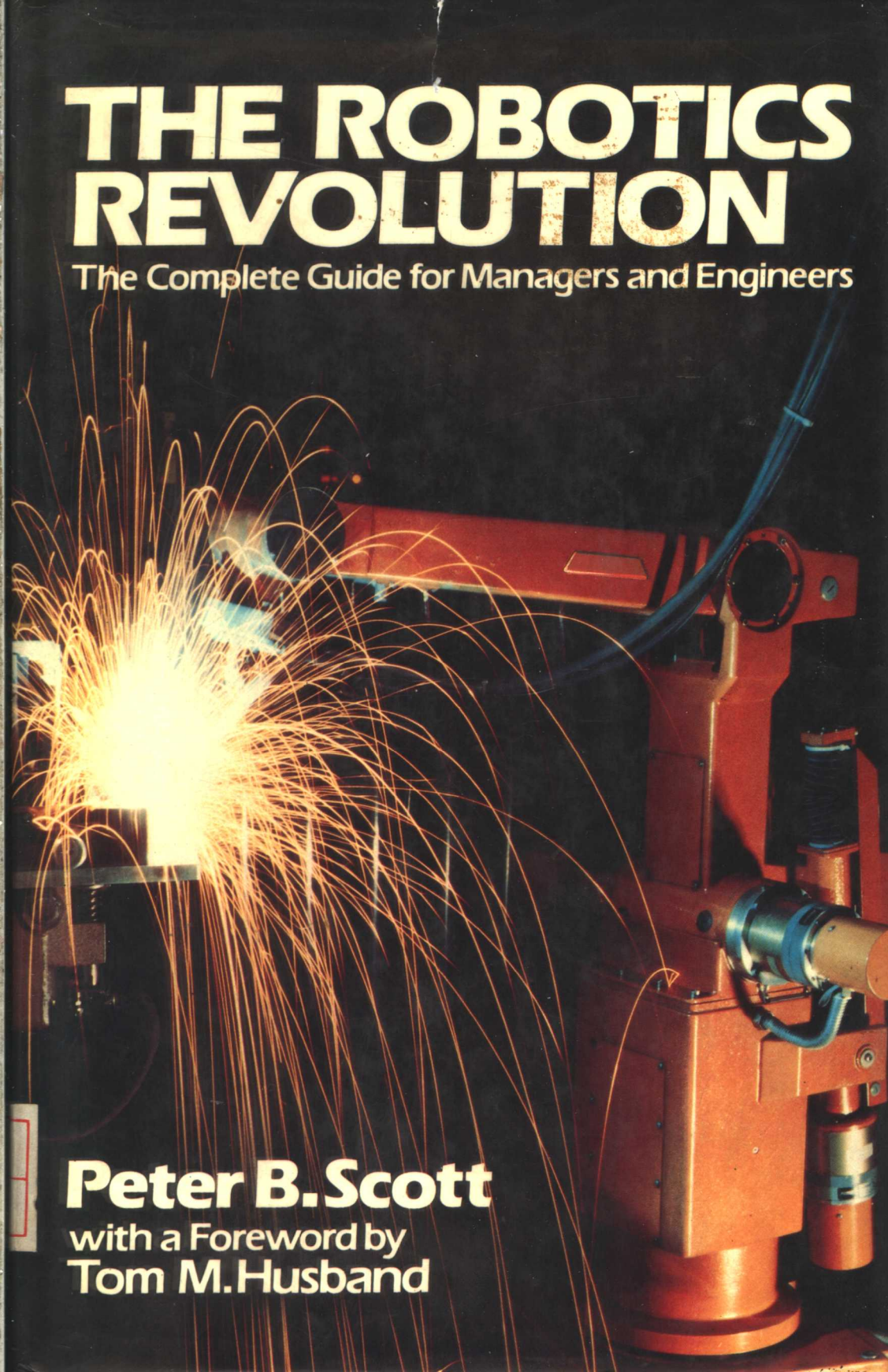


THE ROBOTICS REVOLUTION

The Complete Guide for Managers and Engineers



Peter B. Scott
with a Foreword by
Tom M. Husband

The Robotics Revolution

THE COMPLETE GUIDE FOR
MANAGERS AND ENGINEERS

Peter B. Scott

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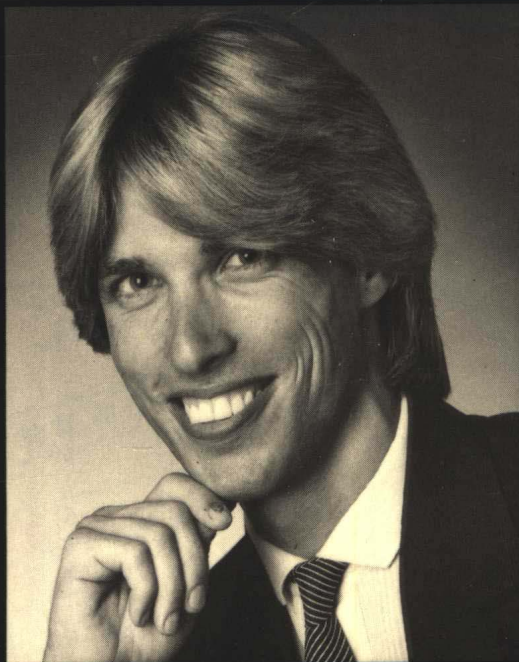
Peter B. Scott

with a foreword by Tom M. Husband

Long-predicted in science fiction, the robotics revolution is now hard technological fact. This book is the complete guide for everyone affected by the transformation of outmoded industrial processes now under way. Written clearly and with the non-specialist in mind, yet not fighting shy of technical detail and terminology, **The Robotics Revolution** addresses all aspects of the subject.

Areas covered include what robots actually are, how they have evolved, how they work and how they are programmed. How are they currently used in industry and what is their future? What are their limitations? Can modern industry afford them – or afford to be without them? And, just as important as their impact on industry, what will be their effect on employment and society at large?

The Robotics Revolution provides a comprehensive introduction to a subject of vital importance to all industrialised societies. For managers, engineers and students, technical and non-technical, this is essential reading.



Peter B. Scott is a roboticist at the Centre for Robotics and Automated Systems at the Imperial College of Science and Technology, University of London, and managing director of Ultratech Video, a high-technology-oriented video company.

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The Robotics Revolution

With sincere gratitude for
friends', relatives', and numerous
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FOREWORD

Tom M. Husband

As the title of this book proclaims, we truly are in the midst of a robotics revolution. The speed at which both software and hardware have developed is breathtaking. Robotics applications are about to change the face of many work (and non-work!) activities.

In the early 1970s industrial engineers grudgingly conceded that the shop floor robot might eventually be useful in simple materials handling work. Soon the role perceived for the robot included straightforward spray painting and spot welding. By the late 1970s the momentum of the emerging technology forced even the most conservative and sceptical engineers to review the horizon. They now accepted that the second and third generation industrial robots available in the 1980s and 1990s would have a significant role to play in inspection, assembly and many other established activities long associated with human skills of manual and mental dexterity.

