



Process Reliability through Weibull Analysis

Paul Barringer, Barringer&Associates, Inc.

This 2-day basic training course for engineers in using Weibull analysis of production data, is organized for the first time as an open session in Europe. The course will learn how to answer 2 basic questions:

1. What is the reliability of my process?
2. How can I use the information to improve margins and financial performance in my plant?

Traditional six-sigma efforts use statistical tools (most often the bell shaped Gaussian distribution) to help find root causes of problems and the six-sigma efforts provide mile-marker metrics.

Since most production output data is not bell shaped data, we need a more advanced tool to help define the problem solving metrics developed with Weibull statistics.

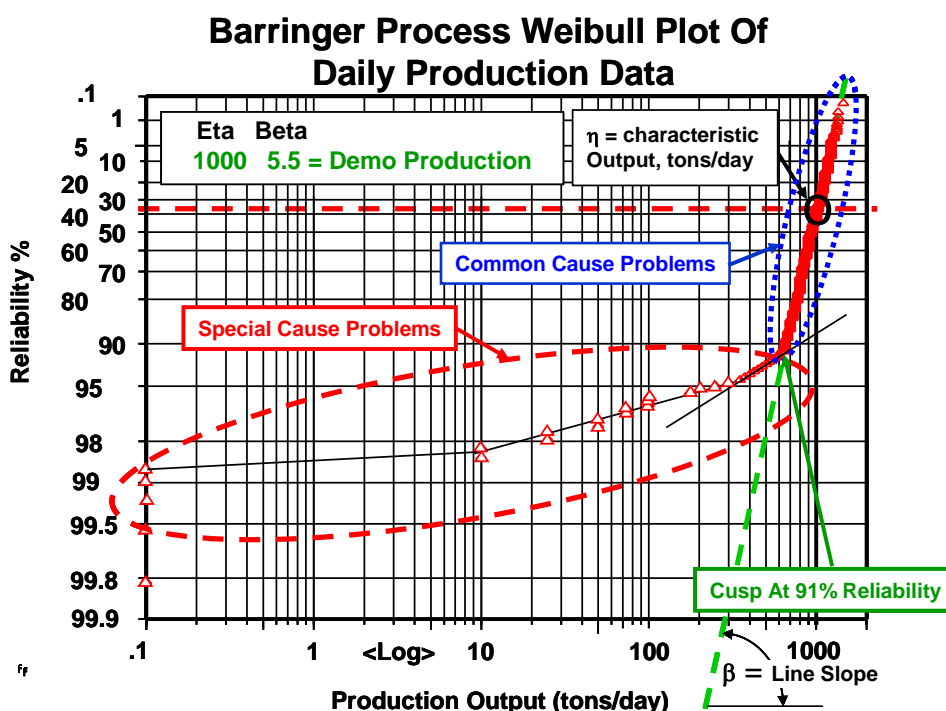
Another advantage of Weibull analysis is that it provides a simple and useful graphical plot of the failure data. The data plot is extremely important to the engineer and to the manager.

Weibull analysis of daily production output (using skewed Weibull distributions) helps quantify problems in four categories:

1. Define and show the reliability of the production process,
2. Identify and quantify losses due to reliability issues,
3. Identify and quantify losses from efficiency and utilization problems; and
4. Quantify the size of the hidden factory with suggestions of what to look for as corrective action

