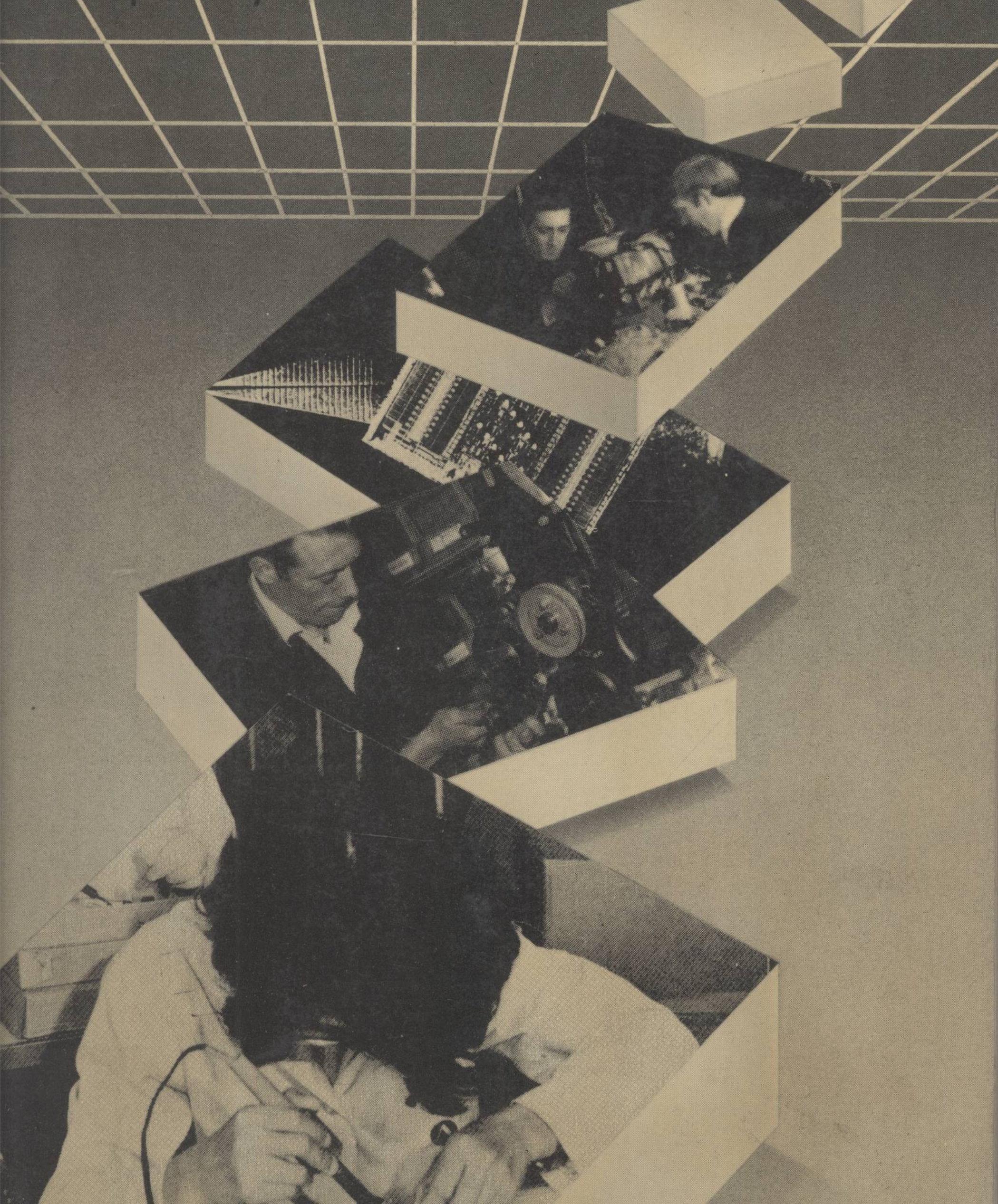
UTOMATION

chnology and society

ael Kaplinsky



Automation

the technology and society

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Preface

The issue of automation has been a matter of continuing debate throughout the post-war period. But in spite of this, as many authors have pointed out, the discussion has remained a very ill-structured and disorganised debate. In Chapter 2 Raphael Kaplinsky indicates some of the reasons for the lack of clarity in the debate, including the lack of agreement about definitions. One of the great merits of his book is that it provides a systematic and coherent framework within which to discuss the subject.

