Benign Failures

Benign failures are failures recognized by an expert but generally not recognized by laymen. "A benign failure does not affect performance of the system. It will go unnoticed until the system is inspected [by an expert]." [Abernethy, section 2.5, The New Weibull Handbook, 4th edition]. "A failure which does not affect performance of the system and goes unnoticed as a problem until the system receives an in-depth inspection." [Section 15—Reliability Definitions, Reliability Engineering Principles]. Benign failures are defects waiting to explode in your face as a time bomb when you least expect them to occur.

Here's an example of a benign defect:

> You look at you left front automobile tire. It appears to be properly inflated. The tire is turned slightly to the left so it's easy to see the tread surface. You do your routine safety inspection for wear by looking at the tread depth. No wear bars are evidenced. No obvious failures observed.
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> However, you do notice the bright surface of a nail head on the tire tread surface. The nail head is shiny from wear. This tells you the nail has punctured the tire and it has been in the tire for some time. The nail has violated the pressure boundary which will lead to a flat tire in a short time interval. The loss of air pressure from the nail has not yet become noticeable to the eye. Air pressure loss will not be noticeable by visual inspection until a substantial amount of air has leaked from the tire. The tire pressure decline may be more noticeable if measured with an air pressure gage during and inspection. Had the visual inspection not been successfully performed, the benign failure will become later an obvious failure described as a flat tire. A less obvious failure of lost air pressure could result in handling deficiencies for the automobile for more discerning performance drivers.
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> If you're the manufacture of a tire, your standards for air pressure acceptance are very strict. You would require corrective action concerning tire pressure with a decline of more than 1 psig per month (0.07 bar). You would not base tire inflation based solely on a visual inspection for inflation. The Goodyear Tire Company recommends monthly inspection of tire inflations based on gage measurements so as to keep inflation at the proper level to prevent build-up of heat which causes significant deterioration of the rubber and tire reinforcement cords.
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> Visual discovery of the nail in the tire without significant loss of air pressure is a benign failure based on attribute inspection. The benign failure must be corrected before it becomes an obvious failure. Clearly a variables inspection by use of a tire pressure gage would have detected evidence of a pressure decline earlier suggesting a benign failure is underway that can grow to a flat tire failure.

Benign failures easily grow to serious problems. Benign failures start the use of "rubber rulers" to define or not define the failure. This leads us to the age-old problem best

described by the tale of the “camel in the tent”.

> "Never let a camel get his nose in the tent". If he gets his nose in, he will get his head in… if he gets his head in, he will get his hump in… if he gets his hump in, he will get his rump in… and soon you will have a camel in your tent. No nose …no camel in the tent.”
> [Ben Kichlow’s The Camel and the Tent, 2001]

Accepting benign failures can cause us to prostitute our acceptance/rejection standards. We walk toward the edge of the ice using the incorrect logic that no failures have occurred so why not loosen the standards. We introduce linear thinking into a probabilistic environment by stretching pass/fail rules in the direction of convenience, greed, or competitive advantage.

Benign failures often spur the use of a euphemism redefining the problem. Note that the euphemism defines away problems!!!

Here is a marketing euphemism:

We don’t sell used cars, we sell pre-owned cars.

Here is a production euphemism:

We prefer to ship product that meets the specification but it’s OK to accept product outside of the specification as long as it does not exceed 2*x the specification limit (summarized as it’s not OK to make but it’s OK to take).

Here is an inspection euphemism:

We have a tight limit for acceptance of pressure relief devices going into production. We have a looser acceptance criteria when the device is returned from the field after use where we allow 5-10*x increase in the limits because it rarely causes problems.

Most failures are not step functions such as working/not working. Failures are subject to degrees, classes, or grades of failure when the degradation has declined to an unacceptable level. Failure is simply defined as the loss of the function when you needed it. Failure is more completely described as an event which renders equipment and processes as non-useful for the intended or specified purpose during a designated time interval. It includes:

- stoppage due to malfunction
- cessation of component function
- cessation of meeting predetermined quality, quantity, or cost expectations
- an unexpected occurrence that interrupts routine operation of a system

Reliability terminates in a failure. Reliability is the probability that a device, system, or process will perform its prescribed duty without failure for a given time when operated correctly in a specified environment. It’s clear that you must specify the characteristics for a failure.

Grade failures or no-failures consistently and clearly. Grade hard to avoid benign failures blowing up in your faced.

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