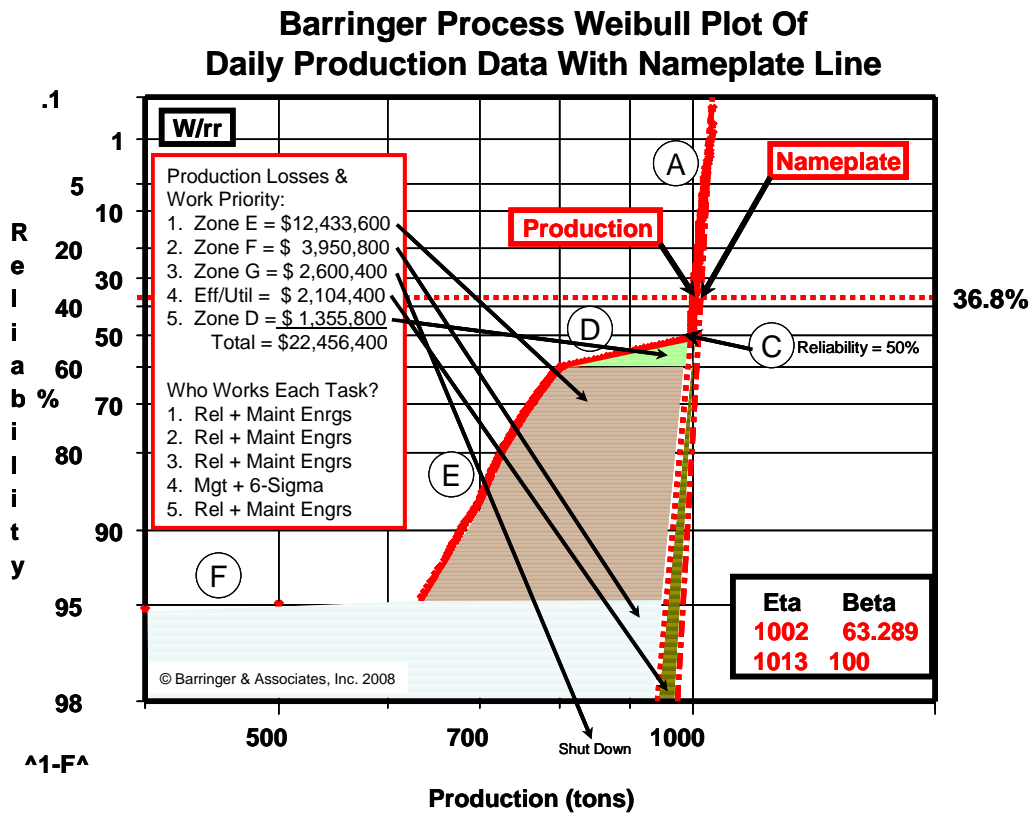
These metrics all go on one side of one sheet of paper in graphical format and they also form mile-marker metrics for the business. [Click here](#) to see examples of the Weibull production data analysis along with the descriptive mile-marker metrics.

Below is a Barringer process reliability plot showing production regimes with common cause problems and special causes:





Below is a Barringer process reliability plot with losses described on one sheet of paper:



Why use Weibull analysis?

Weibull analysis is the world's most popular method of analyzing and predicting failures and malfunctions of all types. About 85%-95% of all life data are adequately described with Weibull probability plots whereas about 85%-95% of all repair times are adequately described by log normal probability plots—thus the methods provide practical tools for analyzing life/repair data.

The Weibull method identifies the category of failure: infant mortality, random or wear out. Weibull analysis provides the quantitative information needed for making RCM decisions which are often made from a qualitative approach.

The primary advantage of Weibull analysis is the ability to provide reasonably accurate failure analysis and failure forecasts with extremely small samples. Solutions are possible at the earliest indications of a problem without having to "crash a few more." Small samples also allow cost effective component testing. For example, "sudden death" Weibull tests are completed when the first failure occurs in each group of components, (say, groups of four bearings). If all the bearings are tested to failure, the cost and time required is much greater.

Course content

Subjects discussed in the course will usually be connected to money issues. Thus the class will combine engineering tools and business tool for a no-nonsense approach to solving problems of a financial nature.

The reliability tools discussed are:

- How to find the reliability of a process
- What data is typically required
- Availability concepts and analysis
- Data for use in solving reliability problems
- Preparing reliability data for analysis
- Normal probability plots
- Log-normal probability plots
- Weibull probability
- Reliability block diagram models for cost of unreliability
- What are the reliability losses and what causes them?
- What are the efficiency and utilization losses and what causes them?