In his earlier work on computer-aided design Kaplinsky already made a substantial contribution to our understanding of automation. He has now extended this to cover three main spheres: design, manufacturing and coordination (Chapters 3 to 5). His distinction between 'intra-sphere' and 'inter-sphere' types of automation in these three sectors is particularly valuable, and enables the reader to grasp the full significance of inter-sphere automation, as well as some of the reasons for the apparently slow take-off of full-scale totally automated systems in the enterprise as a whole. His discussion in Chapter 6 of the technological, economic and social barriers hindering the introduction of this final stage of integrated automation seems realistic, although perhaps still somewhat underestimating the problems of divisive group interests and of management subcultures even in the more successful enterprises of Japan and Western Germany.

Another great merit of Kaplinsky's book is his resolutely historical approach. This helps a great deal to resolve some of the paradoxes, which are otherwise very hard to understand. It has enormous advantages over much of the technical and systems literature which abstracts completely from this historical context of automation. Without a sense of history, the diffusion of automation technology usually appears unaccountably slow, since its technical advantages have been clearly apparent to the professionals in the business for three decades.

The early pioneers of computerized automation, such as Wiener and Diebold, envisaged most of the contemporary developments in the 'automated factory', the 'electronic office', computer-aided design and management systems, as well as 'intra-sphere' automation. However they greatly overrated the speed of this vast social transformation, and of its employment effects.

They failed to take adequate account of the time-scale of investment and training required to build up an entirely new electronic capital goods industry, a huge components industry and a software supply system. They failed also to have sufficient regard for the problem of comparative costs and profitability of automation in relation to alternative investments. Even today, when the microprocessor revolution has vastly reduced the costs of automation in many areas of potential application, and when there has been an enormous expansion of the education and training programmes for computer scientists, technologists, technicians and programmes, there are still major bottlenecks and delays associated with shortage of skilled people and of capital.

Even now, as Kaplinsky shows, the full-scale automation of most manufacturing and service activities has only just begun. By his full recognition of the long-term factors involved in the diffusion of a major new technological system, he avoids some of the pitfalls which have attended much of the discussion on the employment effects of automation. The fears of mass unemployment associated with automation, which were widespread in the 1950s and 1960s, proved to be ill-founded at that time, but as Kaplinsky points out in Chapter 1 and in his more detailed discussion in Chapter 8, the economic context in which automation is now diffusing is very different from the post-war boom. Paul Einzig, who in his book on *The Economic Consequences of Automation* in 1957 justifiably criticized many of the simplistic arguments about automation leading rapidly and inexorably to mass unemployment, nevertheless commented:

> Although fears that automation is liable to lead to slump through over-investment are unfounded, there can be no doubt that, if deflation should develop through no matter what causes, automation would greatly exaggerate any downward trend in purchasing power, prices and employment. Just as under inflationary conditions it strengthens the influences making for a boom, under deflationary conditions it would be used for reducing the number of employees. . . . Once the slump is followed by chronic depression, automation would resume its course, almost entirely with the object of reducing costs of production. (p117–118).

Deep depressions, such as those of the 1930s and 1980s, may be seen as periods when the mismatch between social institutions and the potential of revolutionary new technologies is particularly evident. There is no deterministic solution to these problems today, any more than there was in the 1930s. But whatever political and social solutions are attempted in the 1980s and 1990s they will have to take into account both the technological and social issues identified by Kaplinsky. It would in principle be quite possible to use automation technologies to reinforce the tendencies towards deskilling of the labour force, sophisticated supervision by 'Big Brother' techniques of every second of the working day and a high degree of authoritarian centralization. But it would also be possible to achieve the opposite solution of 'automation with a human face'.

Full recognition of the social, economic and behavioural factors affecting automation is one of the greatest strengths of Kaplinsky's analysis, whether with respect to overall employment effects, skill effects, or the international division of labour. It is a book which is essential reading for anyone wishing to understand the interplay of social and technological factors. It is especially important for its recognition of the element of social choice in shaping the new technologies and mode of application.

