

SEVENTH
EDITION



INNOVATION MANAGEMENT

AND NEW PRODUCT DEVELOPMENT

 Pearson

PAUL TROTT

Innovation Management and New Product Development



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Innovation Management and New Product Development

Seventh Edition

Paul Trott

Portsmouth Business School



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Preface

The demise of Nokia and Kodak is a sharp reminder to all firms, even great big ones, that success today does not ensure success tomorrow. The ability of firms to develop new products and services that people want will surely help them survive into the future. But precisely how should firms go about this? The Kodak case is even more remarkable because Kodak was the pioneer in digital cameras – the technology that, ultimately, led to its decline in income. So, in this case, it is not a lack of innovation *per se* but how it is used to deliver value to the firm and its customers.

We are all well aware that good technology can help companies achieve competitive advantage and long-term financial success; just look at Amazon. But there is an abundance of exciting new technology in the world and it is the transformation of this technology into products that is of particular concern to organisations. There are numerous factors to be considered by the organisation, but what are these factors and how do they affect the process of innovation? This book will explain how and why the majority of the most significant inventions of the past two centuries have not come from flashes of inspiration, but from communal, multilayered endeavour – one idea being built on another until a breakthrough is reached.

In this book we see that many of the old traditional approaches to management need to change and new approaches need to be adopted. Increasingly, managers and those who work for them are no longer in the same location. Often, complex management relationships need to be developed because organisations are trying to produce complex products and services and do so across geographic boundaries. Cross-functional and cross-border task forces often need to be created.

Objective of the book

It is designed to be accessible and readable. The book emphasises the need to view innovation as a management process. We need to recognise that change is at the heart of it. And that change is caused by decisions that people make. The framework in Chapter 1 (Figure 1.9) attempts to capture the iterative nature of the network processes in innovation and represents this in the form of an endless innovation circle with interconnected cycles. This circular concept helps to show how the firm gathers information over time, how it uses technical and societal knowledge, and how it develops an attractive proposition. This is achieved through developing linkages and partnerships with those having the necessary capabilities.

Target audience

This book is written for people who want to understand how firms can improve the way they manage their innovation processes to develop new products and services.

It can be used as a textbook for undergraduate or graduate courses in innovation management. A second audience is the manager who wishes to keep abreast of the most recent developments in the innovation field.

Special features

The book is designed with one overriding aim: to make this exciting and highly relevant subject as clear to understand as possible. To this end, the book has a number of important features:

- A clear and straightforward writing style enhances learning comprehension.
- Extensive up-to-date references and relevant literature help you find out more and explore concepts in detail.
- ‘Innovation in action’ boxes illustrate how real companies are managing innovation today.
- Clear chapter openers set the scene for each chapter and provide a chapter contents list, which offers page references to all the sections within the chapter.
- Learning objectives at the beginning of each chapter explicitly highlight the key areas that will be explored in the chapter.
- More photographs and images are included to help illustrate and enliven the text.
- Topical articles from the *Financial Times* illustrate how the subject is being discussed in the context of the wider business world.
- Summaries at the end of each chapter provide a useful means of revising and checking understanding.
- ‘Pause for thought’ questions are integrated within the text. These are designed to help you reflect on what you have just read and to check your understanding. Answers to all ‘Pause for thought’ questions are given on the book’s online resource, Instructor’s Manual for lecturers.
- Comprehensive diagrams throughout the book illustrate some of the more complex concepts.
- Plentiful up-to-date examples within the text drive home arguments. This helps to enliven the subject and places it in context.
- A comprehensive index, including references to all defined terms, enables you to look up a definition within its context. See also the ‘Key words and phrases’ boxes at chapter ends. Key words are presented emboldened in colour within the main text.
- A substantial case study at the end of each chapter shows the subject in action within actual firms. These have been trialled on classes at several universities and have formed the basis of lively one-hour class seminar discussions.

What is new in the 7th edition

- Condensed with 100 fewer pages and the removal of non core material.
- One entirely new chapter: Public sector innovation.
- Two new cases: Israel and water desalination plants; and Parkrun.
- Updated all chapters with 2019/2020 references.
- New Innovation in Action pieces for each chapter.
- New up-to-date Illustrations for chapters.
- New images for chapters.