- What is the size of the hidden factory and how many days of equivalent production are lost?
- Monte Carlo simulations
- Pareto distributions for vital problems
- Critical items list
- Reliability growth plots and forecast models based on previous experience
- Role in achieving reliability by-
Production
Engineering
Maintenance
Management
- How to measure process improvement
- How Weibull process reliability techniques differ from six-sigma approaches

The PR course is 2-days in length. For training sessions conducted in-house, a 1-hour management overview is available for educating the managers on issues of process reliability. The agenda for the 2-day course is:

Day 1:

- Introductions and general information
- What is reliability and what data is typically required
- What is the difference between availability and reliability
- Probability plots: Normal, Log-Normal, and Weibull
- How do you prepare the data for analysis
- How to make probability plots
- Use of students data to illustrate how to make plots
- Use of students data to find hidden factory losses
- Over commitment and under production
- Monte Carlo simulations for multi-plant output
- Pareto distributions
- Critical items list
- Demonstration Project Introduced
- Homework for Day 2 projects

Day 2:

- Review of Day 1 Homework
- Reliability Models for cost of unreliability
- Computer demonstration of Monte Carlo models
- Reliability growth plots and forecast models
- Student work on their computers with their problems
- Class discussion of students problems/opportunities
- Roles for achieving process improvement
- How to measure process improvement
- Demonstration Project Preliminary Commitment
- Management Overview (if required--1 hour duration)

Note: Students must bring 1 or 2 data sets of production from their facility to analyze in class and present for discussion to the group to demonstrate they have grasped the concepts.

Attention:

During the PR, each student will be encouraged to study process reliability on his own as a homework/demonstration project. The demonstration project will show the student can put both the art and science of engineering to work for reducing costs and improving output from the process.

Students solve problems during the class using their notebook with the current version of [SuperSMITH™ Weibull](#) software to reinforce the lectures.

Each student is expected to bring an Excel™ spreadsheet of production data from one or two processes within his operations for work in class. One dataset should be from a good process and the second dataset should be from a process that performs badly.

About the Lecturer

Paul Barringer has more than 45 years of engineering and manufacturing experience in design, production, quality, maintenance, and reliability of technical products. The breadth of his experiences avoids the usual narrowness of expertise in only a single area of reliability. Barringer is named as inventor in six USA Patents.





Target Public

Basic computer skills in Excel are required for computer literacy. Knowledge of production activities and quality activities a big plus. Who should attend the Process Reliability training class?

Maintenance & Reliability Engineers will find reliability tools helpful for providing supporting evidence during root cause analysis failure investigations. They will find reliability tools and techniques helpful for understanding failure data in their CMSS systems, and how failure data is used to justify making equipment more reliable as a business decision.

Production & Maintenance Managers will find new tools for understanding how operations can improve reliability of their processes. They will learn how to influence improvements in availability, how they can assist in reducing process failures, and how they can calculate the cost of unreliability for making business decisions to attack problems of unreliability.

Engineering personnel will find new modeling techniques for predicting process reliability based on how equipment is installed, operated, and maintained for making life cycle cost decisions in justifying new equipment and new processes.

Operations Managers will find business aspects of process reliability helpful for measuring and motivating improvements in processes, procedures, people, and equipment to reduce the cost of unreliability through use of non-traditional tools as they ferret-out hidden factories wasting time and money. They will learn how to predict future failures as a selling point for improvement projects.

Quality managers, black belts and green belts will find new modeling techniques for predicting process reliability & quality based on how equipment is installed, operated, and maintained for process quality control.

Reliability maturity of the organization:

Starting

First steps taken

Engaged

Totally engaged

Practical Information

Lecture language: English

Date: Wed 31/3 & Thu 1/4/2010 - 8:30-18:00

Participation fee: € 1.695,- / BEMAS members: € 1.395,-

Handouts, lunch and participation at the evening event on 31/3 included. All amounts are excl. 21 % VAT.