The picture is possibly even more dramatic in non-industrial applications. The use of robotics technology in space exploration, in security work, in farming, in helping the disabled and in a host of other fields of activity is quickly gaining acceptance.

From a strictly technological viewpoint this revolution is fascinating. Robotics engineers have developed an impenetrable jargon, robot-user clubs are mushrooming, hobbyist magazines are flourishing. Yet the impact of the robotics revolution is much too important to be left solely to the technologists. It is essential that others resist the jargon (or at least the worst of it) and set about broad understanding of the limits of this particular technological revolution.

There is a special need for social scientists, trade union officials and senior managers to get to grips with robotics. The effects of introducing robotics into an organization are not well understood. There is no empirical 'case law' yet available. It is clear, however, that many traditional work and organizational relationships will be altered. Equally,

there are clear implications for skill displacement. From a strictly managerial perspective there is the question of assessing the cost-effectiveness of certain potential robotic applications.

For all of these reasons this book by Peter Scott is especially welcome. He tackles the subject on a broad front. The jargon is dealt with head-on. For readers who might flinch from such a confrontation he offers a convenient glossary at the end of the book. Questions of a social, economic and organisational nature are considered in an open and honest fashion.

It is often argued that robotics technology exemplifies all of the advanced technologies currently emerging in the developed world. Like information technology or biotechnology, robotics requires technical expertise on many fronts. It carries with it important social implications – relating particularly to employment levels; it implies major upheavals in the way we operate our organisations, the way we educate the younger members of our community, and re-train those in mid-career. It is a very persuasive argument.

