STRATEGIC MANAGEMENT OF BIOTECH FIRMS: INNOVATION, COMPETITION AND VALUE CREATION IN THE KNOWLEDGE ECONOMY

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Strategic Management of Biotech Firms: Innovation, Competition and Value Creation in the Knowledge Economy

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FOREWORD

Biotechnology is commonly defined as the use of living organisms or their components to produce substances beneficial to humankind. In this regard, it is noteworthy that even in prehistory, beverages and foods resulting from fermentation and leavening processes - such as wine, beer, and bread - were already being produced. At that time, however, the mechanisms facilitating the transformation of natural inputs into everyday food products remained unknown. It was only through Louis Pasteur's research that humanity gained an understanding of the microorganisms responsible for these transformations; consequently, Pasteur is frequently cited as the "father" of biotechnology. This was followed, in the early 1970s, by the development of recombinant DNA technology by Cohen and Boyer, which enables the isolation and excision of short DNA sequences and their subsequent transfer into the genomes of other cells, thereby modifying one or more genes. This milestone marked the birth of the innovative or advanced biotechnology sector, of which Genentech -founded in 1977 by Boyer himself - represents the progenitor. Since then, there has been an ongoing expansion in the number of firms basing their business models on these technologies. Depending on the source consulted, the modern biotechnology market is valued between $1.7 and $2.5 trillion, with projections suggesting it could reach nearly $4 trillion by 2030. This magnitude is undoubtedly significant, explaining the keen interest of the financial world and policymakers in a sector that has become strategic for many nations. From a business management perspective, however, the most compelling element lies in the unique characteristics of this industry. It is composed of a growing number of firms applying these technologies across diverse fields, ranging from pharmaceuticals and agriculture to industrial applications, the environment, and marine biology. These entrepreneurial entities operate within a highly innovative context characterized by a profound structural complexity that links diverse actors, including established and startup firms, universities, and both public and private research centers. These factors render the management of biotech firms a subject of particular interest to management scholars, offering numerous avenues for investigating the managerial methods and tools they employ. In this light, the contribution provided by my colleague and friend, Paola O. Achard - based on her teaching and research experience - constitutes an important resource. It serves both students of management courses - including those increasingly prevalent within life sciences curricula - and managers tasked with developing innovative approaches where elements such as innovation, competition, and cooperation must achieve a harmonious balance. Among the primary strengths of this book is its focus on the coexistence and interaction of these three elements, complemented by a thorough characterization of the reference context. In this field, technological, economic, social, and regulatory aspects intersect continuously, to a degree far greater than in other sectors, including those with high technological intensity. Simultaneously, the text is characterized by a seamless integration of a rigorous scientific approach - grounded in management theory - with the analysis of specific empirical cases, which facilitates a deeper understanding of the specificities of such a complex sector.

Regarding the latter, the decision to offer a comparative perspective spanning Europe (with a focus on the United Kingdom, Spain, and Italy) and Asia (South Korea) is particularly commendable, as it allows for a comparison of business models adopted in economically, socially, and institutionally distinct contexts. In my role as University Delegate for Technology Transfer, Third-Party Research, and Spin-off Creation at the University of L’Aquila, I particularly appreciated the part of the volume devoted to the strategic management of innovation processes. These processes are notably complex and risky in this sector, due to the long timelines and substantial financial resources required. Within these processes, a fundamental role is played by the collaboration between universities and industry

- a relationship that is not always straightforward but which, if managed effectively, can become a win-win scenario for both parties, as well as for the broader economic and social system.