Registration: [Click here to download the registration form](#) – Session number to be mentioned: **01**

Organized by:

BEMAS - Belgian Maintenance Association vzw - asbl
Diamant Building (5th floor) - Bd A. Reyers-laan 80 - B - 1030 Brussels

Tel: +32 2 510 61 89 - Fax: +32 2 510 61 91 - E-mail: Info@Bemas.org

Due to the financial situation of many industrial companies, BEMAS has decided to launch a special offer for the participation fee in order to allow everyone to attend the event.

- **Special offer: € 850,- = 50 % reduction** on the normal participation fee of € 1.695,-.
- **Special rate for Bemas members: € 0 + € 270,-** to cover costs for catering and accommodation.

BEMAS members can follow the actual lecture free of charge. We only ask for a small contribution of € 135 pp. per day to cover costs for catering, accommodation and course materials. All employees of a company member of BEMAS can enjoy this special rate. This special BEMAS member rate is however only valid for production facilities and other organizations with an internal maintenance department that are member of BEMAS. Non members, suppliers and consultants can benefit of 50% reduction on the normal rate. [Check here if your company is member of BEMAS...](#)

All amounts are excl. 21% VAT.



More info on the BEMAS RELIABILITY SUMMIT:

Download the [general program](#) or view the [content details of each session](#)

<u>31/03/2010</u>		<u>Speaker</u>	<u>Company</u>	<u>Lan</u>
8:30 - 18:00	Process Reliability through Weibull Analysis - part I	<i>Paul Baringer</i>	Barringer & Associates, Inc.	E
8:30 - 17:30	Reliability Centred Maintenance From Analysis to Implementation	<i>Paul Lanthier</i>	The Aladon Network/Ivara Reliability Services	E
8:30 - 17:30	How to embed Reliability Engineering in your organization?	<i>Peter Decaigny</i>	Mainnovation	E
8:30 - 12:30	Asset Management & Pass55: a Roadmap to Reliability in Infra & Capital intensive Industry	<i>Peter Pansters</i>	PDM	E
13:30 - 17:30	Requirements & Roadmap towards Pass 55 certification	<i>Jan Vanassche</i>	Lloyd's Register	E
8:30 - 12:30	Diminuer les coûts de maintenance tout en augmentent la fiabilité grâce à des technologies prédictives	<i>Fabrice Brion</i>	I-Care	FR
13:30 - 17:30	Easy entry Predictive maintenance using ultrasound - the 21st Century screwdriver	<i>Tom Murphy</i>	SDT	E
<u>1/04/2010</u>				
8:30 - 18:00	Process Reliability through Weibull Analysis - part II	<i>Paul Baringer</i>	Barringer & Associates, Inc.	E
8:30 - 17:30	From good to Great through the basics of Reliability and Maintenance	<i>Christer Idhamar</i>	Idcon	E
8:30 - 17:30	Verhoogde efficiëntie, veiligheid en kwaliteit door een betere werkstroom in onderhoud	<i>Martin van den Hout</i>	Egemin Vadeo	NL
8:30 - 12:30	Reliable shutdowns	<i>Bas Broods</i>	PDM	E
13:30 - 17:30	Hoe Corrosie onder isolatie bestrijden?	<i>IJsbrand van der Plas</i>	HU Utrecht	NL
8:30 - 12:30	Workshop: Wat kan TPM voor uw bedrijf betekenen?	<i>Gert Meiling</i>	SKF Asset Management Services	NL
13:30 - 17:30	How to free up time for Reliability? Increase 'Hands on tool' time!	<i>Joost Van den Brekel</i>	PDM	E

Maturity indicator Legend:

	This lecture is highly recommended for this level of maturity
	This lecture is recommended for this level of maturity
	This lecture is interesting for this level of maturity, but might be too basic or too complicated for your organisation
	This lecture is either too basic or too complicated for this level of maturity