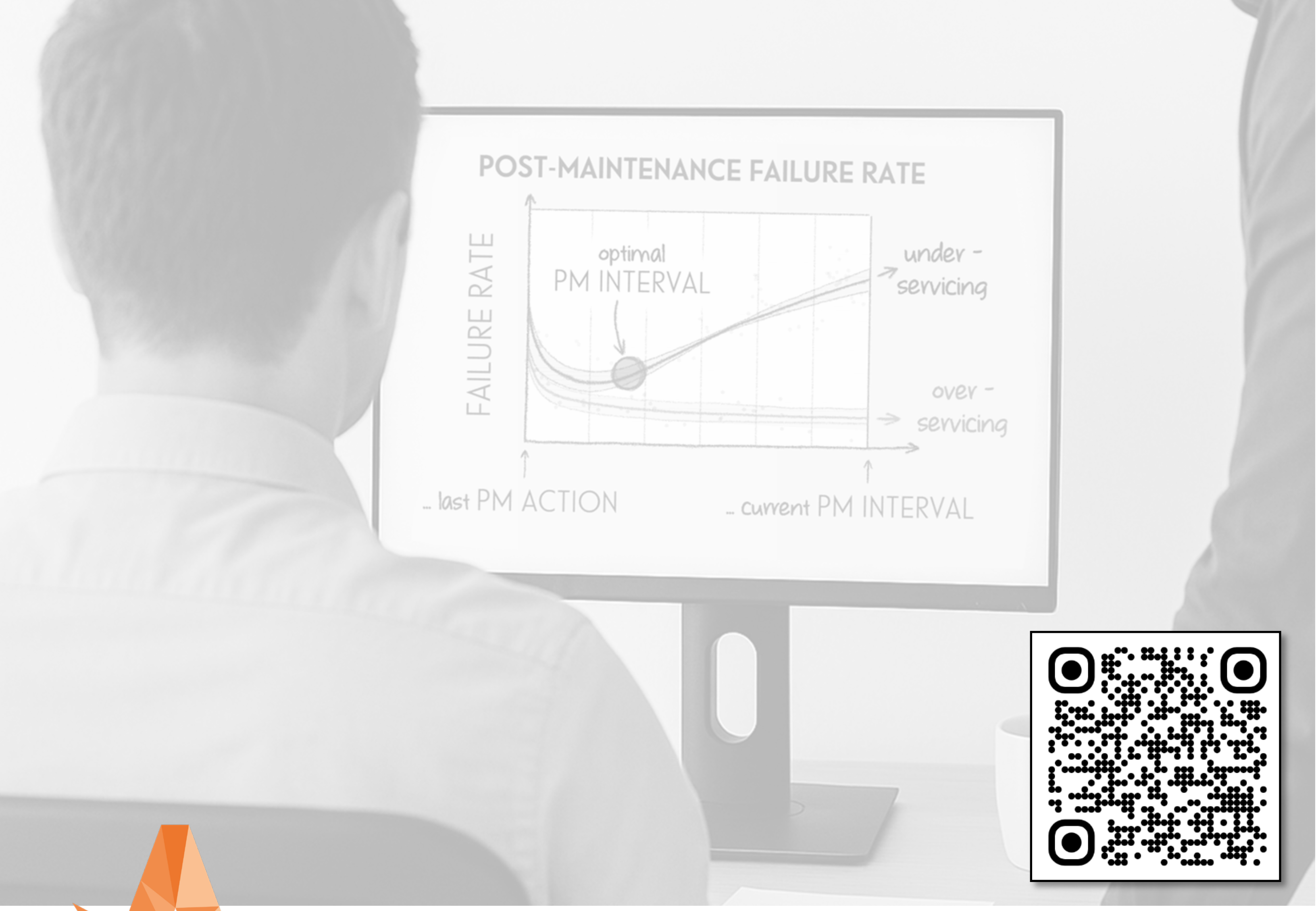
RELIABILITY ENGINEERING SPRINTS

DEEP DIVE into **ONE SYSTEM'S DATA** to support **ACTUAL DECISIONS** with at least **ONE MEASURABLE IMPROVEMENT** ... no matter **HOW 'MESSY'** that data is



acuitas reliability

A clearer path to better reliability engineering outcomes

What is a Reliability Sprint?

