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The Management Quality Metric

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ABSTRACT:

Software quality assurance can be expressed in terms of quality indicators and factors. An index number which quantifies the extent of the relationship between software quality indicators and quality factors is developed. The index, termed management quality metric (MQM), expresses the fractional achievement of the target quality and may be used for measuring and monitoring the management of quality assurance.

INTRODUCTION:

The recognized attributes, criteria, and factors of software quality have been stated as requirements [AFSCP 800-14 1987]. Software quality factors are:

correctness, efficiency, flexibility, integrity, interoperability, maintainability, portability, reliability, reusability, testability, and usability.

Software quality indicators are:

completeness, design structure, defect density, fault density, test coverage, test sufficiency, and documentation.

The interrelation of quality factors and quality indicators is displayed pictorially in Figure 1.

Software Quality Factors / Software Quality Indicators	Correctness	Efficiency	Flexibility	Integrity	Interoperability	Maintainability	Portability	Reliability	Reusability	Testability	Usability
Completeness	o					o		o		o	
Design Structure		o				o		o		o	
Defect Density	o					o		o		o	o
Fault Density	o					o		o		o	o
Test Coverage	o					o		o		o	
Test Sufficiency	o					o		o		o	
Documentation	o					o		o		o	o

FIGURE 1 [AFSCP 800-14 1987]

The intent is to develop a single index number which quantifies the extent of this relationship. This number, designated as the management quality metric (MQM), is derived below.

DISCUSSION:

The software quality indicators are assigned yes-no values. For example, either there is adequate documentation or not. The degree of achievement of a given quality factor is given by the proportion of quality indicators under that factor with a "yes" value. If the quality factors are assigned relative weights which add up to one, then the sum of the products of the individual weights and proportions will reflect the fractional

attainment of the sought-out quality. Hence a number will show the extent of the relationship between quality factors and quality indicators.

This is expressed mathematically as

$$E(p) = w1\ p1 + w2\ p2 + \ldots + wn\ pn$$

where

wi, i = 1, ... , n
is the weight assigned to quality factor i

pi, i = 1, ... , n
is the fractional achievement of quality factor i

E pi = 1

and E(p) is the expected value of the fractional achievement of the target quality. This is the management quality metric or MQM.

To arrive at the relative weights of the quality factors, pair-wise comparisons of quality factors are made using the methodology advocated in the Analytic Hierarchy Process (AHP) [Saaty 1988]. The corresponding quality factor matrix is thus developed. The relative weights are given by the right eigenvector of this matrix. The consistency of the judgments is estimated by computing the principal eigenvalue of the matrix. Computation of the principal eigenvector and its eigenvalue are done transparently to the user using a software package named "Expert Choice" or a simple ad hoc computer program which currently runs on both the main frame and a PC.

CONCLUSION:

The authors suggest that MQM be used and tested in the modernization effort. In particular, a pilot study is recommended to apply to interim LIS as soon as possible.

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