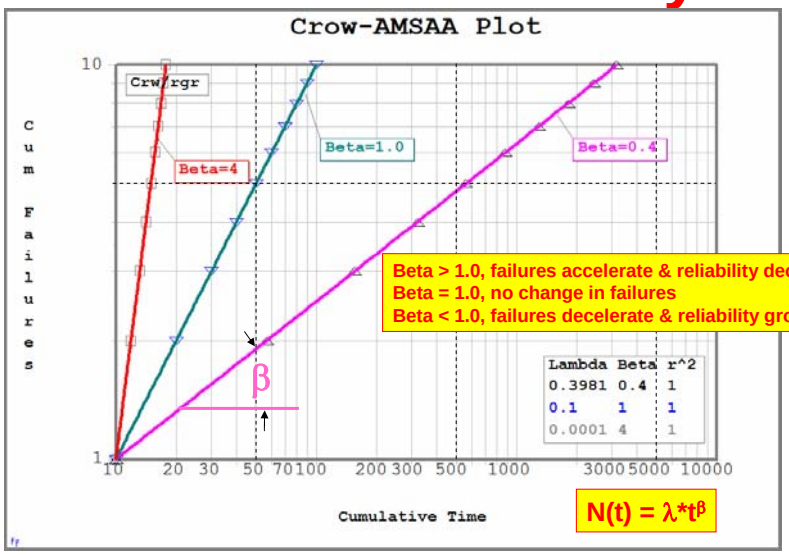
A Crow-AMSAA Plot Says…?



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How To Collect Your Data

- Go to SAP. Get monthly work orders for (emergence repairs + ordinary repairs). This is monthly/weekly/daily interval data.
- Convert interval data into cumulative time (for the X-axis) and cumulative repairs (for the Y-axis).
- Plot cum data on log-log paper. Trend line slope, β, gives clues as to what you are.

Failures: For managers, every maintenance order is a failure because of money spent!

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5-1/2 Years Of Corporate Data

Raw Data		Cum	Cum
Date	Orders	Days	Orders
Jan 2001	444	31	444
Feb 2001	517	59	961
Mar 2001	749	90	1710
Apr 2001	786	120	2496
. . . . .			
Jun 2006	1490	2007	106,475
Jul 2006	1408	2038	107,883
Aug 2006	1503	2069	109,386

← **Plot this data on a log-log plot. The line slope is very important.**

- Plant sites have been stable during the interval—no big expansions, acquisitions, or closures

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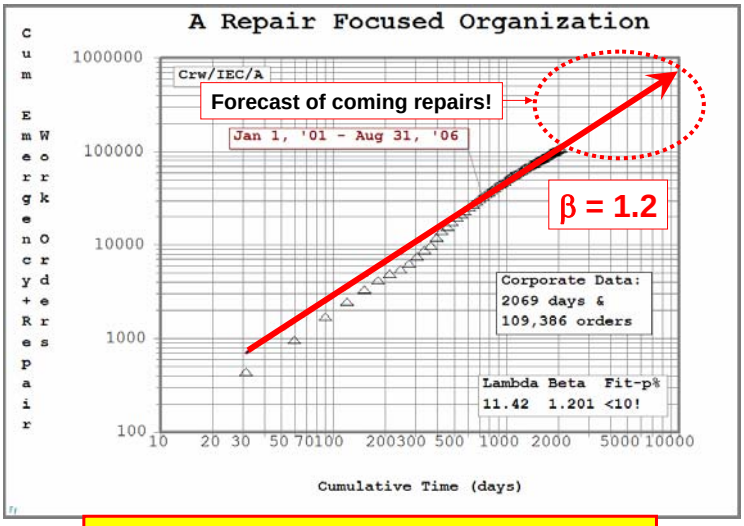
Corporate View Of Repairs



Repair-focused for 5-1/2 years across the corporation!