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Plan of the book

Part One Innovation management		
Chapter 1 Innovation management: an introduction	Chapter 2 National systems of innovation and entrepreneurship	Chapter 3 Public sector innovation
Chapter 4 Managing innovation within firms		Chapter 5 Operations and process innovation
Part Two Turning technology into business		
Chapter 6 Managing intellectual property	Chapter 7 Managing organisational knowledge	Chapter 8 Strategic alliances and networks
Chapter 9 Research and development		Chapter 10 Open innovation and technology transfer
Part Three New product development		
Chapter 11 Business models	Chapter 12 Market adoption and technology diffusion	Chapter 13 New product development
Chapter 14 Market research and its influence on new product development		Chapter 15 Managing the new product development process

Part One

Innovation management

The purpose of this part of the book is to introduce and explore the concept of innovation management. Particular emphasis is placed on the need to view innovation as a management process. A cyclic model of innovation is introduced, which emphasises the importance of internal processes and external linkages. This raises the issue of the context of innovation and Chapter 2 demonstrates that innovation cannot be separated from the wider national system. The United States is often cited as a good example of a system that enables innovation to flourish: hence it is necessary to explore the economic factors that influence innovation and the role of entrepreneurship. Chapter 3 addresses the role of innovation within the public sector. A significant amount of innovation activity has existed in the public sector to solve organisational and societal problems, such as poverty, crime, etc.

Chapter 4 explores the issue of the organisational context and it is from this vantage point that the subject of managing innovation within firms is addressed. Virtually all major technological innovations occur within organisations; hence it is necessary to look at organisations and explore how they manage innovation.

Given that many new product ideas are based on existing products and may be developed from within the production or service operations function, Chapter 5 considers the role of operations within innovation. Many new product ideas may be modest and incremental rather than radical but the combined effect of many, small, innovative ideas may be substantial.

Chapter 1

Innovation management: an introduction

Introduction

Innovation is one of those words that suddenly seems to be all around us. Firms care about their ability to innovate, on which their future allegedly depends (Christensen and Raynor, 2003), and many management consultants are busy persuading companies about how they can help them improve their innovation performance. Politicians care about innovation, too: how to design policies that stimulate innovation has become a hot topic at various levels of government. The European Commission, for instance, has made innovation policy a central element in its attempt to invigorate the European economy (see Chapter 2). A large amount of literature has emerged, particularly in recent years, on various aspects of innovation and many new research units focusing on innovation have been formed (Martin, 2012).

There is extensive scope for examining the way innovation is managed within organisations. Most of us are well aware that good technology can help companies achieve competitive advantage and long-term financial success. But there is an abundance of exciting new technology in the world and it is the transformation of this technology into products that is of particular concern to organisations. There are numerous factors to be considered by the organisation, but what are these factors and how do they affect the process of innovation? This book will explain how and why most of the most significant inventions of the past two centuries have not come from flashes of for-profit inspiration, but from communal, multilayered endeavour – one idea being built on another until a breakthrough is reached (Johnson, 2010). The Apple case study at the end of this chapter helps illustrate Apple's rise and fall over the past 20 years.

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Learning objectives

When you have completed this chapter you will be able to:

- recognise the importance of innovation;
- explain the meaning and nature of innovation management;
- provide an introduction to a management approach to innovation;
- appreciate the complex nature of the management of innovation within organisations;
- describe the changing views of innovation over time;
- recognise the role of key individuals within the process; and
- recognise the need to view innovation as a management process.

The importance of innovation

Corporations must be able to adapt and evolve if they wish to survive. Businesses operate with the knowledge that their competitors will, inevitably, come to the market with a product that changes the basis of competition. The ability to change and adapt is essential to survival. But can firms manage innovation? The answer is certainly yes, as Bill Gates confirmed in 2008:

The share price is not something we control. We control innovation, sales and profits.
(Rushe and Waples, 2008)

Today, the idea of innovation is widely accepted. It has become part of our culture – so much so that it verges on becoming a cliché. But, even though the term is now embedded in our language, to what extent do we fully understand the concept? Moreover, to what extent is this understanding shared? A scientist’s view of innovation may be very different from that of an accountant in the same organisation.

The Toyota flying car story in Illustration 1.1 puts into context the subject of innovation and new product development. In this case Toyota’s investment in aviation technology will help Toyota establish itself as a leader in the airborne urban mobility market of the future. Innovation is at the heart of many companies’ activities. But to what extent is this true of all businesses? And why are some businesses more innovative than others?

Illustration 1.1

Toyota invests in flying car

Toyota is making its first big bet on the airborne urban mobility market of the future by investing \$394 million in Joby Aviation, a California-based company that has developed a four-passenger, battery-electric vertical take-off and landing aircraft.