A RELIABILITY SPRINT iʀ a fŋcţ ʀed•1 0ſŋ 34⁾ dax deeœdiŭe iŋſŋ a
SINGLE RELIABILITY PROBLEM•ASSET•SYSTEM•OR FAILURE MODE ſhaſ ſţ qŋʀ
φaƙv ŋqd daſa iŋſŋ a cʀeaφ DEFENSIBLE ENGINEERING AND BUSINESS DECISION‰
Iſ iŋŭŋʀŭeʀ aœœxiŋg adŭaŋced φʀiabiʀiſx eŋgiŋeeqŋg ł elhŋdʀ
ſhaſ giŭeʀ xŋţ ſhe aŋʀv eqſŋ ŋŋe cqſicaƙþţ eʀſiŋŋ

Whaſ ʀhŋţ ʀd v e dŋ ŋewſ! - aŋd v hx!

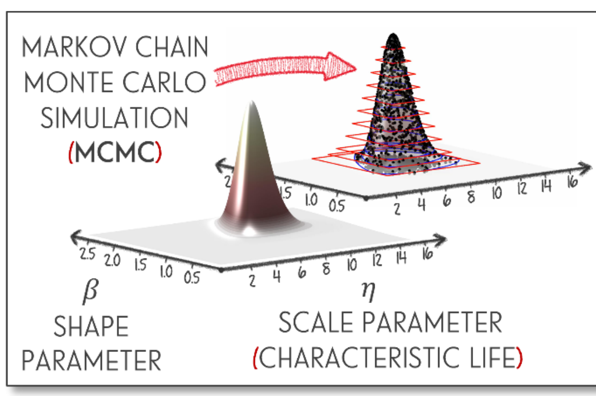
Why Teams Use Them?

Teams use **RELIABILITY SPRINTS** because they **NEED ANSWERS QUICKLY**, or when **TRADITIONAL 'OFF-THE-SHELF' APPROACHES CAN'T WORK**. Modern systems often generate messy, incomplete, and frequently contradictory data. **RELIABILITY SPRINTS** cut through the noise to reveal which **FAILURE MECHANISMS** truly matter, how risk changes over time, and where effort will have the greatest impact.

When downtime, field failures, or test results are piling up, waiting months for a large project isn't practical. A **RELIABILITY SPRINT** provides a focused, deep dive that compresses analysis and interpretation into a short, **COST AND TIME-CONSTRAINED ENGAGEMENT**, allowing teams to move from uncertainty to a **CONFIDENT, DEFENSIBLE DECISION** using **BUSINESS AND ENGINEERING LANGUAGE** in weeks rather than quarters.

What's Special About Acuitas' Data Analysis?

TWO THINGS. The first is that Acuitas has a range of **SOPHISTICATED MODELS** that go beyond simple fitting of 'bell curves' to incorporate wear-in, wear-out, multiple operational conditions, multiple failure mechanisms, and so on.



The second is the use of a tailored **MARKOV-CHAIN MONTE CARLO (MCMC) SIMULATION** algorithm, pioneered by Acuitas (modified from the well-known 'slice sampling' algorithm), to numerically analyze these complex models, going beyond 'off-the-shelf' analysis techniques that are often limited to particular scenarios. A 'two-parameter' example is illustrated above.

The Process and Deliverables

STEP 1: Discovery & Data Intake

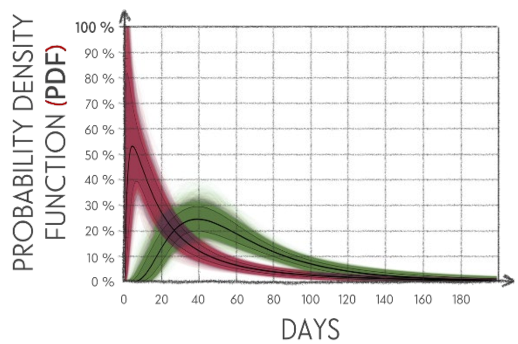
60-minute kickoff meeting where data is provided to Acuitas and its formatting, headings, fields (et cetera) are explained. The most important output is the **CLARIFICATION OF THE GOAL … WHAT DECISION DO WE NEED TO MAKE?**

STEP 2: Reliability & Maintenance Analysis

Acuitas **DEVELOPS ALL MODELS AND SUPPORTING STATISTICAL DISTRIBUTIONS** (based on Weibull, normal, lognormal, or more complex Physics of Failure). Acuitas will then choose the data analysis methodology, but it will often be based on **MARKOV CHAIN MONTE CARLO SIMULATION (MCMC)**, along with maintenance optimization (if applicable).