The book does not discuss the automation of distribution, warehousing and transport. Nor does it discuss the automation of tertiary activities, such as financial services and social services. I very much hope that he will follow his first two books with others which take up these questions. But meanwhile as an analysis of contemporary trends in the automation of manufacturing enterprises this is a first-rate original contribution.

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Introduction

This book has a number of objectives and aims to operate at a number of levels, combining detailed analysis with broader overview, and technical discussion with social comment. It is divided into three parts. In the first part the historical link between the diffusion of automation technologies and the progress of economies is discussed. Whilst it is true that our understanding of the concept of automation is in some senses in a state of crisis (given the widely varying interpretations of the term) the 'crisis' referred to in the first chapter of this book is of a different form. What I have tried to show is that the often cited effect that the diffusion of automation technology creates economic crisis by displacing labour turns real events on their head. What is in fact happening is that the emergence of economic recession and depression in the late 1970s and early 1980s has occurred for autonomous reasons, having to do with the internal workings of our system of economic organization. The consequence has been a sharp rise in competitive pressures and a decline in profit rates. A large number of firms are responding to these circumstances by adopting the new automation technologies which are based upon maturing electronics technologies. Thus automation is considered as arising out of economic crisis, rather than causing it.

Part Two is more technical in content. It is based upon a review of the automation literature which has hitherto largely concerned itself with automation within manufacturing proper. Almost no attempt has been made to link this discussion with emerging automation technologies in design and in the office. Not only is this a serious omission in terms of coverage of technological trends, but it obscures what is probably likely to be the most significant technological-cum-organizational development of the last two decades of the twentieth century. Namely, when digital-logic control systems in individual activities in each of the three spheres of production (that is manufacture, design and coordination) are linked together, the primary benefit realized by successful innovators is systems-gains. It is this fact which is forcing the restructuring of major transnational corporations such as General Electric, Westinghouse, IBM and AT and T and leading to the development of the 'factory of the future'.

In Part Three we assess the 'impact' of the new automation technologies on society. We see how its introduction is associated with an increasing concentration of capital, a destruction of craft skills and displacement of labour, and a whittling away of Third World comparative advantage based on low-labour costs. All this leads to the question 'Is the technology to blame?'. Thus in the concluding chapter we consider whether these negative impacts have in some sense been inevitable, or whether they have reflected the types of social organization within which they have been introduced. If it is the former then our social concern must surely lie in limiting the diffusion of the new automation technologies. But if it is the latter then our concern is better placed in challenging the social environment in which the technology is being developed and diffused.

In convering such a wide territory I have inevitably been forced to consider a broad range of literature, drawing from economics, engineering, sociology, management theory and Marxian political-economy. The disadvantage of this is that in many cases readers are confronted with a 'strange' set of literature which seems too technical for their specific needs or interests. However, I hope that this is outweighed by the fact that readers will be exposed to ideas that do not normally confront them. Thus, for example, engineers will be forced to question whether the particular techniques they are involved with are inevitable, or for the public 'good'; economists will realize that technical progress is not 'manna' from heaven but requires intensive firm-level development; and that sociologists will be exposed to the relationship between social relations and technology, rather than merely focusing upon the social impact of technology. The overwhelming influence of the military imperative in the development of automation technologies over the years continues to send a chill down my spine; I hope I have conveyed this concern to my readers.

In writing this book I have benefited from the help of many people. My primary intellectual debt is owed to Chris Freeman whose work on the importance of electronics has stimulated me constantly over the past five years. Ian Miles and Hubert Schmitz were particularly helpful in their detailed commentary on earlier drafts. I also benefited from comments from John Bessant, Brian Easlea, Tom Husband, Kurt Hoffman and John Irvine and from the many people in industry who have helped me over the years and given me access to their plants and time. I am also grateful to Karen Brewer and Karen Sage who willingly typed and retyped the various drafts. Finally my primary thanks are due, as always, to my family for continuing to put up with my drafting difficulties, and in particular to my wife, to whom I have dedicated this book.

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Understanding Automation

CHAPTER ONE

Crisis and Automation

What makes one of the world's five largest industrial companies change its corporate strategy, moving away from an historic emphasis on consumer products, nuclear power plants and jet engines to provide the 'factory of the future' for American and European industry?

