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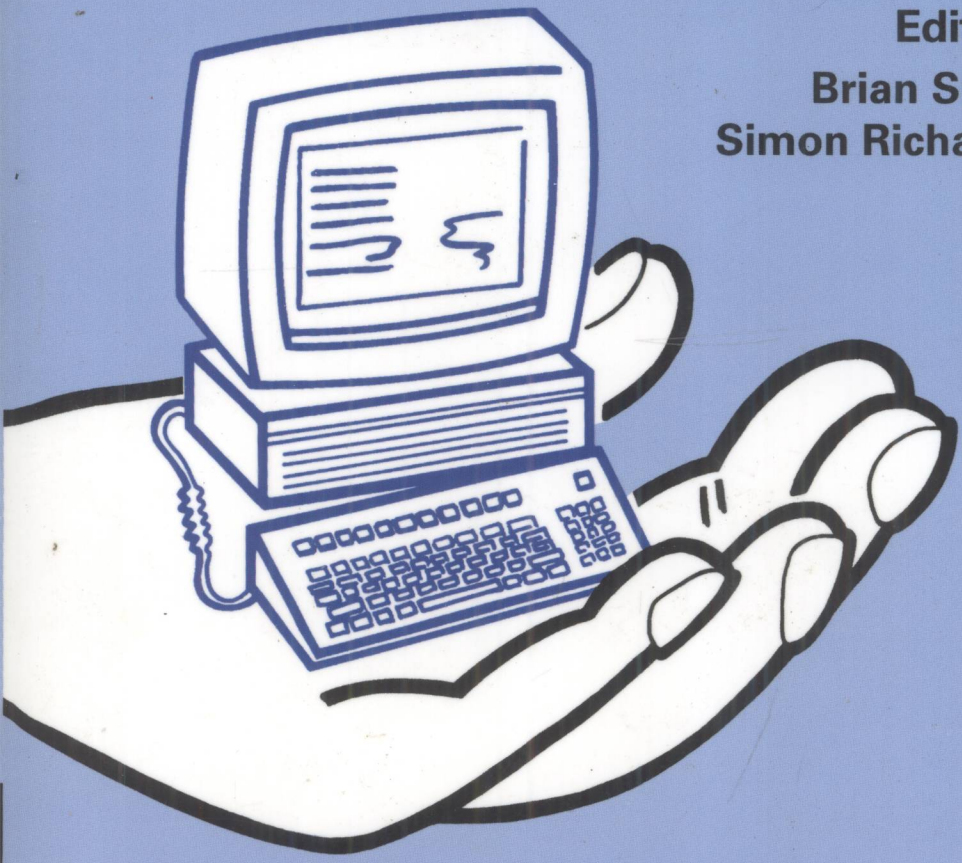
Human Factors for Informatics Usability

Edited by
Brian Shackel
Simon Richardson



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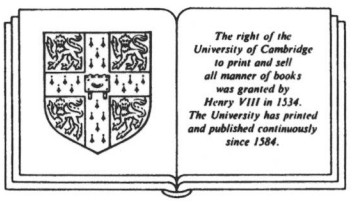

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PREFACE

For most ordinary users and even for some computer professionals the human-computer interface is still more of a space frontier and a time barrier than an open door to communication. As Sir John Fairclough (Chief Scientific Adviser to the UK Cabinet Office) has said, at the time when he was Chairman of the IBM UK Laboratories, "Human Factors is the Nº 1 issue today".

The computer and informatics industry is beginning to realise the need to change from the domination of technology-oriented goals to achieve balanced solutions truly proven to match the expectations, needs, capabilities and satisfaction of the users. The problem is that it is much harder to design for what real users really want. The aim of this book is to show how the knowledge and methods from the discipline of Ergonomics/Human Factors can help to improve Informatics Usability for real people.

The computer and now the informatics industry has grown amazingly during its first 35 years, without much formal attention to Human-Computer Interaction (HCI). Does it really need to be concerned about the user? The answer comes from some leaders of the industry itself. "People costs are already very much greater than machine costs for over 95% of the human-machine interactions. Actions to reduce the human costs and simplify the human interface to computers will have the greatest impact on growth".