STEP 3: Engineering Interpretation

Data analysis goes beyond generating numbers and involves **INTERPRETATION**. Depending on the **GOAL**, this could include identifying likely **FAILURE MODES, MECHANISMS**, and their **ROOT CAUSES**, understanding **MAINTENANCE-INDUCED FAILURES** and **WEAR-OUT**, analysis of key reliability metrics (such as **WARRANTY RELIABILITY, L_5 LIFE**) along with confidence projections.



STEP 4: Report (and Action Playbook if applicable)

The **REPORT** tells you what you need to know. **The ACTION PLAYBOOK** (depending on what package you choose) helps you understand what to do. These are both clearly written documents that use helpful illustrations to recommend actions for PM optimization, redesign, supplier selection, burn-in, and more (along with estimated value and cost savings).

STEP 5: Presentation

Virtual conference where we outline the **PROBLEM, ANALYSIS, INSIGHT, DECISION(s)**, expected **VALUE**, and supporting illustrations

STEP 6: Follow-up and Support

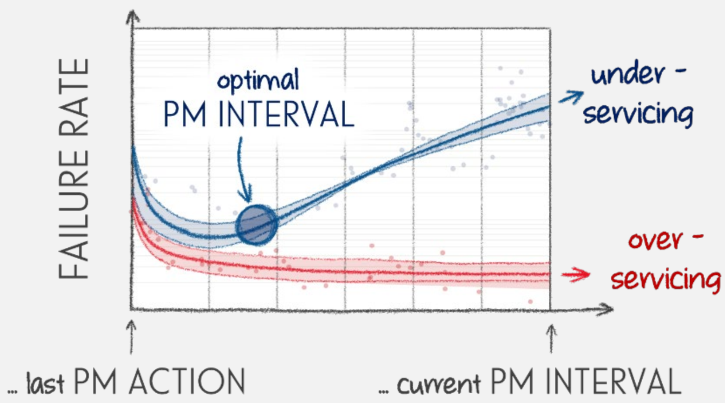
Over the next 30 days, **TWO 60-MINUTE CHECK-IN SESSIONS**, **Q&A**, and decision refinement.

USE CASES

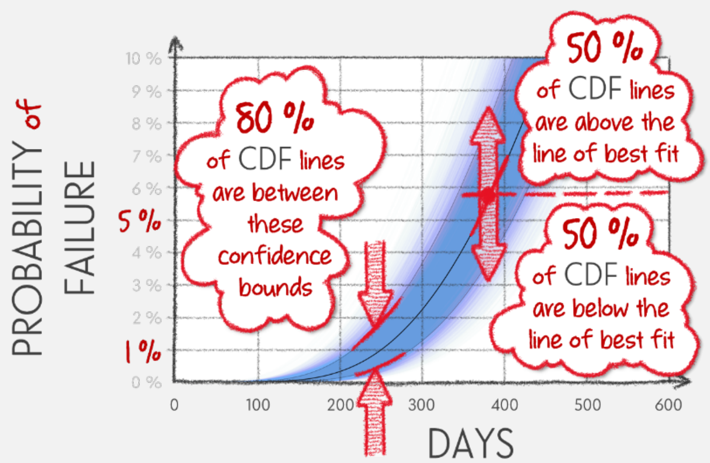
The following use cases are based on **REAL EXAMPLES**, with details generalized or altered to protect confidential information.

MAINTENANCE OPTIMIZATION

Modelled the post-Preventive Maintenance (PM) failure rates to identify over-servicing, or the optimal PM interval if we are under-servicing. The example on the right shows two separate machines at a manufacturing plant, with data outputs spread across the current PM interval.



