

they would be corrected.) However, experience has shown that design flaws do cause failures in operational launch systems, and will likely do so in the future."

The major objection to the parts-analysis approach, hinted at above but not actually expressed, is that all such approaches involve either explicitly or implicitly a so-called K-factor. The K-factor is included in the reliability calculations in an attempt to compensate for the fact that the environment in which a part or system is tested is not the same as the flight environment. Since the K-factor is surely not the same for all components and systems, multiple values must be assumed and the entire process becomes highly subjective.

In view of the objections and limitations just presented, in this report the parts-analysis approach is not considered in assessing vehicle reliability or in estimating the relative probabilities of occurrence of the various failure-response modes.

#### **4.2 The Empirical Approach**

A seemingly more objective way to evaluate vehicle reliability (or conversely, vehicle failure probabilities) is by examining the actual performance of flight-tested vehicles. In support of this approach, the following is quoted from the Office of Technology Assessment<sup>[5]</sup> report previously referenced:

"The only completely objective method of estimating a vehicle's probability of failure is by statistical analysis of number of failures observed in identical vehicles under conditions representative of those under which future launches will be attempted."

Although we agree with the Office of Technology Assessment statement, the obvious difficulty with this approach is that no such sample of identical vehicles exists or is ever likely to exist.

In their report<sup>[4]</sup> previously referenced, Booz • Allen makes the same point in different words by stating that "the empirical approach has one significant drawback in that it can not project the effects of changes in the launch systems". The effects of such changes can only be assessed objectively by further flight testing.

The difficulty in projecting success rates (or failure rates) from past tests to future tests is clearly recognized. Nevertheless, RTI has relied exclusively on this method to estimate the relative probabilities of occurrence for the various failure-response modes. Even so, total objectivity cannot be claimed since, as will be seen later, the answers depend to a large extent on how the performance data are filtered, and how big a risk one wants to take that the true failure probability is underestimated.