

Book Reviews

Shapiro, C., & Varian, H.R. (1998). *Information rules: A strategic guide to the network economy*. Boston, MA: Harvard Business School Press.

For all of the Internet millionaires we read of daily, there are many, many others toiling at their computers with fond hopes of joining this club. Some of these people sit in their spare bedrooms creating html and Java wonders, while the view out the bedroom window shows shaggy, long waiting-to-be-cut grass. Many others work for established companies hoping to catch the wave of the network economy.

All these people wonder about the secret of success, many ruminating over a pint of beer with colleagues at the disheveled pub around the corner from their proverbial garage. Killer ideas flow freely, more so with another pint. Toward closing time — or when they have to pick up the kids — talk turns to how they'll spend their millions. One will become an investor. Another a high school track coach. One young woman stares at her beer, wondering how the conversation got here.

What is the secret of success? Carl Shapiro and Hal Varian, both Berkeley business school professors, provide the answers. They argue, quite convincingly, that fundamental principles of economics still apply in the realm of networks and information. Their book provides a field guide for finding your way through the hope and hype of the Internet prophets to a reality of traditional profits.

The first lesson in their field guide is the simple principle that the selling price of any product or service tends to the marginal cost of production and distribution. In competitive markets, the players will continually push marginal costs down — thus, prices tend to go down. For information products distributed over the Internet, the marginal costs are zero! Consequently, companies will tend to give their information products away — and customers will expect information products to be free.

This principle explains why so many Internet businesses are trying to make money on advertising. They trade free content for your willingness to put up with banners and blinkers proclaiming the wonders of everything from security software to simulated sex. As irritating as this can be, we have long demonstrated our willingness to be manipulated by such messages via television.

Their second lesson is that differentiation can help you to escape the fate of having to give away your products. They suggest you do this by selling customers personalized products at personalized prices. This requires in-depth understanding of customers' needs and values so that you know what to put in the package and which things can command higher prices. For example, some customers value time much more than others.

Put simply, the idea is to sell roughly the same things to different people for different prices. Sounds great, but the network economy enables everyone to know the lowest price for anything. Shapiro and Varian suggest that you avoid this with versioning. With a modular design, based on a common platform, you can create different versions of your products tailored to the desires of different market segments. While you want to avoid blunders, like putting Cadillac badges on Chevrolets, this principle can help provide the differentiation you need at costs you can endure.

A further lesson focuses on lock-in. The essence of lock-in is that customers' future options are constrained by the choices they make now. Once a customer commits to your information products, invests in gaining competence in using these products, and becomes dependent on the tailored information you provide, it will be expensive for them to change providers. The switching costs are likely to be too high. Such customers are locked in. An installed base of locked-in customers can be a company's most valuable asset.

Yet another lesson concerns network externalities and positive feedback. The value of some information products, for instance telephones, is much greater if many people use these products. The more people in the network, the better. In this way, larger networks get larger — this is called positive feedback. For obvious reasons, therefore, you are likely to want to grow the network of users of your information products.

Shapiro and Varian covers many more topics — such as rights management and standards — with comparable clarity. Anyone in the information business will greatly benefit from this book. Conversely, anyone in this business who does not understand the principles in this book may find themselves with lots of time to mow the lawn.

William B. Rouse
Enterprise Support Systems
3295 River Exchange Drive
Suite 380
Norcross, GA 30092, USA

Boer, F. Peter, (1999). *The Valuation of Technology: Business and Financial Issues in R&D*. New York: John Wiley and Sons, 403 pages.

Research and development (R&D) is a core activity that supports technological innovation such as to lead to new products and services that fulfill a customer need and thereby enhances organizational and societal value. The purpose of this book is a wide-ranging investigation of the interconnections between research and development and value.

There are two generically different approaches to R&D (Roussel et al., 1991), or in more general terminology research, development, test, and evaluation (RDT&E), fundamental and applied. Fundamental RDT&E actually involves no DT&E. Applied RDT&E involves a large component of DT&E. We may further disaggregate fundamental RDT&E into curiosity-based fundamental research and directed fundamental research. In a similar way, we can disaggregate applied RDT&E into evolutionary RDT&E and revolutionary RDT&E. The author of this work was, among other positions, the CTO of W.R. Grace. Thus, much of his background is in a rather mature industry where R&D is generally relatively applied. The discussions, however, have general applicability to fundamental research, as well as to applied research.

