Preface

This book is a reference guide to the theory and research supporting the field of technology and innovation management (TIM). Through the presentation of the seminal ideas articulated in the discipline's fundamental texts and most widely cited journal articles, we present pertinent information—from basic definitions to some of the most advanced theoretical knowledge and empirical data of the discipline's pioneers and practitioners—of import to academics, innovators, and managers alike. Citation analysis was performed to identify the articles most referenced, and based on those results the key ideas of the articles were organized into thematic and sub-disciplinary groupings that yielded the sections and chapters of this book. The selection of frequently cited papers at least partially reflects the relative size of the different research communities, and there is a tendency for works to be cited by researchers within the associated traditional discipline as opposed to researchers who also study technology and innovation management from the perspective of an alternative traditional discipline.

In Chapter I, we give primary consideration to books that are critical to the understanding and study of technology and innovation management, then provide a discussion of what technology is, how innovation is now defined—anything that involves a change that is new or novel to the individual or organization involved—considering *new* as the pivotal word. Chapter I contains a discussion of the interaction of innovation and technology with management. Given the academic atomization of different traditional fields that study technology and innovation management, we consider the most frequently cited papers in all fields contributing to TIM with the intention of closing some of the gulf that separates these communities.

Chapter II, with its focus on research and development (R&D) processes and models, begins with a discussion of the level and effectiveness of R&D managers regarding budgeting, an econometric model of the relationships of R&D with financing decision making, the different stresses and influences that investors and consumers place upon the R&D process, and the effects of management structure and diversification on investment by external capital markets in R&D firms. Diver-

sification strategies that affect R&D and their impact on the selection of internal or external R&D sources when technological changes affect the locus of R&D expertise is also discussed, as are the roles of knowledge transfer, both within R&D organizations and among various technology stakeholders. We conclude the chapter with a look at "absorptive capacity," particularly some of the key elements of knowledge transfer.

There are three dominant themes related to organizational innovation strategy that run through Chapter III: the rate and nature of change; attitudes, behaviors, and strategic change; and the role of research in organizational strategy. We begin with the interaction between technology and organizational structure to uncover how this kind of interaction affects how organizations function. A study that contrasts the size of firms to their attitudes toward innovation is presented, followed by a discussion regarding the continuum of incremental-to-radical innovation by taking a very close look at the innovative process—from manufacture to end-user sale. The role of research in strategic change is also a subject of this chapter, with a goal of helping determine the role of 'competence' in an industry's research. Component and architectural competence are examined and explain the nature of variance in research productivity, as is the nature of competition in organizations undergoing strategic change.

Chapter IV concerns new product development, with articles that address the internal processes that assist or hinder development and factors that contribute to the success or failure of a new product, including its performance and diffusion. We begin with the steps that affect the development process and determine how modifying a step-wise structure improves process performance, and continue with a discussion of the tensions and trade-offs that occur among different functional areas and how they affect innovative product development. We then review contemporary new product growth models as a basis for understanding recent diffusion models of new product acceptance. A sociological analysis of people's communicative behavior suggests that the objective of a diffusion model is to illustrate the increases in the scope of adopters and predict the nature of the development of an ongoing diffusion process. This chapter also contains a look at empirical studies of product development that focus on the development project as the element of analysis in order to provide a model of factors that contribute to the success of new product development.

Chapter V, on technology development and innovative practice, begins with seminal work on routinization and how social structures of organizations affect technological development and innovation, approached from both statistical and sociological perspectives. We also look at the changing definition of "innovation" through factors of variability and quantitative methods. The discussion continues with the inclusion of theoretical constructs for innovation that identify variables of

structural differentiation and complexity that affect this domain. Then, researchers describe how a combination of technology sources, user requirements, and potential technology appropriation affect how we understand technical change and the structural relationships between technology and industry. The term "transilience" is highlighted to indicate a set of categories of technological change that is aligned with evolutionary developments, altered by varying managerial environments.

