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Book Reviews

Taguchi on Robust Technology Development: Bringing Quality Engineering Upstream, by Genichi Taguchi, Published by ASME Press, New York, NY, 1993, $24.95.

REVIEWED BY ANTHONY J. RAFANELLI[1]

In reviewing Genichi's book, *Taguchi on Robust Technology Development: Bringing Quality Engineering Upstream*, this reviewer approached the book from the eyes of a trained total quality management instructor. The book is a unique reference source that deals with the "mechanics" of quality.

Chapter 1 concerns itself with Quality and Productivity and while at first appearing to be "motherhood and apple pie", it ends with some interesting information. Taguchi does a good job in explaining optimization of parameters and uses some very basic mathematical equations to illustrate his approach. He introduces some very interesting terminology, i.e., productivity loss being the sum of quality loss and production cost and productivity index being the inverse of productivity loss. It is not until p. 13 that he defines "robust design" which is the design of products and processes such that they are minimally sensitive to environmental effects, deteriorative effects, and manufacturing imperfections.

Chapter 2 deals with Methods for Evaluating Quality. Included is the quality loss function, $L(y)$, which is an expression of quality level associated with financial loss. Basic calculus is used in minimizing financial loss by striving to make a quality level y equal a target m, i.e., for a loss function $L(y)$,

$$L(m) = 0 \text{ (ideal condition)}$$

and subsequently

$$L'(m) = 0 \text{ (for financial loss to be a minimum at } m)$$

Included are Taylor series expansions for the above expressions and with mathematical manipulations, the effects of quality and tolerance deviations can be determined.

"Specifying Tolerances" is the subject of Chapter 3. Included are discourses on Economical Safety Factors, Loss Functions, and a well-written section on specifications for "smaller is better"/"larger is better" problems.

Chapter 4 addresses quality management systems for production processes. In this chapter, Dr. Taguchi notes that control limits should not be confused with tolerance specifications of products. The former are adjustments used in quality management systems to help identify trends whereas the latter are in-line measurements to ensure conformance of the product to quality requirements.

The fifth and last chapter deals with parameter design; it proved to be the most interesting to this reviewer. Dr. Taguchi cites three important research factors necessary for robust technology development: 1) technological readiness 2) flexibility and 3) reproducibility. The first factor refers to having acquired all necessary information for the functional design of a new product, i.e., somewhat of a precursor to concurrent engineering. This would also include understanding the capabilities of production technologies. (A design is of no value unless it can be manufactured.)

The second factor, flexibility, simply means that any technologies (engineering and production) developed for one product should be applicable or adaptable to other product-types. A modern-day analogy would be the philosophy behind the U.S. Government's Dual Use technology programs, i.e., the ARPA Technology Reinvestment Program. Finally, reproducibility relates to the efficiency and cost-effectiveness of mass producing the product. Reproducibility should be considered back in the research phase of product design.

In general, Dr. Taguchi has provided the TQM community with a reference that provides some very useful "tools" in developing many of the details of quality management. For example, Chapter 1 sets the stage in describing and differentiating between quality and productivity which are concepts that a beginner TQM student must grasp. Chapter 2 addresses methods for evaluating quality which become important concepts in a TQM program, e.g., Dr. Deming's fourteen points of quality. Tolerance specifications (Chapter 3) are almost always involved in TQM problems dealing with a specific product. Quality mangement for production processes (Chapter 4) is a concept critical to implementing improvements as a result of a TQM team effort. Finally, parametric design (Chapter 5) is crucial to a Quality Improvement Team since metrics are needed when describing and baselining the process.

Dr. Taguchi's concepts, as related in the book, have particular applicability in the electronic packaging industry. As a multi-faceted technology, electronic packaging encompasses a wide range of manufacturing processes (assembly, inspection, cleaning, soldering, etc.). With progress constantly changing and expanding, electronic packaging certainly qualifies as a robust technology and should be so developed using Dr. Taguchi's guidelines.

This reviewer's final comment lauds Dr. Taguchi's emphasis on the influence of research on product quality and robust technology development: "The only way for companies to survive in the present era of rapidly changing technology is to make the change from product-orientated research to technology-oriented research."

The book is well suited to TQM students/instructors and should be a part of their library.

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