Most analyses we have completed show machines are chronically OVER-SERVICED, making the blue post-PM failure rate above very rare. This means that many machines can be SERVICED LESS and IMPROVE RELIABILITY. It should also be noted that there is ALWAYS MAINTENANCE-INDUCED failure, as shown by the initial (and temporary) increase in failure rate.

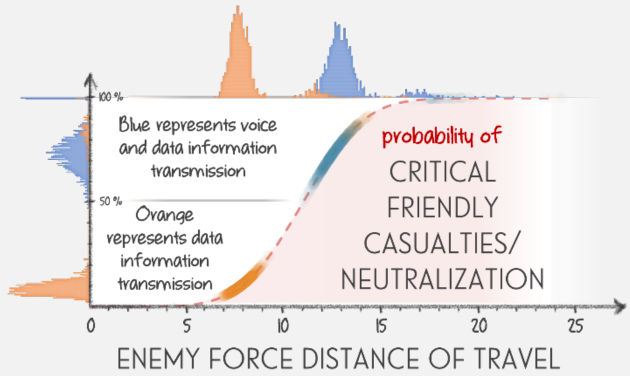


WARRANTY / SERVICE LIFE

Combined test and field data to project failure probability for a HYDRAULIC PUMP used on a heavy industrial vehicle.

We used Markov Chain Monte Carlo (MCMC) to project future failure probabilities to help the client understand warranty periods and when to replace the pumps.

MCMC allows confidence intervals based on a large (huge) number of simulations. Acuitas illustrates and explains how confidence lines and intervals work, and how they can be used to make risk-informed decisions. In this case, they can be used to estimate the L_1 and L_5 lives, which are the times at which 1 % and 5 % of failures are expected to have occurred, respectively.



MILITARY TACTICAL SIMULATION

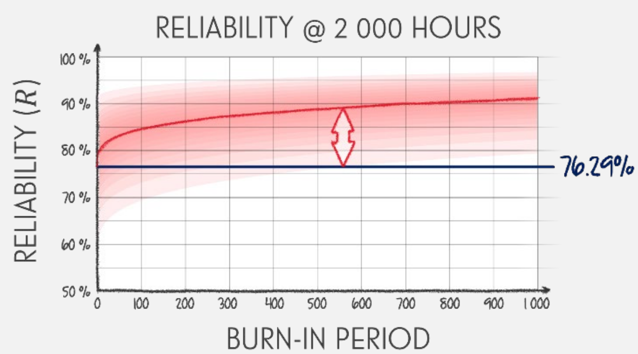
Tailored simulation to model the lethality of military attack helicopters during attack runs.

The effect of voice versus voice-and-data transmission on destroying a hostile enemy force was linked to harmful tactical effects.

This was one of our 'different' analyses, but thoroughly rewarding. One of the challenges with this sort of analysis is illustrating the outputs in a way that allows people to understand what is 'actually happening.'

MODELLING BURN-IN

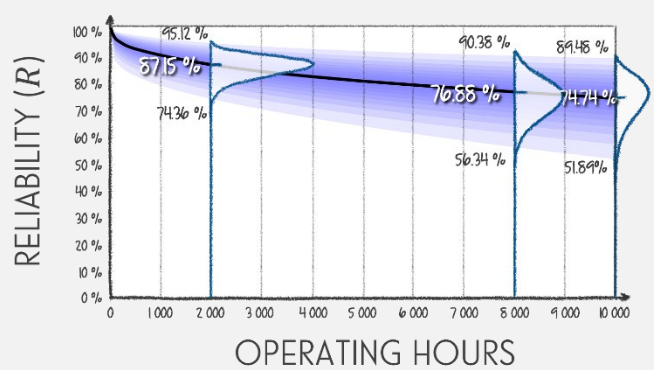
Test and field data for a Gallium Nitride (GaN) device were analyzed to understand the benefits of burn-in.



The original 2,000-hour reliability was estimated at 76.29 %. The effect of burn-in was modelled out to 1,000 hours, showing how 2,000-hour reliability increases to over 90 %. The illustration above-right shows the projected improvement for various burn-in scenarios, along with confidence bounds, to help the client balance burn-in duration with reliability performance.