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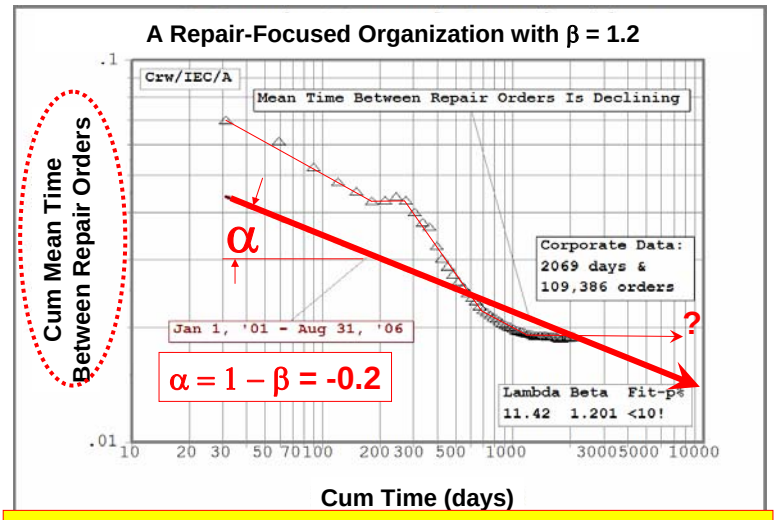
Corporate View Of Repairs



Mean time between repair orders has recently stabilized at ~53 orders/day

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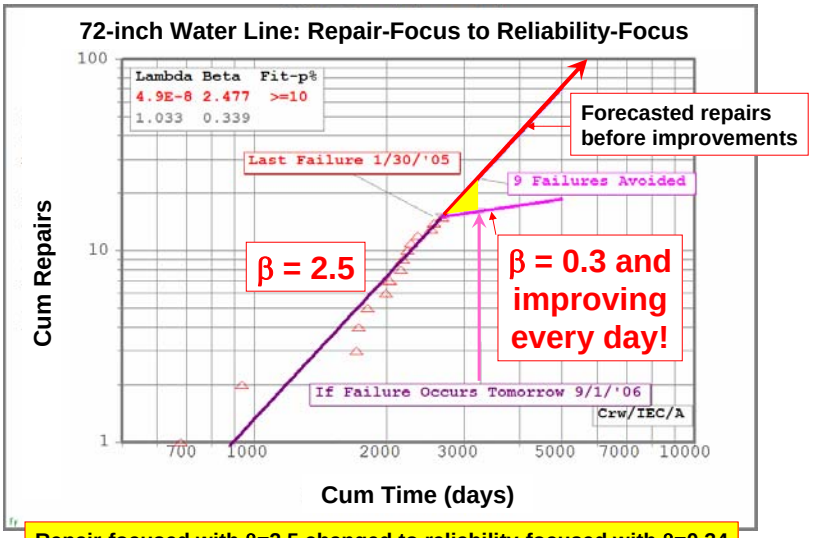
72-inch Cooling Water Line



Repair-focused with β=2.5 changed to reliability-focused with β=0.34

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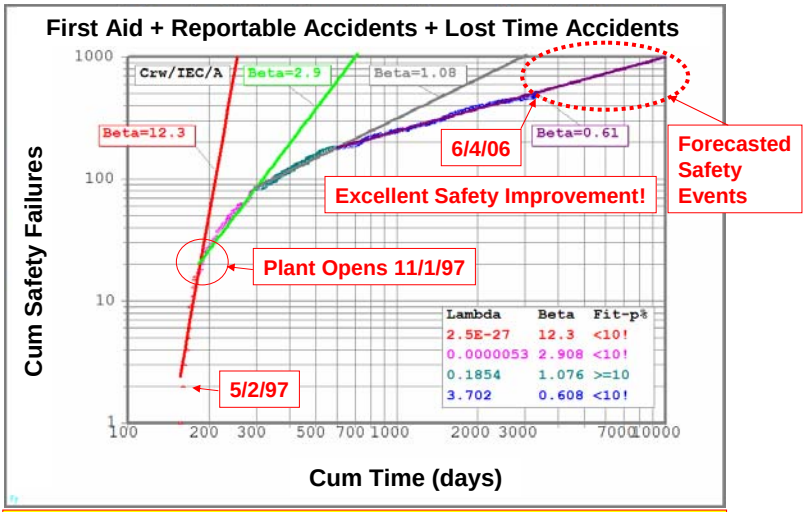
Chemical Plant Safety Data