Consider the case of General Electric (GE), the largest engineering company in the world. With its subsidiaries producing a wide spectrum of products, ranging from coal to domestic refrigerators, jet engines, nuclear power plant and numerical controls, GE had a turnover of over $27 billion in 1981 and employed over 400,000 people worldwide. Its profits in that year were $1.5 billion, despite the expenditure of over $1 billion on research and development. Yet this appearance of success was not enough to satisfy the new management which took over in spring 1981. Careful examination of the company's performance had revealed three major problems which seemed likely to confront GE in the 1980s. First, nuclear power plant orders were declining for a variety of reasons (for example declining growth rates for electricity demand, increasing environmental concern and technical problems), and what had earlier seemed to be a major sector of potential growth now looked more uncertain. Second, failure to keep pace with new technology in the traditional consumer products division – notably in the use of electronic controls to be incorporated in the final product, and in the installation of automated plant to cut costs and improve product quality – suggested that unless something was done quickly, GE would soon lose its dominance of the US market. The fact that the consumer products division contributed 22 per cent of GE's total profits, whilst only accounting for around 16 per cent of total sales, lent urgency to the need to upgrade the division's competitiveness. And third, even in the higher technology divisions, GE had displayed a tendency to rest on its technological laurels and was feeling the effects in final markets. For example, in the US machine tool numerical controls market, traditionally dominated by GE, a Japanese-German joint venture captured 15 per cent of the market in its first five years and aimed for a 25 per cent share within the next five. These advances were almost entirely due to its prowess in taking advantage of the potential offered by advanced electronics-based technologies.

Faced with this bleak outlook on the future, GE has instituted a major change in corporate strategy. Rallying behind the call 'automate, emigrate or evaporate', GE is aiming at the 'factory of the future'. In part this involves the installation of automated production plant in its own manufacturing operations, but more significantly GE is aiming to become the major US supplier of automated 'factories of the future' which it believes will need to be installed in the 1980s if the US economy is to survive competitive pressures. Amongst other steps, this strategy has involved the following key acquisitions:

– purchasing the third largest computer-aided design supplier (Calma) for $170 million in 1981, ten times the price paid two years earlier by its owners;
– acquiring a major manufacturer of metal-oxide integrated circuits, Intersil, for $235 million; these particular types of components are especially well-suited to harsh factory environments, and hence for automation equipment. (In the early 1970s GE had actually disposed of its electronic subsidy);
– developing its own manufacture of industrial robots initially through technology licences from foreign firms such as Volkswagen and Hitachi; GE is aiming for 20 per cent of the US robot market by 1986 and for 30 per cent by 1990;
– beefing up its sagging numerical controls and industrial controls divisions by investing over $100 million and establishing a Microelectronics Research Centre at an additional cost of over $50 million;
– through an acquisition of 48 per cent of the equity in Structural Dynamics Research Corp (SDRC), GE will establish a series of productivity centres throughout North America and Europe. These will offer the combined service of GE subsidiaries in helping downstream user-industries to capitalize on the potential offered by new automated equipment;
– acquiring a number of smaller computer service bureaux for over $100 million, to make GE's own subsidiary GEISCO, the largest computer service firm in the world;
– selling off subsidiaries in other areas. The Australian coalmining offshoot was sold for $2.4 billion and the air-conditioning subsidiary for $135 million.

This radical change in structure in which GE's 'strategy is to become the number one integrator of factory automation and the number one solution producer' represents an extreme reaction to the changing economic climate of recent years, and cost the company upward of $700 million in acquisitions and $2 billion in automating its own plants. But it is not unique and many of GE's competitors, in the US as well as Europe and Japan, are making similar decisions. Westinghouse, for example, another large US engineering firm, describes its new strategy as covering 'the entire spectrum of factory automation and includes: processing information through computer-aided design, computer-aided manufacturing and computer-aided testing; productive machinery including robots, machine tools and material handling equipment; and the communication links that connect these islands of automation.' IBM, too, with its recent introduction of microcomputers and industrial robots (made actually to Japanese designs) clearly shares a similar perception of future strategy.

But why this major change in strategy, concentrated as it is into such a short