Toyota says it will share its vaunted expertise in manufacturing, quality and cost controls to help Joby develop, produce and commercialise its electric vertical take-off and landing (VTOL) aircraft. Toyota will also appoint Executive Vice President Shigeki Tomoyama to the Joby board of directors.

The move gives the automaker a presence in the increasingly popular ‘flying car’ segment that has seen the likes of Hyundai, Porsche, Audi and Uber start to develop airborne taxi concepts as one solution to rising urban traffic congestion.

Toyota filed for patent protection back in 2018 for a car capable of driving on terra firma and flying, courtesy of the ability to transform itself via a pair of struts that tilt upward and sprout



Source: andrey_l/Shutterstock

spring-loaded rotor blades from the wheels, enabling it to fly.

Source: Sven Gustafson (2020) Toyota invests \$394M in all-electric flying car startup Joby Aviation.

What is meant by innovation? And can it be managed? These are questions that will be addressed in this book.

‘. . . not to innovate is to die’, wrote Christopher Freeman (1982) in his famous study of the economics of innovation. Certainly, companies that have established themselves as technical and market leaders have shown an ability to develop successful new products. In virtually every industry, from aerospace to pharmaceuticals and from motor cars to computers, the dominant companies have demonstrated an ability to innovate (see Table 1.1). Furthermore, in The Boston Consulting Group’s annual report on the world’s most innovative companies, these same firms are delivering impressive growth and/or return to their shareholders (see Table 1.2).

A brief analysis of economic history, especially in the United Kingdom, will show that industrial technological innovation has led to substantial economic benefits for

Table 1.1 Market leaders in 2015

Industry	Market leaders	Innovative new products and services
Smart phones	Samsung; Apple	Design and new features
Internet-related industries	Google; Facebook	New services
Pharmaceuticals	Pfizer; GlaxoSmithKline	Impotence; ulcer treatment drug
Motorcars	Toyota; BMW; Tesla	Car design and associated product developments
Computers and software development	Intel; IBM and Microsoft; SAP	Computer chip technology, computer hardware improvements and software development

Table 1.2 World’s most innovative companies

2019 Rank	Company	Innovation activity
1	Alphabet/Google	Google’s expertise in artificial intelligence (AI) and machine learning (ML).
2	Amazon	using AI in its retail business, has pioneered voice recognition technology (Alexa) and platform-based services (Amazon Web Services).
3	Apple	pioneer voice recognition software (Siri) and provided a premier virtual workplace for app developers with its iOS platform.
4	Microsoft	provider of AI and platform-based services.
5	Samsung	Has become the dominant smartphone producer in the world.
6	Netflix	World leader in streaming content and production of content.
7	IBM	A world leader in cloud technology and open source technology.
8	Facebook	Uses its network effects to generate advertising revenue.
9	Tesla	Pioneer in electric vehicle technology.
10	Adidas	Has become the sports brand of choice across the world and has been able to challenge Nike.

Source: <https://www.bcg.com/en-gb/publications/2019/most-innovative-companies-innovation.aspx>

Table 1.3 Nineteenth-century economic development fuelled by technological innovations

Innovation	Innovator	Date
Steam engine	James Watt	1770–80
Iron boat	Isambard Kingdom Brunel	1820–45
Locomotive	George Stephenson	1829
Electromagnetic induction dynamo	Michael Faraday	1830–40
Electric light bulb	Thomas Edison and Joseph Swan	1879–90

the innovating *company* and the innovating *country* (see Illustration 1.2). Indeed, the industrial revolution of the nineteenth century was fuelled by technological innovations (see Table 1.3). Technological innovations have also been an important component in the progress of human societies. Anyone who has visited the towns of Bath, Leamington and Colchester will be very aware of how the Romans contributed to the advancement of human societies. The introduction over 2,000 years ago of sewers, roads and elementary heating systems is credited to these early invaders of Britain.

Illustration 1.2

A review of the history of economic growth

Economic historians argue that the world’s economy has experienced unprecedented growth rates only after 1800, following millennial relative stagnation, because of the role of technology in affecting economic change.

The classical economists of the eighteenth and nineteenth centuries believed that technological change and capital accumulation were the engines of growth. This belief was based on the conclusion that productivity growth causes population growth, which in turn causes productivity to fall. Today’s theory of population growth is very different from these early attempts at understanding economic growth. It argues that rising incomes slow the population growth because they increase the rate of opportunity cost of having children. Hence, as technology advances, productivity and incomes grow.