So the industry is changing orientation, and may be expected to spend much more effort and resources on 'computer ergonomics' or 'computer human factors' to improve the usability, efficiency and quality of the HCI.

This book has been developed from the review papers presented by invited speakers at an Advanced Study Course held at Loughborough University 14–19 December 1986. The Course was sponsored by the European Science and Technology Research Committee of the Commission of the European Communities

(CREST) and by the Science and Engineering Research Council (SERC) of the United Kingdom. It had three objectives:

1. to review the knowledge and methods available from the field of human factors to help improve the usability of informatics systems;
2. to present recent theoretical and methodological developments in this field; and
3. to stimulate increased application of this knowledge and these methods and developments.

On completion of the course, students were expected to have gained an advanced overview of the theory and practice presented and to be able to start applying at least some of the knowledge gained.

To achieve these objectives some of the leading international authorities on human factors presented review papers, attended panel sessions, provided demonstrations and answered the many questions one would expect from advanced academic, industrial and commercial students. The speakers presented a rich and stimulating mixture of research and practice, built up from many years of experience in this complex field.

All the chapters in this volume are based upon their contributions, but they have been substantially revised and expanded to present a comprehensive review. They have been grouped together in five parts, as indicated in the list of contents, and the scope of the book is outlined in the latter part of Chapter 1.

The material in this book is as timely today as when presented; it is not out of date. Indeed in many respects it is more timely, because the industry is now recognising the need to heed the users. Computer designers are becoming receptive to the importance of the human factors aspects. I am very grateful to the contributors for their tolerance of the interchanges and delays inherent in editing and revision, including delays due to my eye operations, and I wish to thank them for their forebearance and above all for the quality of their contributions.

This book is not intended primarily for professionals or experts in human factors or human-computer interaction, although they may well find substantial new material here. Its principal target audience comprises the very many designers, software and hardware engineers, system design managers, management services managers and user managers who are now becoming aware of the importance of usability. The book is intended to provide for them not only a comprehensive introduction and a thorough overview but also some substantial first guidance about what they can do and how they can approach the problems of informatics usability.

The book is also intended to serve as an introductory text for postgraduate conversion courses and for undergraduate courses in computing and information

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technology, and for short advanced courses in informatics. Many courses are now being developed and established; this overview and primer on usability and human-computer interaction should provide a good foundation for them. Further, it will serve its purpose even more fully if it helps not only to structure and stimulate this field of research and application but also to increase the interaction between readers and writers. The addresses of all the contributors are given in the next section. The intensity of involvement of all at the course and subsequently during editing has been such that probably every author will welcome communication from any reader.

Looking to the immediate future of HCI, it seems likely that there will be considerable development in two distinct directions. In research and system development, the study of new HCI possibilities will probably accelerate, in such areas for example as speech systems, natural language systems and storage structures using different approaches. In application and system design, there will probably be a marked growth of attention to formal methods of designing for human use. Some research will also be needed to improve and generalise these methods, particularly the approach of user-centred design; but in the main the concentration needs to be upon disseminating and applying the knowledge and techniques already available from the human sciences.

It will be evident to the reader, from the way in which different chapters deal with different issues from different orientations, that the subject of HCI is still developing, with much to be done and with many interesting challenges. For the researcher, in both computing and human sciences there is still much to learn about people and the possibilities which computer technology may bring for human development. For the computer professional and designer, the challenge is to learn new skills and facts about people, to accept new methods and advisers, and especially to work with users. As a result, computers and informatics systems with good usability may gradually evolve to a new status as useful, symbiotic, servants and partners of society.

Brian Shackel
Quorn, June 1990.

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We should also mention, by name, Denise and Cliff McKnight, Linda Deal and Helen Savage for their part in production and Cambridge University Press for their patience and guidance.

Finally, a special thanks to our partners, friends and close colleagues for their unquestioning tolerance and support, without whose aid we might still be writing.

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CONTENTS

CHAPTER ONE

HUMAN FACTORS FOR INFORMATICS USABILITY — BACKGROUND AND OVERVIEW

BRIAN SHACKEL AND SIMON RICHARDSON

1. Introduction

The purpose of this chapter is to provide the general background and context for human factors and usability, to present a brief historical outline, and to give an overview of the contents of the book.

