

A Benefit/Cost Model for Metrology in Manufacturing

Author: James Potzick

Every measurement of a feature's size or placement on a wafer or photomask is made for a reason. Usually a measurement leads to a decision, often involving a process adjustment or business transaction, and there are costs and benefits attached to these decisions. Every such measurement, however, contains unknown errors. Since the errors are unknown (else they would have been removed), they are best characterized by probability distributions. Thus a measurement result is a probability distribution of likely values for the measurand, with a mean and a variance characterized by its ISO measurement uncertainty. These concepts lead to an econometric rationale for feature metrology where the benefit and cost depend on the cost and uncertainty of the measurement and on the consequences of the dependent decisions.

Description of the econometric metrology model is followed by a discussion of the evaluation of measurement uncertainty and practical definitions for the relevant terms. Some notes on parametric measurement errors and the correlated errors often found in comparing measurements at different sites or different times are presented.

Since the photomask is an integral and key component in patterned wafer production, it must be included in the overall design and metrology strategy. Some general notes will be presented on the relation between the photomask metrology process, the wafer manufacturing process, and real mask features, followed by a model for integrating metrology modeling and process modeling into wafer exposure process optimization.