The Austrian economist, Joseph Schumpeter, was the founder of modern growth theory and is regarded as one of the world’s greatest economists. In the 1930s he was the first to realise that the development and diffusion of new technologies by profit-seeking entrepreneurs formed the source of economic progress. One important

insight arising from Schumpeter’s ideas is that innovation can be seen as ‘*creative destruction*’ waves that restructure the whole market in favour of those who grasp discontinuities faster. In his own words ‘the problem that is usually visualised is how capitalism administers existing structures, whereas the relevant problem is how it creates and destroys them.’

Robert Solow, who was a student of Schumpeter, advanced his professor’s theories in the 1950s and won the Nobel Prize for economic science. Paul Romer has developed these theories further and is responsible for the modern theory of economic growth, sometimes called neo-Schumpeterian economic growth theory, which argues that sustained economic growth arises from competition amongst firms. Firms try to increase their profits by devoting resources to creating new products and developing new ways of making existing products. It is this economic theory that underpins most innovation management and new product development theories.

Source: Adapted from Parkin, M. et al. (2008) and McCloskey, D.N. (2013).

Pause for thought

Not all firms develop innovative new products, but they still seem to survive. Do they thrive?

The study of innovation

Innovation has long been argued to be the engine of growth. It is important to note that it can also provide growth, almost regardless of the condition of the larger economy. Innovation has been a topic for discussion and debate for hundreds of years. Nineteenth-century economic historians observed that the acceleration in **economic growth** was the result of technological progress. However, little effort was directed towards understanding *how* changes in technology contributed to this growth.

Schumpeter (1934, 1939, 1942) was amongst the first economists to emphasise the importance of *new products* as stimuli to economic growth. He argued that the competition posed by new products was far more important than marginal changes in the *prices* of existing products. For example, economies are more likely to experience growth due to the development of products, such as new computer software or new pharmaceutical drugs than to reductions in prices of existing products, such as telephones or motorcars. Indeed, early observations suggested that economic development does not occur in any regular manner, but seemed to occur in bursts or waves of activity, thereby indicating the important influence of external factors on economic development.

This macro view of innovation as cyclical can be traced back to the mid-nineteenth century. It was Marx who first suggested that innovations could be associated with waves of economic growth. Since then, others such as Schumpeter (1934, 1939), Kondratieff (1935/51) and Abernathy and Utterback (1978) have argued the long-wave theory of innovation. Kondratieff was, unfortunately, imprisoned by Stalin for his views on economic growth theories, because they conflicted with those of Marx. Marx suggested that capitalist economies eventually would decline, whereas Kondratieff argued that they would experience waves of growth and decline. Abernathy and Utterback (1978) contended that at the birth of any industrial sector there is radical product innovation, which is then followed by radical innovation in production processes, followed, in turn, by widespread incremental innovation. This view was once popular and seemed to reflect the life cycles of many industries. It has, however, failed to offer any understanding of *how* to achieve innovative success.

After the Second World War, economists began to take an even greater interest in the causes of economic growth (Domar, 1946; Harrod, 1949). One of the most important influences on innovation seemed to be industrial research and development. After all, during the war, military research and development (R&D) had produced significant technological advances and innovations, including radar, aerospace and new weapons. A period of rapid growth in expenditure by countries on R&D was to follow, exemplified by US President Kennedy's 1960 speech outlining his vision of getting a man on the moon before the end of the decade. But economists soon found that there was no *direct* correlation between R&D spending and national rates of economic growth. It was clear that the linkages were more complex than first thought (this issue is explored more fully in Chapter 9).

There was a need to understand *how* science and technology affected the economic system. The neo-classical economics approach had not offered any explanations. A series of studies of innovation were undertaken in the 1950s, which concentrated on the internal characteristics of the innovation process within the economy. A feature of these studies was that they adopted a cross-discipline approach, incorporating economics, organisational behaviour and business and management. The studies looked at:

- the generation of new knowledge;
- the application of this knowledge in the development of products and processes;
- the commercial exploitation of these products and services in terms of financial income generation.

In particular, these studies revealed that firms behaved differently (see Carter and Williams, 1957; Simon, 1957; Woodward, 1965). This led to the development of a new theoretical framework that attempted to understand how firms managed the above, and why some firms appeared to be more successful than others. Later studies in the 1960s were to confirm these initial findings and uncover significant differences in organisational characteristics (Burns and Stalker, 1961; Cyert and March, 1963; Myers and Marquis, 1969). Hence, the new framework placed more emphasis on the firm and its internal activities than had previously been the case. The firm and how it used its resources was now seen as the key influence on innovation.