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Preface

This volume is conceived as a strategic management textbook on biotechnology firms, designed to provide students and interested readers with a clear, structured, and research-informed analytical framework. Biotech firms represent a particularly relevant context for analyzing competition in the knowledge economy, as they operate under conditions of high scientific and technological uncertainty, stringent regulatory environments, significant capital requirements, and complex inter-organizational networks involving universities, research centers, investors, pharmaceutical companies, and public institutions. The book adopts a didactic approach, interpreting managerial phenomena through established management theories, integrated with empirical evidence and the sector-specific characteristics of a knowledge-intensive industry. Each chapter, therefore, combines theoretical concepts, managerial implications, and a critical analysis of key industry trends, supporting both the acquisition of foundational knowledge and the development of analytical skills applicable to case studies, assignments, and projects. The volume is structured into five chapters organized around three analytical blocks. The first block addresses the competitive context of biotech firms, focusing on macro-environmental factors and industry structure, including critical success factors and competitive forces. The second block examines interorganizational collaborations as strategic levers, analysing alliances, cross-sector partnerships, and mergers and acquisitions as mechanisms for knowledge access, risk sharing, and strategic evolution. The third block focuses on the governance of innovation processes within biotech firms. In this perspective, the analysis examines business models, value-generating activities, strategic resources, intellectual property management, and sustainable value-creation dynamics. The book is primarily intended for undergraduate and postgraduate students in economics and management, but it may also be used in postgraduate and executive education contexts. It further offers an analytical framework for researchers, managers, and policymakers interested in understanding strategic choices and innovation trajectories in biotechnology firms, systematically linking theory, research evidence, and managerial implications.

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DEDICATION

To M., for the support along the way.

And to A., who remains with me.

ACKNOWLEDGEMENTS

The preparation of this volume results from a long-standing scholarly and teaching trajectory, developed through continuous interaction with colleagues, students, and academic institutions. The author gratefully acknowledges colleagues who, through scientific dialogue and academic collaboration, contributed to consolidating the analytical framework and managerial perspectives developed throughout the book. Special recognition is extended to the students at the University of L'Aquila enrolled in undergraduate and postgraduate programmes in economics, management, and biotechnology, whose critical engagement in the classroom contributed to shaping the empirical grounding and conceptual framing of the models, decision-making logics, and strategic interpretations presented in this volume. Chapter 2 benefited from the scholarly contribution of Chiara Bellini, who participated in the development of its conceptual architecture, contributed to content refinement, and supported the preparation of visual materials. Responsibility for the final content and interpretations remains solely with the author. The author also acknowledges Leonardo Ioannucci for his assistance with bibliographic research and documentary analysis, which support the empirical and contextual sections of the book. Finally, the author acknowledges the academic institutions and national and international research environments that provided opportunities for structured discussion and intellectual exchange, contributing to the refinement of the strategic and organizational analyses presented herein.

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CHAPTER 1

The Biotech Sector: Analysis of the External Environmental Factors

Abstract: This chapter provides a systematic analysis of the external conditions shaping the strategic choices of biotechnology firms operating in Europe. The analysis is articulated across two complementary levels: the macro-environment and the competitive environment. At the macro level, three interdependent factors are examined *i.e.*, political-institutional orientation, technological trajectories, and regulatory frameworks, which together create both constraints and opportunities for biotechnology firms, particularly in the red biotechnology subsector. The chapter highlights how research and development investments, digitalization processes, and European policy initiatives influence access to financial resources, stimulate cross-sector collaborations among healthcare, pharmaceutical, and ICT actors, and encourage the development of innovation clusters and networks. At the sectoral level, the European biotech sector is characterized by high barriers to entry, low substitutability, strong supplier specialization, and medium-to-high customer bargaining power. Consequently, critical success factors include firms' ability to absorb and integrate knowledge, manage strategic partnerships along the innovation chain, and translate scientific research into scalable therapeutic and industrial solutions. The chapter concludes by outlining managerial and policy implications for strengthening European competitiveness in knowledge-intensive industries.

Keywords: Biotech sector, Competitive forces, Critical success factors, External environment, Innovation ecosystems, Knowledge-based firms, PESTEL.