Take the question of the breadth of technical expertise required. The robotics engineer needs a good understanding of mechanical, electrical, electronic, hydraulic and pneumatic engineering. He (or, increasingly, she) must also be conversant with appropriate software procedures. Yet we still do not train engineers in this fashion in the great majority of our universities. Robotics technology, like so many other technologies, call for *systems* engineers. Engineers in mid-career face particular difficulties in catching up, and keeping up, with developments across such broad frontiers.

This book is, I believe, the first to tackle these problems in the context of robotics. As the author points out, there are sections of the technical chapters which will seem simplistic to readers who are specialists in one particular field. Similarly, readers with a management background may be familiar with certain of the material on the economic aspects of robotics. It is very unlikely, however, that many readers will have been exposed to the breadth of material discussed in this book.

For this reason the book should prove particularly valuable for both student and professional courses, in addition to providing an ideal introduction and overview for all busy professionals who may come into contact with robotics, in however slight a fashion. Final year undergraduates in, for example, computing will find much of value in the chapters relating to mechanical and control engineering. Similarly, undergraduate mechanical engineers will derive benefit from Peter Scott's treatment of software and sensor technology. The book will surely also be of great use to teachers and students on the growing

number of specialist postgraduate courses in robotics and automation. For mid-career short courses the book offers a sound background text for a very wide range of mature students, whether managers or technologists.

At Imperial College we set up a Centre for Robotics and Automated Systems in 1981. We run postgraduate and short courses in robotics. We also pursue research and development activities involving robotic applications ranging from pork deboning to television assembly. In the course of our work we collaborate closely with engineers and managers from robot-maker and robot-user firms. We also supervise, naturally, young project students and research workers. In all of our dealings we meet a recurring problem. It is the need for a broad, basic, minimal awareness of the total technology of robotics. This includes an understanding of the economics and the social implications. Since 1981 we have regularly bemoaned the lack of a basic text which tackled the field in the necessary breadth.

I am delighted therefore that one of our own Centre colleagues has now produced the goods. I know this book will be invaluable to those we deal with at Imperial College. I am sure it will be equally useful to a very wide range of others in education, industry and elsewhere.

PREFACE

Of all the years to publish a book on robotics, 1984 must surely be the most theatrical! Yet the world we live in is, thank goodness, very different from that portrayed in Orwell's view of the future, and there is hope in that. I am essentially optimistic about the future of mankind and of the role robotics is to play in it, yet our options on both scores are far from settled.

As with any major discovery, robotics has potential for evil as well as good – indeed there are those who feel it is far from 'neutral'. Yet it must always be remembered that robotics is a *dynamic* discipline. It is, to a large extent, what we make it. Many have fears that robots may gradually take over the work of humans yet provide nothing to 'fill the vacuum'. But the field is not quite like a runaway train. If sufficient numbers wish to change its course it can be steered – as has been demonstrated by many government robotics initiatives throughout the world. Some roboticists, for example, suggest that enhancement of man (rather than his replacement as at present) is, in the long run to be preferred both economically and socially. Robotics will not decide on which course to take – people will. The responsibility for the robotic future is ours.

A decade ago I was studying science, and soon after, computing science. For fun, I learned everything that I could about robotics – even though I had been told that it was a 'a dead-end subject'! But times were changing, and in the nick of time great men like Joe Engelberger opened the world's eyes to robotics, so that I was able at last proudly to put ROBOTICIST on the sections of forms asking for 'occupation'! Suddenly I am living the science fiction of my youth.

It is pure luck to be paid to do one's hobby, but then to be asked to write a book on it, is a great privilege. I am extremely grateful to all those who have been involved at Blackwells, especially Tony Sweeney and René Olivieri who have helped me through the course. At Imperial College, many of my overworked colleagues have gone beyond the call of duty and actually read and commented on some of my draft chapters,

for which I give my sincere thanks – most of all to Tom Husband, friend and professor, without whose constant encouragement and practical support I could never have written the book. I am particularly indebted to him for being willing, despite his very heavy workload, to write a Foreword. Special mention must also go to Steve Bedley and all those others who so kindly sacrificed much time and peace of mind during the preparation of photographs and also to Francis Morgan, who provided such invaluable assistance during the preparation of the index. Finally, deepest thanks to my close friends and family who supported and helped me during the writing process – at the end of the day, however wonderful the robots, it is the *humans* who mean the most.

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