Injury accepting with β=12.3 changed to injury prevention with β=0.61

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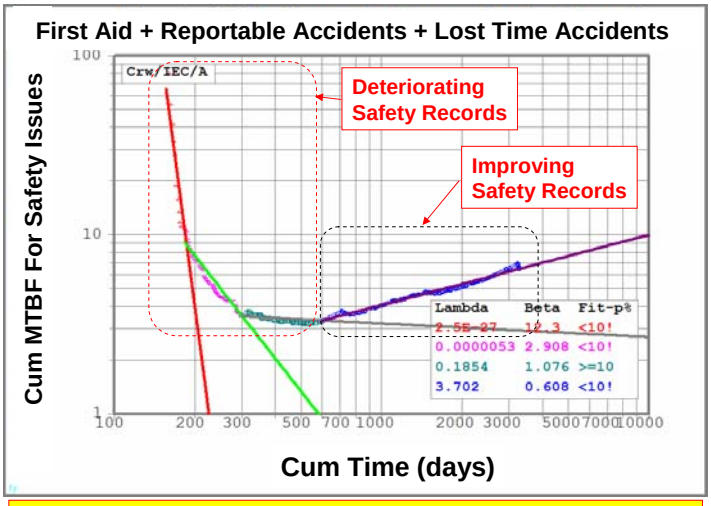
Cum MTBF-Safety Data



Mean time between safety event is growing from a reliability-focus

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Which Is More Important?

- **Avoiding failures OR repairing failures?**
  - **You cannot repair yourself to happiness!**
- **Equipment OR processes/people?**
  - Equipment = not as effective as working on Processes/Procedures/People = greater gains
- **Trained operators OR maintainers?**
  - Untrained operators and poor processes/ procedures can break equipment faster than trained maintainers can make repairs

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Maintenance Is?

- Maintenance is concerned with retaining function or quickly correcting failures, by use of trained employees using correct procedures.
- The ultimate aim of maintenance is minimizing maintenance costs and downtime to keep equipment operating as designed.

MIL-HDBK-338: Maintenance-All actions necessary for retaining an item in or restoring it to a specified condition.

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Engineers Are---?

- **Reliability Engineers**-Strategic Assets
  - Dedicated to mainly preventing failures
- **Maintenance Engineers**-Tactical Assets
  - Dedicated to mainly correcting failures
- You need ~10 Maintenance Engineers to every 1 Reliability Engineer
  - No increase in plant head count

Need job descriptions?: http://www.barringer1.com/jobdescriptions.htm

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Business Is?

- **Business** is all about making money. This is a balance between avoiding failures, repairing failures, and keeping the process operating to make money.
- **In the end, reliability and maintenance are all about money.**
- The ultimate aim of business is satisfying customers with on-time deliveries of quality products while producing a satisfactory long-term return for stockholders.

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Get Organized

- Most mangers talk about reliability but emphasize maintenance---they cross communicate!!
  - **Get your organization right**
  - **Get your emphasis right—say the right things**
  - **Get your motivation right—what's the reward?**
  - **Be consistent—no wishy-washy positions!**
  - **Work for long terms improvements**
  - **Work your Pareto list based on $'s—not nose counts of problems!!!**
  - **Show your progress with Crow-AMSAA plots**

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Where To Improve

- Go for the **money**—not your love affair!
- Does the **system** need improvement?
- Does a **device/component** need improvement?
- Does a **process/procedure** need improvement?
- Do the **people** need improvement?
- What are your alternative**s**?—say it with money
- Correct the big **$** problems by considering alternatives. Show how you're doing with Crow-AMSSA plots.

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Best Place For Gains?

- Improve **people performance**—~38% of problems
  - Make it easy for people to do right & hard to do wrong
- Improve **procedures and practices**—~34%
  - Write it down correctly and train, train, train
- Improve **hardware**—~28% of problems
  - Hardware problems may disappear if above corrected
- Engineers, by nature, think reliability issues are resolved with hardware and components and thus they often work on the wrong issues!

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So You Doubt?

- Verify that **people/procedures/process** issues are at the heart of major problems by reading:
- **BP's Final Report:**

http://www.bp.com/liveassets/bp_internet/us/bp_us_english/STAGING/local_assets/downloads/t/final_report.pdf

- **The Baker Report:**

http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/SP/STAGING/local_assets/assets/pdfs/Baker_panel_report.pdf

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Summary

- Get your reliability program right
- Think about reliability issues strategically
- Look for gains **first** via people, **second** by processes and procedures, and last by way of components—many component issues disappear when people/processes/procedure issues are solved to achieve inherent component reliability!
- Show your organization how you're doing with Crow-AMSAA plots: **Show me, don't tell me!**

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Want To Read More?

- http://www.barringer1.com/mil_files/MIL-HDBK-189.pdf
- http://www.barringer1.com/nov02prb.htm
- http://www.barringer1.com/jan04prb.htm
- http://www.barringer1.com/may04prb.htm
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- http://www.barringer1.com/pdf/PredictFutureFailures.pdf

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