In Chapter VI we discuss how information that supports innovation flows throughout an organization, the construction and effects of team composition, the innovative process that teams employ, and the development, implementation, and evaluation of systems used to manage the flow and distribution of information. Research indicates that effective communicators rise as a result of their willingness to engage information. We also discuss why innovative processes require the development of effective information networks, confirming how important it is for successful innovation that there exist effective external and internal communication networks, and that individuals collaborate to share information. Team composition is another theme of this chapter, with researchers suggesting that certain demographic factors affect a team's ability to be innovative, but resource diversity—including communication ability—is ultimately essential to innovation, as are corporate executives' abilities to understand and adapt to the fact that the innovation environment is filled with surprise.

Chapter VII introduces the seminal literature addressing technological diffusion, innovative product diversification, and the organizational strategies and constraints that firms face when introducing and adopting new technologies and innovative management strategies, drawing critical distinctions between the processes undertaken by rational adopters of inefficient technologies and the conditions that promote the irrational rejection of efficient innovations. Chapter VII also addresses diversification and organizational structure by locating a theoretical basis for the identification and validation of factors that influence diversification innovation adoption strategies. The important concept of structuration provides an alternative conceptualization of the role of technology, focusing on the theory's social and historical substrata to provide an explanation of how we might rethink the roles of technology in organizations.

The focus of Chapter VIII is on the role of knowledge in the operation of organizations, and it consists of two main thrusts: the effects of knowledge (accrual, dissemination, and implementation) on organizational change, and more specifically, the manner and effects of knowledge transfer within and among firms conducting innovative product design and development. We look at the importance and processes of knowledge coordination within a firm's administrative hierarchy, the role of radical change on the theory of neo-institutionalism, and how one identifies and exposes organizational capabilities in the face of organizational structures

that promote management practices having the potential to stifle innovation rather than institute and nurture change. Researchers investigating knowledge transfer offer reasons for and processes by which competing firms exchange organizational knowledge, finding a range of distinguishing characteristics between the subject matter and substance of inter-organizational arrangements and the organizational structures and complexities of those firms. The chapter also discusses the symbiotic relationship between technological innovation and its adaptation into the organizational environment, how research is organized in science and technology sectors to point out how interrelated and complex their activities are, and how knowledge can be viewed as an instrument of organizational change.

Chapter IX, on information and communication technology management, first presents the development of research concerned with behavior—specifically, attitudes and decision behavior in the early realm of management information systems—then shifts focus toward methodologies and practices of MIS development and their implementation.

The third and concluding section of this chapter follows the progression of information and communication technologies from the mid-1980s to present as it shifted focus to the individual customer—as development partner, and as arbiter of product design and modeling. The well-known theory of reasoned action (TRA) and technology acceptance model (TAM) are discussed, as is an approach to information systems development from a strategic and organizational (as opposed to a user-based) vantage point: adaptive structuration theory (AST). Other research introduces situated practice as a methodology to understand the relationships between organizational change and IT, and an alternative to established perspectives such as planned change, technological imperative, and punctuated equilibrium. We conclude this chapter with further discussion of the Technology Acceptance Model, but with consideration given to additional variables and their effects on perceived usefulness and perceived ease of use of information technologies.

Chapter X concerns open source and software development innovation, with research that addressed the development of software and the challenges it poses to commercial concerns, as well as specific situations in which management and innovation theory is responsive to non-proprietary software development. Researchers introduce advances in theory to aid software project management and discuss risk management as it pertains to software development projects. Knowledge management in software process innovation management environments is addressed, and the chapter concludes with an overview of strategies for organizations seeking to meld proprietary and open source methodologies and management styles with established theories of appropriability and adoption as they pertain to software development.

We conclude the book with a look to the future, but one in concert with the underlying theme that holds together the research considered in previous chapters: the tension between the old (current routine) and the new (innovation). While it is not possible to state with any certainty which recent research will be considered seminal work several decades from now, it is possible to give insights into current trends in research and to project these out into the future. We employ a methodology similar to the one identified in the seminal work discussed in the earlier chapters. Identifying the most cited articles in TIM through the Science Citation Index (SCI) and Social Science Citation Index (SSCI), a count of individual and pairs of words was conducted to identify the frequency of occurrence, then the list was compared to a similar list of words from all management journals listed on both indices. We identified the following areas as trendsetters for future research in TIM: new product development, technology transfer, supply chains, network or relationship-related concepts, and new emphases and approaches to technology transfer research. There is increased attention to technology and innovation management in emerging and developing economies, and it is likely that there will be a reemergence in discussion of appropriate technology (as opposed to high tech).