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Reliability Models and Metrics for Space Shuttle Maintenance Position Statement

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Introduction

The use of software reliability models as an aid to software maintenance, with applications to the Space Shuttle on-board software, will be described. In addition to supporting the maintenance function, the use of reliability models throughout the life of the software supports other functions such as reliability assessment, design feasibility assessment, and management of human and computer resources. By assessment we mean an evaluation of how well the software meets reliability goals.

Reliability Prediction During Prototype

If we view maintenance as a continuous process that is in effect throughout the life of the software as opposed to a strictly post-delivery process, we can start to make reliability predictions in support of maintenance as soon as failure data is available. It is not necessary to wait until the test phase to acquire failure data. It is highly desirable to develop a prototype for early assessment of: 1) maintainability, 2) reliability, and 3) design feasibility.

1) Reliability assessments obtained during design have *direct* implications for future maintainability (i.e., high failure rates suggest poor maintainability). High failure rates could be used as a management trigger to redesign or scrap the prototyped software.

2) Apart from maintainability, reliability predictions can be used to assess whether the software is likely to meet reliability goals that were defined during the requirements phase.

3) Lastly, prototyping is used for the traditional purpose of assessing design feasibility. However, when viewed in the context of reliability assessment, prototyping assumes greater importance: in addition to evaluating whether the proposed design is realizable, which is a function of size, structure, complexity, etc., we also predict reliability to evaluate the influence of these same characteristics on future maintainability and reliability. The process described for prototype should be continued during design.

Reliability Prediction During Test

Reliability predictions made during test are used to identify modules which *may* be difficult to maintain during the post-delivery phase; these modules should be given the highest priority for maintenance action. This is achieved by allocating manpower and computer time in accordance with predicted number of failures or failures per KLOC (i.e., allocate the most resources to the highest failure rate modules). In addition, reliability predictions made during test can be used to earmark modules that need to be watched during the remainder of the life of the software, including post-delivery maintenance, and to flag modules that are candidates for rework.