INTRODUCTION

For more than two decades, new applications in healthcare, agriculture and food production, and environmental protection, alongside scientific breakthroughs, have brought about profound changes in the knowledge base underpinning the life sciences and biotechnologies. Significant investments in Research and Development (R&D) are driving the growth of the biotech sector at global scale. These investments are shaped by demographic changes, increased life expectancy, transformations in biomedical models, social globalization, and the substantial expansion of access to healthcare services. In fact, innovations in the biotech sector are disruptive and have a direct impact on social and economic well-being,

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as well as on planetary sustainability. The growing focus on sustainable development (United Nations, 2025) is presenting new challenges for biotech firms. Firms operating within the sector can make a significant contribution by creating solutions that are in harmony with, and conducive to, the long-term balance of living systems (European Biotechnology Network, 2025). These developments have also been affected by the changes brought about by the COVID-19 pandemic (Tabish, 2020). The pandemic underscored the strategic importance of the biotech sector for global health and security, highlighting the critical role of biotech firms in preventing, treating, and managing the effects of pandemics.

All the aspects referenced thus far highlight the strategic significance the biotech sector has assumed globally over the past decade, prompting scholars in the managerial field to examine the strategic profiles of modern biotech firms. The study of the strategic configuration of biotech firms, in turn, opens the way to important analyses and reflections on the modes of value creation (Porter & Kramer, 2019) that firms activate through their activities, processes, and involved actors.

The biotech sector is knowledge-intensive, with value creation predominantly oriented towards generating new knowledge, which is subsequently leveraged, disseminated, and translated into novel products and/or services. Knowledge represents a competitive asset (Mowery, Oxley & Silverman, 1996). Indeed, competition on a global scale is fundamentally grounded in the creation, acquisition, absorption, sharing, and transfer of new knowledge (Doz, 2023). The generation of new knowledge significantly affects both the quality and quantity of innovation-related products and processes. Concurrently, the capacity to integrate knowledge has profound implications for innovation performance, that is, the extent to which a firm is capable not only of generating innovative ideas but, more critically, of converting them into tangible and sustainable outcomes over time (Mardani *et al*., 2018). Biotech firms strategically harness innovation to secure competitive advantage (Porter, 1985), at both local and global levels, and to adapt their strategic orientations in response to the evolving demands of the external environment.

Recent data show that the health sector accounts for more than one-fifth of the global R&D investments (European Commission, 2025a). This phenomenon is attributable to the increasing presence of biotech and pharmaceutical firms among the principal corporate investors in R&D over the past ten years. As of 2024, the global biotech sector generated approximately 559 billion US dollars in revenue, comprising 12,487 firms, reflecting a 4.6% growth from 2023 (IBISWorld, 2025).

In Europe, as of 2022 (Statista, 2024a), the latest year for which data are available, slightly more than 6,500 biotech firms are operating, as depicted in Fig. (**1**).

