Taguchi on Robust Technology Development

ASME PRESS SERIES ON INTERNATIONAL ADVANCES IN DESIGN PRODUCTIVITY

Intelligent Engineering Systems Through Artificial Neural Networks, Volume 1, edited by Cihan H. Dagli, Soundar R. T. Kumara, and Yung C. Shin, 1991

Intelligent Engineering Systems Through Artificial Neural Networks, Volume 2, edited by Cihan H. Dagli, Laura I. Burke, and Yung C. Shin, 1992

Taguchi on Robust Technology Development: Bringing Quality Engineering Upstream, by Genichi Taguchi, 1993

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Bringing Quality Engineering Upstream

by Genichi Taguchi
translated by Shih-Chung Tsai

ASME Press ■ New York ■ 1993

Originally published as *Quality Engineering for Technology Development* in 1990 by the Central Japan Quality Control Association.

Library of Congress Cataloging-in-Publication Data

Taguchi, Gen'ichi, 1924–
Taguchi on robust technology development: bringing quality engineering upstream/ Genichi Taguchi; translated by Tsai, Shih-Chung.
p. cm.
Includes bibliographic references and index.
1. Taguchi methods (Quality control) I. Title

TS156.T342 1993
658.5'62 – dc20 92-30947
CIP

ISBN 0-7918-0028-8

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Editor's Note

This book defines and amplifies the emerging science now called *quality engineering*. Several companies (including AT&T, Xerox, Ford and ITT) have applied Dr. Taguchi's work in the various phases of product realization. Thousands of case studies are now available in industry that demonstrate the power of the Taguchi system of quality engineering. It is now clearly understood that quality cannot be inspected into a product or a process. In this important work, Dr. Taguchi demonstrates the applicability of his methods to the earliest phases of the design process. The reader will learn how to develop robust technologies. Since, generally, 80 percent of the cost of a product is determined by decisions made in the first 20 percent of the design process, it is important to build quality into technologies that will at some point be employed in new products. This implies a sequence of activities including identification of potential noise factors, control and tuning factors, and appropriate performance criteria, which can be used (through experimentation or simulation) to maximize the "functionability" of a new or traditional technology. This will allow development of high-quality, low-cost products in a timely fashion. In fact, the techniques presented offer the opportunity to make "time to market" an input rather than an outcome.

Kenneth M. Ragsdell

Translator's Note

Dr. Genichi Taguchi's off-line quality control is a very efficient tool for developing high-quality products at a low cost. The theme of off-line quality control is to design robust products that can withstand both downstream production and disturbances due to usage. It does not, however, attempt to control the sources of downstream disturbances; hence, it is much more cost efficient than traditional on-line quality control. In this book, Dr. Taguchi brings off-line quality control concepts upstream to the technology development stage.

The keynote of this new approach is to design robustness into a generic technology so that the new technology can perform its intended functions under realistic downstream production or usage conditions. After one generic technology is developed and matures, the accumulated technological know-how can be applied repetitively and flexibly to develop a range of new products. Thus, in today's quick-changing market, this approach will be more time and cost efficient in meeting various customers' needs. Consequently, the newly developed technology can increase both the productivity and profitability of a company by reducing development cost and time to market. In the next century, the capability of developing robust technology will be essential to the competitiveness of any manufacturing enterprise.

Shih-Chung Tsai

Dr. Shih-Chung Tsai specializes in quality engineering and Taguchi-type experimental design and is an instructor and consultant of experimental process using robust design in the Department of Engineering Processes at General Motors Corporation, Rochester Division.

Foreword

Since its introduction into the United States in 1980, Dr. Taguchi's system of quality engineering has been widely applied and broadly discussed. Implementation has suffered from the blind-men-and-the-elephant syndrome. Most people who have encountered this comprehensive system of quality engineering have grabbed on to some part of it and said, "Now I understand what this elephant is." Also, there have been contextual problems. Many researchers have complained that it does not seem similar to research, which is not surprising since it is intended for development and production, not research.

In this book Dr. Taguchi has set forth in simple, concise terms the full, comprehensive system and has clearly shown its role in developing and producing new products. Even more importantly, he has described the role of quality engineering in providing flexible technologies that will enable the rapid development of the product variety that is the new competitive playing field.

Dr. Taguchi's comprehensive system of quality engineering is one of the great engineering achievements of the twentieth century. This book will help communicate the full scope and context of this system to workers in product development and production. This book is required reading for the product people in any corporation that hopes to remain competitive.

Don Clausing

Preface

The term *Taguchi methods* was coined in the United States. It pertains to the evaluation and improvement of the robustness of products, tolerance specifications, the design of engineering management processes, and the evaluation of the economic loss caused by the functional variation of products. However, I prefer the term *quality engineering* instead. The purpose of this book is to explain just what quality engineering is.

In this high-tech generation, it is very important for any enterprise to develop robust technologies that can efficiently develop new products, refine current ones, and manufacture products flawlessly in terms of quality and cost. This book is written for administrators, managers, technology developers, and engineers of manufacturing enterprises to help meet this challenge. It also contains a general discussion about the productivity of manufacturing enterprises, which is equivalent to cost reduction and quality improvement at the following five manufacturing stages:

1. technology development
2. product planning
3. product design
4. design of the production process
5. management of the production process

In addition to an economic evaluation of the quality of products, I present several easy-to-understand examples to show managers and engineers how to develop technologies, design products, and invest in process design and process management more eco-

nomically and meaningfully than before. In the United States, economic evaluation of products is usually considered to be a management affair; however, I consider it a technical affair. The methods of applying the economic evaluation of products to engineering problems and improving the quality of products at low cost by parameter design are the major themes of this book.

This book can be used for a twelve-hour course on quality engineering. The exercises in each chapter illustrate how to solve different types of quality engineering problems that actually arise. For a one-day course (six or seven hours), engineers or technicians from manufacturing departments can refer to Chapters 1, 2, and 4; those from design departments may refer to Chapters 1, 3, and 5.

For a more basic treatment of the subject, I suggest the seven-volume *Quality Engineering*, particularly volumes 1 and 2 (Japanese editions are available from the Japanese Standard Association, and English editions will be published soon.). Finally, I hope that administrators, managers, and engineers of manufacturing enterprises understand the importance of technology development, product design, and process management after reading this book.

Genichi Taguchi