Hans-Jörg Bullinger (Editor)

Technology Guide

Principles – Applications – Trends

With 1092 illustrations and 37 tables

Springer

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Foreword

"Everything that can be invented has been invented," declared Charles H. Duell, commissioner of the US patent office, in 1899. As we all well know, this was a grand misconception, seeing that Albert Einstein only a few years later heralded the beginning of a century of revolutionary discoveries. These precipitated such fundamentally important innovations as the computer, the electron tube, the laser and the microchip, which have in turn initiated an abundance of other inventions. Today we are once again at the forefront of profound structural change, as we move from the industrial towards a knowledge society. Driven by new technologies, this change is characterized by a tendency to treat information as a product and knowledge as a strategic commodity. The Internet now serves as the catalyst that gives information global reach on a massive scale, linking media and communication systems into an ever more finely interwoven and efficient network. Mobile devices have set the stage for an unlimited exchange of data, independent of time and place. In much the same way, biological technologies have broken ground beyond the health and food sectors, gaining an ever greater foothold in the production of materials.

Although it has grown rapidly in volume and complexity, information on new technologies is now essentially available to everyone, thus doing away with the long-held assumption that such knowledge remains the preserve of experts. Which begs the question, then, of whether it is still appropriate nowadays to compile information on new technologies in a book? We believe so – more than ever before, in fact. In our opinion, the decisive factor is not the medium by which content is presented – i.e. in a book or in electronic form – but the fact that this technology guide competently und comprehensively reports on up-to-date technologies on a consistent level, with clear cross-references between the technologies. It is important to maintain a clear overview. What we most urgently need in today's age of unmanageable quantities of information is orientation and reliable selection. Information can only become retainable knowledge if it is presented to the user in such a way that it can be recognised as new and relevant, and can also be readily understood. But only rarely is it available in the desired condensed form presented here.

What alternative could better serve the inquisitive mind than that which has stood the test of centuries? We turn to experts we can trust. Just like a theatre-goer might browse a playbill or a tourist consult a guidebook, everyone who now works with technology, or takes an interest in it, can refer to this technology guide. It is neither a conventional encyclopedia, nor a study of the future, offering visionary scenarios of tomorrow's world. Numerous publications already fulfill that description. The technology guide is more a work of reference that also makes a good read. It equips voyagers into the future with all the information they need, helping them navigate through current technologies, illustrating their applications, and signposting new trends that give readers a bearing on where we are going.

The book intends to inspire readers, to peek their curiosity as they browse through the pages. In discussions about the development of Fraunhofer's technology portfolio, we have learned that communication between researchers of different disciplines is facilitated by their having an up-to-date overview of the latest technologies. Tabling the latest topics and trends inevitably furthers the development of constructive new ideas and discussions of where these might be interlinked. Suitable platforms need to be created to promote understanding in dialogue between different specialists. Nowadays, innovations mainly emerge wherever knowledge is pooled in an unusual way, i.e. at the interfaces between disciplines and fields of expertise. The philosopher Jürgen Mittelstrass introduced the term "transdisciplinarity" in order to stress how formative the problem-oriented approach has become in overriding an adherence to thinking in disciplines.

In order to stimulate and accelerate the process of transdisciplinary collaboration, it is necessary to structure the wide variety of technologies and their applications in a form that helps inquirers get their bearings. Our science system has become worryingly unclear and confusing. Since we, the publishers of this guide, are unwilling to resign to this complexity, we risk an attempt here at multi-dimensional integration. The material has been grouped into four essentially discipline-oriented cross-section technology categories (materials, electronics/photonics, information and

communication technologies, and biological technologies) and into nine chapters covering application-oriented technologies such as mobility or health. Although the contents of the cross-sectional and application-oriented technology fields in this book sometimes overlap, they are presented from a different perspective and with a different focus in each case. Our method of grouping together 13 topic areas covering 100 subjects is only one of many possibilities for structuring the available material, but – in our opinion – a very logical one.

However, anyone who picks out their specialist topic in the technology guide expecting to find something completely new has misjudged the intention of the book. Naturally, they will miss several things that they themselves would have considered essential, or at least worth mentioning. Nevertheless, each specialist article provides even experts with an overview of their own technological domains – and each and every reader is invited on this basis to judge the fundamental quality of this book. The need to present all relevant current technologies correspondingly forced us to condense the material. It was more important to us to clearly portray several prominent aspects of each topic in the limited space available – in such a way that readers can grasp the technical principles behind them and retain an understanding of them in the long term. A complete representation of each specialist area on just a few pages would only have led to a tandem sequence of technical terms on a very abstract level, throwing up more questions than answers. It was not easy for the authors to find a stable middle ground between broad-band superficiality and narrow-lane expertise, and to separate the blurred technology fields into clean-cut, easily digestible chunks. The Internet references provided offer a deeper insight into each topic.

The technology guide makes a particularly exciting read if readers let themselves be guided to areas that lie beyond the knowledge horizon already familiar to them: establishing interconnections to their own areas of work can spark new ideas, and precipitating such inspiring moments seemed more important to us than deeply profound scientific explanations.

At the same time, the technology guide is a reference book that briefly and concisely describes all the important current technologies. It explains the basic fundamentals, portrays applications and comments on future trends. A detailed keyword index and cross-references between different topics help to establish relevant links.

The discourse on future technologies and the search for innovations concern us all. Large international companies and research establishments are not the only ones responsible for innovation – operators and users of technology, too, play an important role, since new ideas could never succeed were society not open to innovation. Anyone with a better understanding of the latest technologies and how they are interlinked can competently join in on discussions of how to shape the future. The technology guide is a suitable aid in gaining this understanding: it is aimed at entrepreneurs, politicians, teachers, students, and ultimately anyone with an interest in technology.

In conclusion, we would like to make another comment on the format of the book. This is an anthology with contributions from more than 150 renowned technology experts from both small and large companies, research establishments, universities, associations and authorities; even a Nobel Prize winner has contributed to this book. When such large numbers of participants are involved, the homogeneity of the end product tends to suffer. In order to avoid a "patchwork character", a dedicated team of editors had to adapt the contributed articles to the pre-defined concept of the Technology Guide, through intensive dialogue with the authors. The goal was to create a uniform standard in terms of technological depth and a homogeneous structure throughout all the articles. The finished book is the result of these thorough review and verification efforts. I would like to thank the editorial team and also the authors, who, throughout several iteration loops, remained open and tolerant towards the sometimes unusual representation of their field of expertise.

Why did we invest so much effort in this project? Because we are confident that the Technology Guide will contribute towards a broader understanding of today's technologies. But the most desirable effect this guide could achieve would undoubtable be to stimulate readers and to spark new ideas that lead to further innovations. After all, we should not leave it to others to shape our own future.

The present issue is a strongly revised version of the German "Technologieführer" printed for the first time in 2007. On account of its success, we decided to update the book's content, perfect its structure, and make it available to a wider circle of readers by publishing it in English.

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