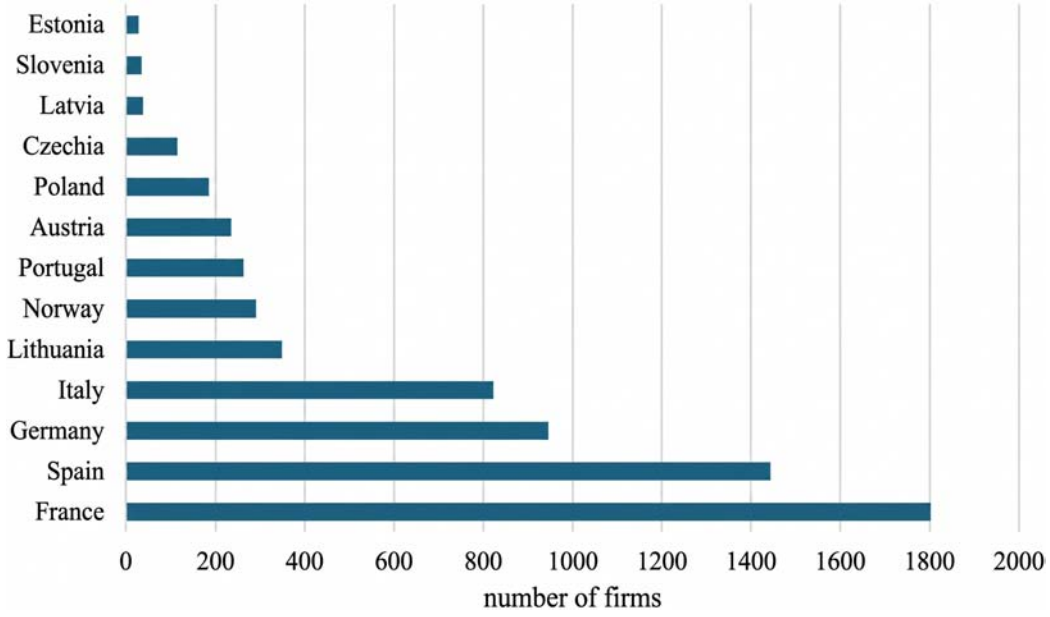

Fig. (1). Distribution of biotech firms in Europe (Statista, 2024b).

A biotech firm is defined as a firm engaged in key biotechnological activities, such as the application of at least one biotechnological technique to produce goods or services and/or the execution of biotechnological R&D activities (OECD, 2005). The differentiated and heterogeneous nature of biotech firms does not permit a clear-cut classification. In this volume, the color-coding criterion (DaSilva, 2004) is employed, allowing the distinction of biotech firms by their predominant subsector of activity. The most widely recognized colors are three. Fig. (**2**) illustrates the distribution of firms by subsector affiliation in Italy: red (medical-pharmacological area), green (agri-food area), and white (Gene-based Bioindustries).

Firms specializing in genomics, proteomics, and enabling technologies (Key Enabling Technologies, KETs, or General Purpose Technologies, GPTs) play a transversal role across all other subsectors. In addition to these three, there are five other subsectors identified in Table **1**, although an additional color (orange) is often used to designate firms involved in the dissemination of knowledge, applications, and discoveries within the biotech sector. Furthermore, it is possible to distinguish biotech firms according to their core business (Abell, 1980;

CHAPTER 2

Managing Competition Through Strategic Collaborations

Abstract: This chapter analyzes the strategic importance of interorganizational collaborations in the biotech sector, emphasizing their role as key drivers of innovation and competitiveness in knowledge-intensive contexts. It first examines the theoretical and strategic dimensions of collaborative relationships, including their objectives, enabling conditions, governance mechanisms, and main organizational forms such as strategic alliances, research joint ventures, university–industry partnerships, networks, and innovation ecosystems. Attention is devoted to cross-sector collaborations involving biotechnology firms and organizations operating in pharmaceuticals, information technologies, agri-food systems, and academic research. These partnerships facilitate knowledge exchange, resource sharing, and risk distribution while supporting technological convergence and long-term value creation. The chapter also explores the strategic evolution of collaborations into mergers and acquisitions, which often represent a natural development of earlier partnerships. Through these processes, smaller biotech firms can capitalize on intellectual property and technological knowledge generated through collaborative projects, while larger corporations strengthen their innovation capabilities and expand their global competitive position. The chapter concludes that collaborations and acquisitions operate as complementary mechanisms for entrepreneurial renewal and sustainable competitiveness in the biotechnology industry.

Keywords: Cross-sector partnerships, Interorganizational collaborations, Mergers and acquisitions, Open innovation, Strategic alliances, Value creation.