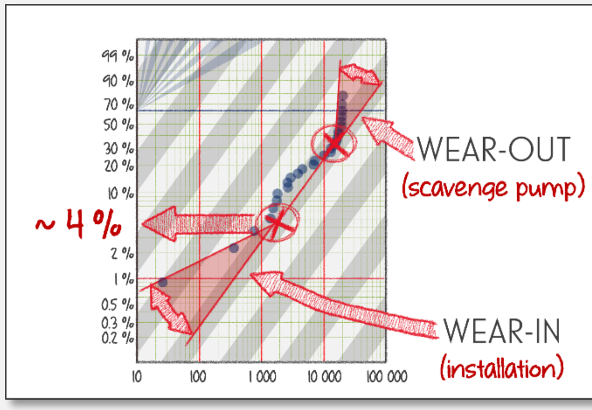
SMALL SATELLITE SYSTEM RELIABILITY MODELLING

Completed system reliability analysis where component and system tests, simulation, Accelerated Life Test (ALT), and previous model data were combined to project system reliability.



This informs not only the warranty but also the number of satellites that need to be launched to achieve the mission. The chart above-right illustrates distributions of predicted reliability from MCMC simulations to help the client understand the risk of decisions based on reliability performance.

COAL HAULER ENGINE MULTI-FAILURE MODE WEIBULL ANALYSIS



With a lot of censored (and missing) data, different life phases of the coal hauler engine were analyzed - identifying that around 4 % of failures were caused by installation issues, and a simple scavenge pump wearing out causes the engine's end of life (an EASY UPGRADE AND FIX!) The illustration to the above right is an example of a Weibull plot, where the shape of the line the data traces out illustrates 'how' the coal hauler is failing.

PACKAGE AND PRICING OVERVIEW

STANDARD SPRINT

$ 8,500

PERFECT FOR A SINGLE FAILURE MODE OR MECHANISM IN A SINGLE COMPONENT

- **FULL RELIABILITY ANALYSIS** that involves identifying specific reliabiltiy performance statistics
- **DETAILED RELIABILITY REPORT** that summarizes the outcomes of this analysis
- **SELECTED CHARTS AND IMAGES** generated to be included in slide descks and brochures
- **30 DAYS OF SUPPORT** where questions regarding the report can be asked and addressed

PRODUCTS DELIVERED WITHIN 21 CALENDER DAYS

ADVANCED SPRINT

$ 12,500

GREAT FOR A COMPLEX SYSTEMS WITH MULTIPLE FAILURE MODES THAT COULD NEED MAINTENANCE OPTIMIZED

Everything in the STANDARD SPRINT plus ...

- Modelling and analyzing **MULTIPLE FAILURE MODES AND MECHANISMs** that complex systems tend ot have
- **ACTION PLAYBOOK** that includes (but is not limited to) optimizing **PREVENTIVE MAINTENANCE, BURN-IN**, or anything else to that goes from making a decision to **COMING UP WITH A PLAN**

ENTERPRISE MULTI-SPRINT

... tailored package

FOR OEMs, UTILITIES, AND ASSET-INTENSIVE ORGANIZATIONS LOOKING FOR 3-6 SPRINTS PER YEAR

Everything in **STANDARD** and **ADVANCED SPRINTS** but tailored to an organizations needs

KEY OUTCOME:

A rolling, always updated, reliability (risk) portfolio that contains historical analysis results, and an ONGOING ACTION PLAN

WHO LEADS IT

Dr Christopher Jackson has a PhD in reliability engineering and has spent most of his professional life applying his theoretical and analytical skills to 'real-world' scenarios. He has authored or co-authored multiple books and textbooks on reliability engineering and special topics such as reliability life models.

He has worked across a wide range of industries, including mining, medical devices, defence, and others. Learn more about Christopher at https://www.acuitas.com/about.

HOW TO GET STARTED

Visit us at https://www.acuitas.com/reliability-sprints or use the QR code to the left to set up a conversation and see how we can help with your reliability, life, and maintenance data analysis needs.