Informatics usability is one of the major technical areas within the field of Human-Computer Interaction (HCI). HCI deals with all aspects of the human use of computers, usually in the context of interactive Informatics systems. Informatics is used in this book as equivalent to the term Information Technology, and both terms will often be abbreviated as IT.

Human-Computer Interaction (HCI) is a major part of the larger subject termed Human-System Interaction (HSI) and HSI is a large part of the applied side of the discipline known as Ergonomics or Human Factors — see Figure 1.

So Human Factors for Informatics Usability involves a consideration of all the possible contributions which could be made from anywhere in the discipline of Human Factors (HF) to improve the usability of IT systems. Further, since Informatics Usability is obviously an inter-disciplinary applied field, a proper treatment of this subject must include reference to and relevant inputs from the closely related areas such as software system design and cognitive psychology. Therefore, the contents of this book range from computer-human interface design to organisational issues, from formal models in HCI and designing expert systems to the contributions of cognitive psychology, and from HF strategy and the design process to evaluating usability.

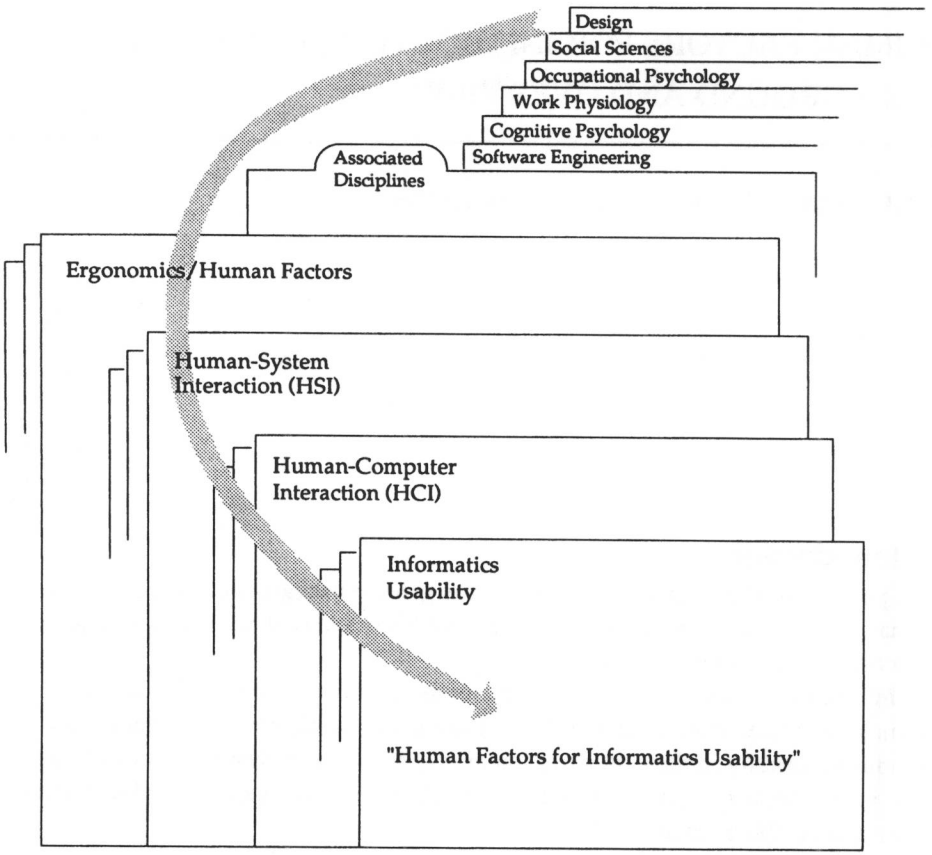

Figure 1: The context of this book and the associated disciplines.

To present the background and overview, we shall proceed from the general to the particular. So, the growth of Ergonomics/Human Factors will first be summarised; then Human-System Interaction (HSI) and the growth of Human-Computer Interaction (HCI) will be outlined; the importance of Human Factors and Usability will next be discussed; and finally the scope and contents of this book will be reviewed.

1.1 *The growth of Ergonomics/Human Factors*

In Great Britain, what is now called ergonomics had its beginning in the scientific study of human problems in ordnance factories during World War 1. This kind of work continued under the Industrial Health Research Board between the wars.