In applied research efforts, new products and services generally come about through a system (product or service) lifecycle acquisition process. Prior to undertaking acquisition, there is generally a systems planning and marketing effort that identifies a societal need for new or reengineered products and services and ways to bring about insertion of the product or service in the marketplace. Often, there will exist needs for research and development, and associated test and evaluation (RDT&E) in order to create value through technological innovation and the resulting identification of a sufficiently mature technology needed to accomplish successful acquisition. This is the case since new product development, or systems acquisition, is limited by:

1. technological capabilities needed to supply the emerging technologies from the research and development (RDT&E) that is required to produce innovative products and services;
2. market knowledge needed to supply information concerning the potential costs and benefits, including risks, associated with large scale system acquisition; and

3. systems management capabilities that affect abilities to evolve appropriate processes for acquisition, to supply the needed RDT&E for those emerging technologies which will make a new product or system competitive, and to supply the needed planning and marketing such that the products and systems that are delivered fill a market need.

For a new system to be developed, there must be an available technology base that supports development. Existing large investments in production facilities may encourage innovations that capitalize this investment. On the other hand the existence of a large investment in one form of technology may well impede the propensity to allocate resources to an entirely new approach that could make the old approach obsolete as the very fact that there exists one satisfactory way to do something often provides an intellectual bias against thinking about new methods of approach. Thus, a successful technology or system developer must be motivated and prepared to demonstrate that a new and potentially innovative approach is *better* in some market-driven, societally-acceptable ways. If this is not done, any enthusiasm for technology innovation through R&D will likely soon fade over time.

A potential new technology can be nurtured by one unit through use of one, or through a combination, of the following two basic approaches: internal development of the technology or system product itself, or venture funding of others to develop the system or product and subsequent acquisition, or transfer, of the technology. In either case, R&D is needed if there are non mature technologies, that are desired for incorporation in a new or reengineered system, and which much be brought to an appropriate state of maturity through an emerging technology development effort.

The viewpoint taken in this seminal work is that a quantitative dollar value can be assigned to such intangible assets as technologies. It explores the various linkages between R&D and value, and espouses *value-based management* as a “mind-set” leading to effective decision making relative to the diverse aspects of technology development through R&D. No silver bullet, in terms of a set of quantitative analysis approaches to management of R&D is proposed; instead, the book provides a wealth of guidance relative to technology creation through R&D and the valuation of alternatives that may lead to this. Organizational and strategic issues are examined from multiple perspectives, as well as quantitative and formal analysis of potential economic returns. The book is addressed to three professional groups that are commonly involved in R&D processes: scientists who create new knowledge and engineers who develop innovative technologies based on this knowledge; R&D organizations and business managers who are concerned with R&D management; and financial professionals, investment analysts and investors who need to estimate the value of the intellectual and other capital that may be created through R&D.

There are five fundamental parts to the book:

- Human and lifecycle process issues associated with R&D (Chapters 1 and 2)
- Key financial concepts for R&D valuation (Chapters 3 through 5)
- Value assessment for individual R&D projects (Chapters 6 through 10)
- The R&D portfolio (Chapters 11 through 13)
- Metrics for R&D productivity and futures, and R&D infrastructure issues (Chapters 14 and 15)

Each of the 15 generally short and informative chapters in the book addresses important facets of R&D and technology valuation. Chapter 1 addresses communications issues that often arise across these three major professional groups in terms of cultural and motivational issues and the resulting perceptions and value models that result. Chapter 2 provides an introduction to research and development and a typical lifecycle process for R&D. These two introductory chapters are basically concerned with human and lifecycle process issues for R&D management.

Chapters 3 through 5 are concerned with classical financial accounting principles as they apply to R&D efforts. Chapter 3 is concerned with income statements, balance sheets, cash flow statements, financial leverage, and alternative measures of return. Chapter 4 discusses breakeven analysis, economies of scale, ways to reduce capital-related costs of new product development through R&D, and concerns associated with matching capacity to demand. Chapter 5 is particularly concerned with discounted cash flow, the

time value of money, and dangers associated with an inordinate focus on cash flow. These are the most micro-level focused chapters in the work.