Neo-classical economics is a theory of economic growth that explains how savings, investments and growth respond to population growth and technological change. The rate of technological change influences the rate of economic growth, but economic growth does not influence technological change. Rather, technological change is determined by chance. Thus, population growth and technological change are exogenous. Also, neo-classical economic theory tends to concentrate on industry or economy-wide performance. It tends to ignore differences amongst firms in the same line of business. Any differences are assumed to reflect differences in the market environments that the organisations face. That is, differences are not achieved through choice but reflect differences in the situations in which firms operate. In contrast, research within business management and strategy focuses on these differences and the decisions that have led to them. Furthermore, the activities that take place within the firm that enable one firm seemingly to perform better than another, given the same economic and market conditions, has been the focus of much research effort since the 1960s.

The Schumpeterian view sees firms as different – it is the way a firm manages its resources over time and develops capabilities that influences its innovation performance. The varying emphasis placed by different disciplines on explaining how innovation occurs is brought together in the framework in Figure 1.1. This overview of the innovation process includes an economic perspective, a business management strategy perspective and organisational behaviour, which attempts to look at the internal activities. It also recognises that firms form relationships with other firms and trade, compete and cooperate with each other. It further recognises that the activities of individuals within the firm also affect the process of innovation.

Each firm's unique **organisational architecture** represents the way it has constructed itself over time. This comprises its internal design, including its functions and the relationships it has built up with suppliers, competitors, customers, etc. This framework recognises that these will have a considerable impact on a firm's

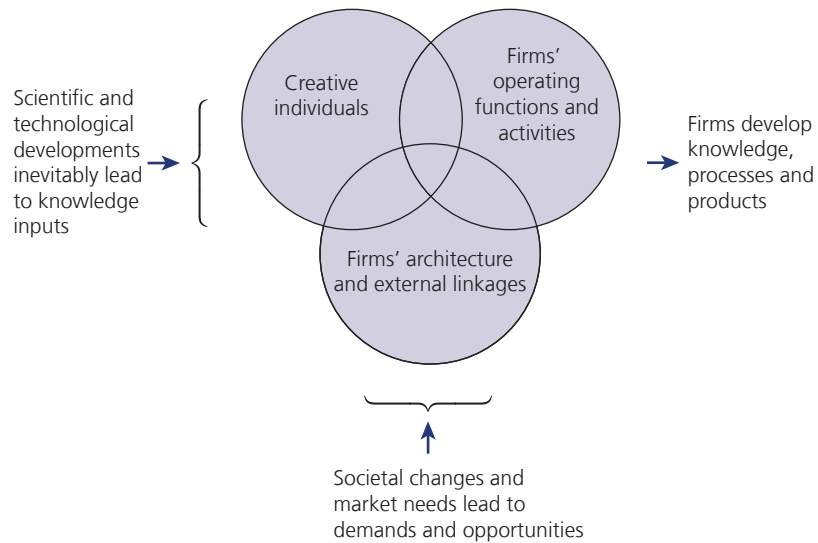


Figure 1.1 Overview of the innovation process

innovative performance. So, too, will the way it manages its individual functions and its employees or individuals. These are separately identified within the framework as being influential in the innovation process.

Two traditions of innovation studies: Europe and the USA

Benoit Godin has written extensively on the intellectual history of innovation. His work provides a detailed account of the development of the category of innovation. In his two papers 'Innovation Studies: The development of a speciality I and II' (Godin, 2010a; 2010b) he explains how two traditions emerged. The first in the USA was concerned with technological change as the use of inventions in industrial production and the second in Europe, which was concerned more specifically with commercialised invention. The European tradition, which was developed as late as the 1970s, restricted the previously broader definition of innovation as the introduction of change to a narrower focus on technology and commercialisation. Christopher Freeman is largely credited as responsible for this so-called European tradition, which shifted the focus of studies of innovation to the process from invention to diffusion and the consideration of policy issues, specifically economic growth. The idea of a professionalised R&D system was proposed as having a key role. According to Godin, this is now the position adopted by many public organisations, including the OECD. Godin argues that Freeman transformed an old meaning of technological innovation; that of introducing technical change within firms to commercialising technological invention and so helped build a new tradition. The European tradition saw invention as part of the innovation process and introduced the function of market uncertainty. This begins to shift the focus to product development and the role of users in the testing of such products. In addition, Godin identified another rationale that Freeman put forward for wanting to include users of the technology. This was: 'Freeman believed that there is a failure in the market mechanism in