World War 2 led to greater emphasis not merely on matching men to machines by selection and training, but also, much more than previously, to the designing of equipment so that its operation was within the capacities of most normal people. This fitting the job to the man increased considerably the collaboration of engineers in certain fields with the biological scientists. This collaboration, beginning primarily with military problems, because it was there particularly that operators were pushed to their limits, continued after the war and led to the formation in 1949 of the Ergonomics Research Society.

Similar developments occurred in other countries, leading in the USA to the formation of the Human Factors Society in 1954. On the international scene, the formation meeting which accepted the first constitution and rules of the International Ergonomics Association was held during the Annual Conference of the Ergonomics Research Society in Oxford in 1959; the first international conference of the IEA was held in Stockholm in 1961. The IEA now has 16 member societies in nations around the world.

1.2 *Ergonomics/Human Factors — scope and definition*

The principal purpose or philosophy of Ergonomics is not primarily to improve productivity or output or human methods of doing work; these are quite properly the main aims of other disciplines. The prime purpose of Ergonomics is to study and understand the situation of people at work and play, and thus to be able to improve the whole situation for the people. Of course this knowledge may also be used to assist with productivity, and at times managers may need to be persuaded to use Ergonomics by the expectation of some such benefit, but the main thrust of Ergonomics remains always user-centred.

Therefore, Ergonomics is defined as the study of the relation between man and his occupation, equipment and environment, and particularly the application of anatomical, physiological and psychological knowledge to the problems arising therefrom. This definition is in two parts and clearly describes both a science and a technology.

Thus, the scope of work in Ergonomics must clearly embrace both research and practical application. Research is essential to increase our knowledge about how people behave in total situations, how they are similar to and different from engineering components, and how they respond to and are influenced by their task and environment.

In the study and treatment of practical situations, Ergonomics (or Human Factors — the equivalent name used in the USA) places major emphasis upon efficiency in the operation of the equipment as measured by the human performance of actual users. Allied with efficiency are the safety, comfort and

satisfaction of the operator. Because the aim is to optimise the human-machine and human-environment combinations by improving the system and the environment, this aspect has also been termed 'Fitting the System to the User'. Equally important are the personnel factors such as selection, training, and adaptation to environmental and working conditions. These are studied both as part of ergonomics and as separate topics under the headings of Work Physiology and Occupational Psychology. From this knowledge people can be helped to alter themselves, within limits, to improve the human-machine partnership; this personnel aspect has also been termed 'Fitting the User to the System'.

1.3 *Why is Ergonomics/Human Factors essential?*

There are three basic reasons why Ergonomics is essential for modern industry, especially in relation to product and system design.

First the complexity and sophistication of modern industrial technology sets continually higher demands upon the human operatives and controllers; but complexity also causes designers to need too long a training and to be too busy with technical problems either to deal with the human factors properly or to learn enough about how to deal with them.

Second, there is a time and space barrier. The complexity of modern technology also separates designer and user, and thus usually prevents effective feedback from the user to improve the design. Therefore the ergonomist is an essential link who operates as a sort of preventive and predictive feedback channel.

Third, there is the separation of responsibilities and of the cost consequences. A further problem which follows from the complexity is that often the designer, manufacturer/marketer, buyer and user are separate. They may well be in separate organisations and certainly will have separate aims and criteria. The designer (and engineer) will aim for a good machine solution, and will expect to spend all his budget costs on technical machine factors; the manufacturer/marketer will aim to cut the capital cost (but not necessarily the running costs); the buyer will aim to pay a low price and will expect savings to come from the purchase (perhaps by staff reductions); the user will aim to minimise his personal loss (of skill, earnings, etc.) due to the new machine or method of working. Therefore, the separation between them may often cause each of these four people not to use ergonomics, because they cannot see the cost justification within their own cost limits. Only the manager in charge of the user sees the final result, where the true cost of the extra training, and of the inefficiency and losses if the design is not ergonomic, can exceed any savings in purchase cost.

Because each sector of responsibility is separate, as noted above, the cost-benefit evaluation of ergonomics can often be difficult to prove (but for references and

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