

## Chapter II

# R&D Process Models

### INTRODUCTION

This chapter on research and development processes and models begins with a section concerning the economics and finance of R&D. Liberatore and Titus (1983) address the level and effectiveness that R&D managers have over the budgeting activities related to their projects and how best to improve these activities. Guerard, Bean, and Andrews' (1987) focus is on the financial decisions hypothesis and development of an econometric model to examine the relationships of R&D with financing decision making. Hill and Snell (1988) discuss the different stresses and influences that investors and consumers place upon the R&D process, while Hokisson and Hitt (1988) examine management structure and diversification to understand their effect on investment by external capital markets in R&D firms. Baysinger and Hoskisson (1989) are also concerned with diversification strategies that affect R&D, reporting on their empirical research findings that suggest a positive relationship between the level of R&D intensity and the level of business dominance. The section concludes with Pisano (1990) and his discussion of sources of transaction costs, particularly small-numbers-bargaining hazards and appropriability concerns, and their effect on the selection of internal or external R&D sources when technological changes affect the locus of R&D expertise.

The second section of this chapter focuses on the roles of knowledge transfer, both within R&D organizations and among various technology stakeholders. Martin and Irvine (1983) propose a model for assessing the level of contribution that different research groups of a specific content area contribute to their field's knowledge base. Gupta, Rai, and Wilemon (1986) present a discussion of how the information relationship between research and development and marketing integration is fundamental to a firm's business strategy and its approach to environmental

uncertainty, while Cohen and Levinthal (1990), with the introduction of the term “absorptive capacity,” focus on how individuals and the firms that employ them identify, assimilate, and use information to fuel innovation. Lane and Lubatkin (1995) refine Cohen and Levinthal’s construct, absorptive capacity, by focusing on what they consider the three key elements of knowledge transfer: the knowledge offered by the “teaching” firm, the similarity between “teacher” and “student” firms regarding compensation practices and organizational structures, and the level of familiarity the student firm has with the teacher firm’s organizational problems. Mansfield (1991) examines the nature and degree to which technological innovations are based on academic research and the time innovators expend in engaging academic research and industry’s subsequent use of their results. Christensen and Bower (1996) investigate the relationship between technological innovative firms and their customers’ demands and expectations, and why firms that are attuned to customer needs sometimes fail to produce innovations that are known to be critical to their own success. Surprisingly, too much attention to those needs results in infeasible goals and strategies.

## **R&D AND ECONOMICS**

### **The Value of Financial Measurement to R&D Management**

Noting the paucity of empirical studies that take quantitative techniques into account when researching R&D project management, yet acknowledging how advances in computing technologies benefit quantitative investigations, Liberatore and Titus (1983) conducted an empirical study of the use of management science techniques, selecting 29 Fortune 500 firms from a variety of industries located around the U.S. The term ‘project management’ as defined in this study includes “the activities of screening, selecting, evaluating, budgeting, scheduling, and controlling R&D projects.” Forty respondents were interviewed, all R&D budget heads or upper management. The authors collected demographic information, data “related to familiarity and usage of project management techniques,” as well as data regarding “the perceived impact of techniques on project decision-making, and any recent/planned changes in the cadre of techniques.” The authors examined techniques such as “heavy use and high perceived impact of financial methods for project selection, selective use of network models, [finding] some dissatisfaction over the methods available for project scheduling and control, and no usage of mathematical programming models for R&D resource allocation” (p. 962).

While the use “of the standard measures of financial analysis for screening and evaluation of R&D projects [was nearly ubiquitous,] discounted cash flow

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