Preface

For over a century now there has been an increase in the scale of those industrial, scientific and technical activities which are generally known as "Research and Development" or, more accurately, as "Research and Experimental Development". Starting in universities and scientific societies in the Middle Ages, scientific research is now a driving force of economic growth and international competition all over the world. It was the German chemical industry and the American electrical industry which first realised the possibility, that by organising their own "in-house" scientific research and development they could gain a big competitive advantage by winning new markets with new products and new processes.

Following the early successes of these industries, most large firms in all the industrialised countries now organise their own "R&D", and this mode of technological competition is now spreading from the manufacturing industries to the service industries as these branches of the economy now develop their own software for service innovations.

As the professional R&D department became a regular feature of the industrial landscape in the inter-war period, there was increasing interest in the possibility of measuring these activities. It was obvious that there were wide variations in the scale of commitment of different firms, industries and countries to R&D, and managers, scientists, engineers and economists were all interested in the comparative performance of more or less "research-intensive" firms or industries.

The first surveys were made by industrial federations and by independent university-based scientists such as Huxley and Bernal. But these early estimates suffered from a lack of standard definitions and from low response rates, so that they generally underestimated R&D activities, particularly the "D" part of "R&D".

It was not until after the Second World War that the US government (through the National Science Foundation) began its first regular surveys of R&D using definitions which were largely adopted by most other OECD countries as they followed the US lead in the 1950s and 1960s. The OECD standardised these definitions in the 1960s in the so-called "Frascati Manual", named after a Conference at Frascati in 1963 which was convened by Yvan Fabian, who had just been appointed to the OECD staff to head up the work on science and technology statistics.

It proved to be an excellent appointment. From the start until his untimely death in 1985, Yvan Fabian devoted himself wholeheartedly to improving the accuracy, scope, timeliness and comparability of these rather specialised but very important statistics. He was extraordinarily helpful and considerate to all those people throughout the OECD area (and outside it) who were starting up surveys for the first time, or trying to introduce new types of statistics or improve the system. This was perhaps his most admirable quality and made his group a centre of research and new ideas and not just a routine statistics collection operation.

From the very beginning in 1963 at the first Frascati Conference, Yvan Fabian recognised that the official R&D statistics were only the first step. He was more aware than anyone else of their limitations and understood the importance of other scientific and managerial activities in bringing about technical innovations. Most important of all, he knew perfectly well that R&D expenditures and personnel statistics were only measures of *inputs* and that it was the measurement of *outputs* which was the real challenge.

For this reason he insisted on including a section on output measurement even in the first Frascati Manual, which proclaimed the objective of output measurement, even though this was thought by many to be an impossible goal. Over the next 20 years Yvan seized every opportunity to promote the attainment of his goal. Recognising that it was not possible for an international organisation to take the initiative directly, he nevertheless did everything possible to encourage researchers in universities to experiment with in-

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novative ideas and also stimulated governments and industrial organisations to take new initiatives. As important steps in this prolonged campaign he organised a series of international seminars in the 1980s, where the results of work in progress were presented.

As a result of two decades of research and experiment, much progress has been made in the use of a variety of "output" measures, especially patent statistics, bibliometric and citation analysis, and numbers of innovations and their diffusion. The papers published in this book are a representative set of the results of empirical research in all these fields. It is for the reader to judge how far the authors have succeeded in using "output" statistics to illuminate their comparisons between firms and countries and to analyse various problems in science policy and the management of R&D. The papers were first published as a special triple issue of the journal *Research Policy* in 1987 in honor of Yvan Fabian. I am certain that he would have been delighted with the original publication and happy to see the papers made available to a wider audience in book form. I know too that, like me, he would have hoped that this publication would stimulate further efforts to improve these statistics and to establish them on a regular national and international basis.

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