Implementing a software quality metric program based on the Rome Laboratory initiatives

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Rome Laboratory is a U.S. Air Force laboratory within the Air Force Material Command that plans and executes an interdisciplinary program in research, development, testing, and technology transition in support of Air Force Command Control, Communications and Intelligence activities for all Air Force platforms. Rome Laboratory has conducted an extensive research and development effort into the identification and measurement of software quality characteristics for the past twenty years and is considered by most experts as the international leader in this field. The authors have built upon this foundation and their own experience as practitioners of software quality measurement via the Rome Laboratory Framework. They have successfully applied this methodology in the industrial and scientific communities for the past fifteen years. This paper describes, based on a series of lessons learned, techniques for implementing a software quality measurement (metric) program to real software development applications in a real competitive environment. Reference is made to results obtained in past applications and to a recently released guidebook for applying the framework. Potential problem areas are defined, concerns listed, background information given, case histories discussed, and guidebook topics outlined.

1. INTRODUCTION

Hesitation by the industrial community in accepting software quality measurement as standard practice for all software development is, in large part, the result of an ongoing debate concerning the merits of its theoretical base, purpose, function, and proposed effectiveness. These concerns are often couched within the general category of "validation" (or in this case, lack of validation). The debate has been continuing for over twenty-five years and unless some bold action of redirection and acceptance is assumed, the debate will likely continue as solely an academic exercise. Surveys indicate that the commercial industrial complex feels it will not accept on its own
the notion of early quality measurements and their associated cost as an effective, competitive advantage in the pursuit of marketplace dominance. Notable exceptions include the Japanese industries, whereby inclusion of software quality measurement, as standard practice throughout the software development life cycle, is consistent with their approach to quality and cost containment.

In this paper we have used as a basis, a set of concerns expressed by many US Aerospace/Defense corporations, Government agencies, commercial companies manufacturing software driven systems, and various professional societies. These concerns, many of them identified in this paper, relate to problems encountered in introducing software quality measurement within an existing software quality program. Some of the systems contain, in addition to many of the major issues found in a typical software development scenario, the high reliability and precision requirements of a system operating in an environment whereby the fate of human lives is often a consequence. The paper defines the problem, presents a brief synopsis of past and current Rome Laboratory initiatives, examines the results of some case studies which are related to many of these concerns, and indicates areas where the Rome Laboratory Framework Implementation Guidebook (RLFIG) addresses them. Finally, we present an overview of the RLFIG, suggesting how its detailed list of procedures for applying software quality metrics (SQM) may be used by even the inexperienced SQM user.

2. THE PROBLEM

The frequently recognized need for the measurement of software quality has been an issue at most aerospace/defense/communication companies and others since the formation of independent Software Quality Assurance (SQA) organizations and its current emphasized importance on contracts, including those imposed by NASA and other highly technical precision agencies.

This need, however, has not been fully realized to any degree greater than those required by corporate or divisional policies or those specified in NASA, DoD, IEEE, ANSI, and/or other standards. In December 1992 the IEEE Standards Board approved the Standard for a Software Quality Metrics Methodology, 1061, the first IEEE-issued standard that deals specifically with software quality metrics. As a process standard, 1061 does not mandate specific quality metrics for use. Reasons given included the lack of a methodology available for implementing a quality metrics program that is independent of any one particular set of metrics which may be used for all applications and in all environments. The 1061 Working Group supported the objective of putting “measurement into practice” as long as there is a plan to implement it. Rome Laboratory has produced such a plan in the form of a guidebook. The guidebook is consistent with the 1061 Working Group’s desire to provide a “global metric menu” from which each application may customize a model unique to its development. The guidebook will be discussed in some detail below.

Incomplete customer requirements are common in the research and development arena and are often at the forefront of searches for improved software quality