Analysis of Field Failures & Quantitative Prognosis Analysis

Deformation, Fatigue and Fracture analyses are key tools in understanding unexpected fatigue failures. Finite element analyses (FEA) can be used to analyze the part in the as-built configuration, and under loading conditions which may not have been expected when the part was first designed. Stresses in the unanticipated conditions can often reasonably explain early failures. Similarly, variations in expected material properties can be examined. CAE Associates has helped clients with these types of investigations for many applications These analyses are powerful tools when combined with physical analyses of failed parts or with material tests.

It is sometimes useful to anticipate how often failures can be expected in a population of parts. Scatter in material properties, variability in loading, the number and the age of parts in service all affect when a part will fail. For example, a "young" part (having recently entered service) is less likely to crack than an older part. However, if the younger part is subjected to higher loads, or has been made from the lowest strength material, it may crack sooner.

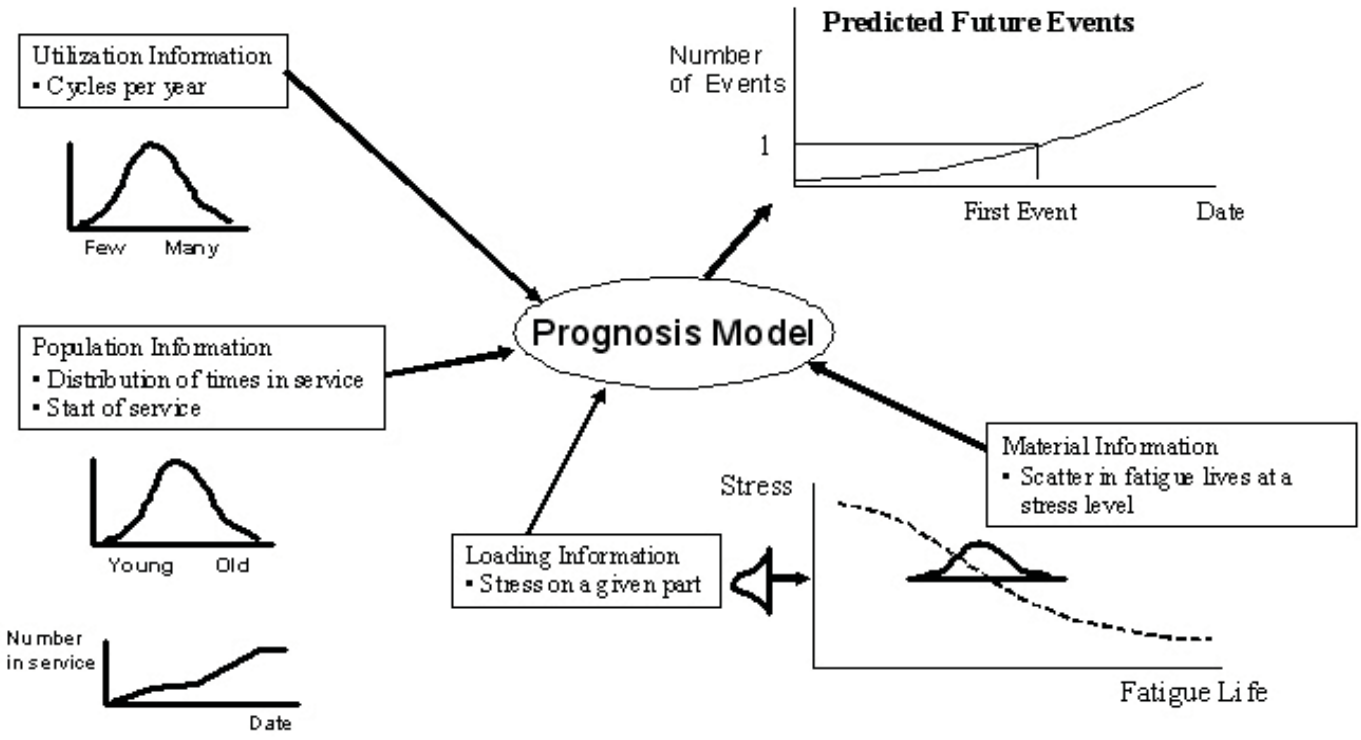

Figure 1: Elements of Prognosis Analysis for the number of fatigue cracking events in a large population of parts.

Continues >

1579 Straits Turnpike, Suite 2B / Middlebury, CT 06762 / P 203.758.2914 / F 203.758.2965

Each of the variables can be modeled as a statistical distribution which then can be combined in a quantitative Prognosis Analysis to predict a probability of a future event, as illustrated in Figure 1. A variety of risk analysis methods can be used, including "Monte Carlo" simulations, where life calculations are made by assigning characteristics from each of the important variables to a hypothetical part. In the Monte Carlo simulation, thousands of these hypothetical parts are examined to obtain a distribution of failure lives. Using the theoretical failure distribution, the expected number of future events can be determined.

1579 Straits Turnpike, Suite 2B / Middlebury, CT 06762 / P 203.758.2914 / F 203.758.2965