Chapters 6 through 11 are basically concerned with valuation of individual R&D projects, primarily through use of the financial accounting principles discussed in Chapters 3 through 5. Chapter 6 is a very brief chapter concerned with introductory relations between shareholder value and the management of R&D activities. The claim is made that R&D productivity is an enhancing influence of shareholder value. Chapter 7 speaks to the relationship between corporate strategy and technology strategy and value. Of particular interest in this regard is the identification of the R&D component of strategic plans. The pitfalls associated with formal approaches to strategic plans are well described. In Chapter 8, attention turns to the creation of a revenue model and the use of market analysis tools to estimate the revenues that are anticipated to follow from ultimate product acquisition and commercialization. Various pricing strategies, such as cost-plus and reinvestment, are discussed. This chapter provides the essential background in marketing as it relates to R&D support. The author considers the *pro-forma* project spreadsheet the key component of technology valuation. A major use of this spreadsheet is for sensitivity analysis purposes, such as to enable estimation of the effects of potential changes in various input factors associated with producing an innovative technology. Chapter 9 is devoted to this effort and the author considers this a pivotal chapter in the book. It illustrates how market research and estimates are used to create likely future scenarios for technology or product evolution. Chapter 10 is concerned with the use of various approximate methods that enable quick calculation of market based approaches to value. Such tools as sensitivity analysis are used to calculate how potential changes in the parameters of large systems will affect product evolution. The resulting estimates, particularly net present value (NPV) are suggested for purposes of R&D project evaluation and justification. Licensing and royalty issues are also discussed.

The next three chapters are concerned with identification of an appropriate mix of R&D projects in order to minimize R&D risk and enhance shareholder value. Chapter 11 extends the efforts in Chapters 6 through 11 by considering R&D portfolios, or sets of individual R&D projects that taken together provide a complete picture of the R&D activities of a given organization. This portfolio concept is particularly useful in total risk management of the composite of individual risks associated with specific projects. Chapter 12 introduces the use of decision trees and Monte Carlo methods for the analysis of both individual projects and a portfolio of projects. Portfolio diversification considerations to enhance risk management capabilities are introduced in Chapter 13. Issues associated with strategic sourcing and strategic alliances are also considered. The essential conclusion of this chapter is that an R&D organization should maintain a sufficiently diversified portfolio of new conceptual R&D projects in order to create a high-value portfolio.

The last two chapters in the book provide a brief overview of R&D metrics not discussed earlier in the text, Chapter 14, and the role of such R&D infrastructure issues as patents, technology transfer, globalization, and physical environmental issues, Chapter 15. These chapters are quite brief and much more could be said relative to the many infrastructure issues that affect the R&D organization.

This book provides an excellent perspective on the many issues affecting the transformation of scientific results into technological products and services and the use of these technology innovations for enhanced shareholder value. The process advocated by the author for accomplishing this valuation is generally well described. It is a process apparently originated by the author of this work, who has had much experience in the valuation of R&D efforts. While this experience is evident in the maturity of the discussions, it would have been helpful to have a given case study worked out in some detail. While this is missing, and it would not necessarily be a trivial matter to present a complete analysis in a relatively few pages, a floppy disk associated with the disk contains a number of useful Excel Spreadsheet representations for:

- Discounted Cash Flow
- Discount Factors as a function of Time and Cost of Money

- Terminal Value Factors using Growth in Perpetuity Method
- Proforma Financial Statements for Polyarothene Business
- Projects and Costs in Model Laboratory Unit
- Project Flow in Model Laboratory Unit
- Probability-weighted Decision Trees for Polyarothene Project Outcomes
- Black–Scholes Option Calculator

Use of these spreadsheets will enable calculation of many of the results in the book and others desired by readers of the book. To a considerable extent, this offsets the lack of a single comprehensive example. The author describes well his recommended process for the valuation of R&D technology products.

In general, this is an excellent book. The author covers a wealth of financial analysis material. Some of this may be unfamiliar to many with interests in R&D management. Generally, references are provided that contain extended discussions of these approaches. While an advantage of the work is that it presents a wide scope adaptable approach due to efforts of the author, there have been a number of other treatments of R&D management and valuation such as (Roussel et al., 1991) and (Matheson & Matheson, 1998), and some discussions of these would add to the pedagogical nature of the book. Also, there are such strategic organizational measurement approaches and processes as the Balanced Scorecard (BSC) (Kaplan & Norton, 1996) and it would also have been worthwhile to have some discussions of the applicability and integration of such processes with the one advocated by the author. This would be especially desirable in terms of those aspects of the BCS approach that are not easily or at all captured by the financial measures so well articulated in this book. It would also have been desirable to have some discussion of detection, diagnosis, and correction strategies to enable R&D organizations to reengineer their valuation approaches for enhanced effectiveness. Nevertheless, the author deserves much credit for having provided a very needed and useful work concerning technology valuation and the business and financial issues in research and development. This is, without doubt, a very valuable book for those in Information, Knowledge, and Systems Management.

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Andrew P. Sage
University Professor and First American Bank Professor
Department of Systems Engineering and Operations Research
George Mason University
Fairfax, VA 22030, USA