

COMPLETELY REVISED *AND* UPDATED

HANDBOOK OF INDUSTRIAL ENGINEERING

Technology and
Operations
Management

Third Edition

Edited by
GAVRIEL SALVENDY

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Purdue University



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FOREWORD

Many people speculated about what industrial engineering might look like in the 21st century, and now here we are. It is exciting to see how the profession's definition of the work center has broadened to embrace the information age and the global economy. Industrial engineers, with their ever-expanding toolbox, have a greater opportunity to help corporations be successful than ever before.

But while these changes and opportunities are exciting, they presented a challenge to the editor of this handbook. I met with Gavriel Salvendy as he began working to integrate all the thoughtful input he had received from his advisory committee, so I had a firsthand opportunity to observe the energy and creativity required to develop this content-rich edition. This handbook is truly an accomplishment, fully supporting industrial engineers engaged in traditional as well as new facets of the profession.

This edition has stepped up to this multidimensional challenge. The Technology section updates the previous edition, with coverage of topics such as decision support systems, but also delves into information-age topics such as electronic commerce. Look closer and you'll see that attention has been given to the growing services sector, including chapters covering specific application areas.

"Enterprise" has become a popular way to describe the total system and the broad organizational scope of problem-solving initiatives. I am pleased to see this addressed specifically through topics such as enterprise modeling and enterprise resource planning, as well as globally, as in the Management, Planning, Design, and Control section. This edition truly recognizes that IEs can and do contribute in every phase of the total product life cycle.

The mission of the Institute of Industrial Engineers is to support the professional growth of practicing industrial engineers. This third edition is an all-encompassing Handbook for the IE professional that rises to the task. Students, engineers of all types, and managers will find this a useful and insightful reference.

JOHN POWERS
Executive Director
Institute of Industrial Engineers

PREFACE

Industrial Engineering has evolved as a major engineering and management discipline, the effective utilization of which has contributed to our increased standard of living through increased productivity, quality of work and quality of services, and improvements in the working environments. The *Handbook of Industrial Engineering* provides timely and useful methodologies for achieving increased productivity and quality, competitiveness, globalization of business and for increasing the quality of working life in manufacturing and service industries. This Handbook should be of value to all industrial engineers and managers, whether they are in profit motivated operations or in other nonprofit fields of activity.

The first edition of the *Handbook of Industrial Engineering* was published in 1982. It has been translated into Japanese and published by the Japan Management Association; translated into Spanish and published by Editorial Lemusa; published in a special edition in Taiwan by Southeast Book Company; and translated into Chinese and published by Mechanical Industry Publisher; and adopted by the Macmillan book club. The Handbook was selected by the Association of American Publishers as the Best Professional and Scholarly Publication in 1982 and was widely distributed by the Institute of Industrial Engineers (IIE). The Foreword of the first edition of the Handbook was written by Donald C. Burnham, retired Chairman of Westinghouse Electric Corporation. In this Foreword Burnham wrote, "The Industrial Engineering principles that are outlines are timeless and basic and should prove useful to corporations, both large and small, both continuous process as well as discrete part manufacturing, and especially to those working in the service industries where most of the jobs are today." The second edition of the *Handbook of Industrial Engineering* maintained this thrust.

In the Foreword to the second edition, the former president of NEC Corporation wrote, "The Second Edition of the Handbook of Industrial Engineering will serve as an extremely powerful tool for both industrial engineers and managers." The many contributing authors came through magnificently. I thank them all most sincerely for agreeing so willingly to create this Handbook with me.

Each submitted chapter was carefully reviewed by experts in the field and myself. Much of the reviewing was done by the Advisory Board. In addition, the following individuals have kindly contributed to the review process: Stephan A. Konz, K. Ronald Laughery, Jack Posey, William B. Rouse, Kay M. Stanney, Mark Spearman, and Arnold L. Sweet.

For the third edition of this Handbook, 97 of the 102 chapters were completely revised and new sections added in project management (3 chapters), supply-chain management and logistics (7 chapters) and the number of chapters in

service systems increased from 2 to 11 chapters. The 102 chapters of this third edition of the handbook were authored by 176 professionals with diverse training and professional affiliations from around the world. The Handbook consists of 6441 manuscript pages, 922 figures, 388 tables, and 4139 references that are cited for further in-depth coverage of all aspects of industrial engineering.

The editing of the third edition of the Handbook was made possible through the brilliant, most able, and diligent work of Kim Gilbert, my administrative assistant, who so effectively coordinated and managed all aspects of the Handbook preparation. My sincere thanks and appreciation go to her. It was a true pleasure working on this project with Bob Argentieri, the John Wiley senior editor, who is the very best there is and was a truly outstanding facilitator and editor for this Handbook.

GAVRIEL SALVENDY

*West Lafayette, Indiana
September 2000*

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