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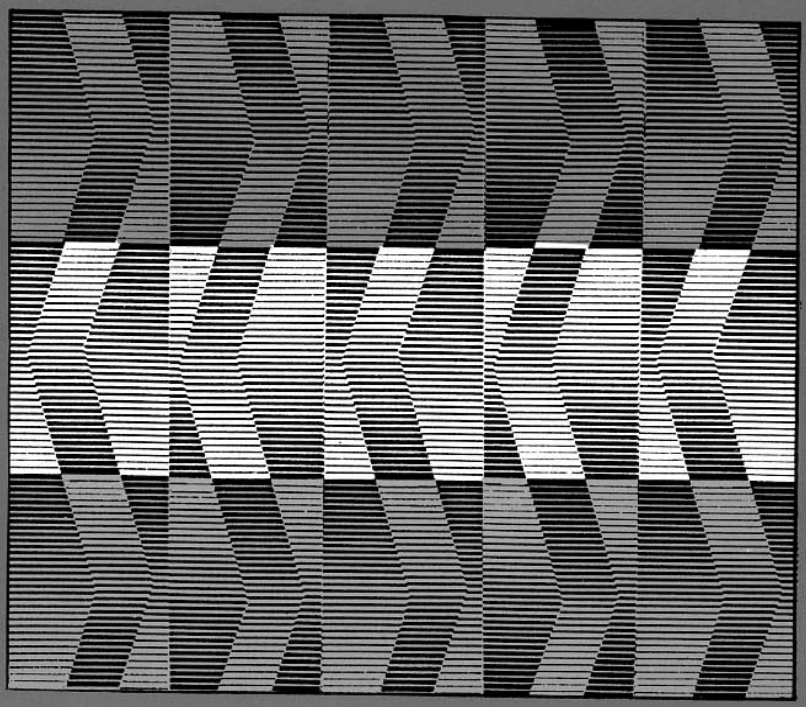

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by

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Abstract

As many organizations are aware, the world marketplace is now demanding significantly higher levels of customer satisfaction and product quality at lower cost. For those industries involved in manufacturing, this demand has led toward a relentless quest for excellence. One aspect of this quest is related to design producibility and process characterization. These two issues constitute the central theme of this booklet.

The booklet opens with a thought-provoking discussion related to the principal motivators of industrial change. After this, the discussion is focused on how manufacturing and materiel variation affects the first-time yield of any given product characteristic, how the first-time yield of a characteristic is correlated to producibility, and the notion of product complexity and how it interacts with first-time yield influencing product quality, reliability, cycle-time, and costs. From this vantage point, the reader can readily see the driving need behind Motorola's Six Sigma initiative.

The remainder of the booklet is divided into two major parts. Part I presents the engineering methods and metrics associated with the quantitative analysis of producibility. Part II zeros in on the scientific method and statistically based indices necessary for characterizing virtually all types of manufacturing processes, material, and components.

Within Part I of the booklet, the reader is introduced to modern probability theory. The theory is then applied to develop the underlying concepts and equations pertaining to rolled-throughput yield—the probability that any given unit of product can be manufactured with zero defects. It is also pointed out that this performance index, or "metric," is the quantitative cornerstone of producibility measurement. Based on this discussion, the reader is then analytically guided to the concept of normalized rolled-throughput yield. Following this, the authors mathematically demonstrate how the metrics can be applied to eliminate the influence of complexity so as to better assess the intrinsic producibility of competing design/process alternatives. This portion of the booklet closes with the presentation of a hypothetical case analysis involving an actual product.

At the onset of Part II, the reader is presented with a tutorial on descriptive statistics and the conventional indices of capability. Within a related discussion, it is noted that short-term variation reflects the instantaneous reproducibility of a characteristic; i.e., the capability of a parameter when only random variations are present. In contrast, it is pointed out that long-term variation reflects not only random error, but also the perturbing nonrandom influences which emanate from the underlying cause system. From this perspective, the foundation is laid for the construction of a scientific process characterization strategy. The general strategy is then formed into a four-phase application methodology.

A better understanding of the mechanics is presented with a carefully detailed step-by-step scenario focusing on the characterization and analysis of short-and long-term variation for the unilateral and bilateral cases. The scenario ends with a general discussion and illustration of the metric reporting formats.

The booklet closes with a substantive case study. The case study is related to the characterization and optimization of plated through-holes within a certain printed circuit board. Through this product, the reader is able to better understand how the producibility and characterization tools are employed on a real-time basis.

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