INTRODUCTION

Competition at a global scale relies on the creation, acquisition, absorption, sharing, and transfer of new knowledge. Knowledge creation strongly influences the speed, quality, and quantity of innovation, while knowledge integration significantly impacts innovative performance. Firms strategically leverage innovation for three main reasons: to gain a competitive advantage, both locally and globally, to adapt their strategies to the evolving demands of the external environment, and, finally, to create value (Arsawan *et al*., 2022). The propensity for innovation is greater in so-called knowledge-intensive sectors, such as pharmaceuticals, chemicals, biotechnology, electronics, telecommunications, and

information technology (Bloem & Salimi, 2023). Highly competitive sectors, such as biotechnology, tend to exhibit more cooperative interactions among firms.

The coexistence of competition and collaboration depends on a combination of sector-specific characteristics and the distinctive features of a firm's activities (primary and secondary). Relevant factors in the biotech sector include a high level of firm concentration (dichotomous structure; geographic clustering), along with the threat posed by potential new entrants. In addition, the presence of high entry barriers, including the need for large financial investments required for production and access to distribution channels (Fraterman, Wübbels & Kniss, 2023), as well as strategic barriers, should be considered. Finally, the ability of firms to build collaborative relationships is a key factor in determining their survival and long-term development. From a strategic perspective, the proliferation of collaborative strategies and strategic alliances for corporate governance is certainly one of the most compelling aspects of this sector.

The creation and dissemination of specialized knowledge, the containment of R&D costs, and the reduction of time-to-market are key competitiveness factors for European biotech firms. The transition from scientific discovery to market application represents a critical inflection point for biotech firms (Simon & Giovannetti, 2017). In this scenario, interorganizational collaborations (IORs) often arise to integrate complementary knowledge, share risks and capital, and develop solutions that would otherwise be unattainable with a single approach.

The present chapter aims to investigate strategic IORs in the biotech sector. To this end, it is divided into three sections. The first section introduces the strategic dimensions of IORs, highlighting their objectives, supporting factors and barriers, governance arrangements, and the typical forms of collaboration observed. The second section explores in greater depth the cross-sectoral dimension, illustrating its advantages, diffusion data, and several emblematic cases. Finally, the last section examines the evolution of collaborations into Merger & Acquisition (M&A) processes, presenting data and trends that underscore how such strategies are shaping the entire biotech ecosystem. A brief conclusion synthesizes the principal findings that have emerged, linking the analysis to the sector's future trends.

INTERORGANIZATIONAL COLLABORATIONS: RELEVANT STRATEGIC ELEMENTS

IORs represent a fundamental element for competitiveness and innovation across many sectors. In the biotech sector, characterized by high technological complexity and substantial R&D costs, these forms of collaboration play an even more critical role. The growing prevalence of alliances, joint ventures, and

collaborative networks reflects the need to share resources, know-how, and the risks associated with developing innovative products and/or services (Achard & Bellini, 2023).

IORs are generally considered distinctive forms of interaction among two or more firms aimed at creating synergy that amplifies the scope and effectiveness of individual actors' strategies and behaviors (Taylor & Doerfel, 2005). Such a definition suggests that collaboration goes beyond mere cooperation and coordination (Gulati, Wohlgezogen & Zhelyazkov, 2012; Tee, Davies & Whyte, 2019). The development of IORs is particularly relevant for biotech firms in addressing the defining challenges of the macro-environment. These challenges include increasing healthcare demands associated with population aging, the growing incidence of chronic diseases, limited financial resources, the rapid pace of technological advancement, and heightened public expectations, particularly from informed and empowered citizens. From a strategic perspective, it is assumed that the cooperative choices of biotech firms are partly influenced by macro-environmental and sector-specific characteristics (see Chapter 1). Indeed, macro-environmental factors encourage biotech firms to pursue collaborative initiatives to enhance their governance capacity within competitive contexts. Furthermore, participation in collaborative networks is often motivated by firms' intention to expand their portfolios of distinctive resources and capabilities (Prahalad & Hamel, 1999), which can be leveraged to enhance innovation management. This highlights how strategic, collaborative interactions contribute to achieving biotech firms' strategic objectives.

Collaboration, in relation to a firm's competitive positioning, can manifest horizontally (within the same business area), vertically (along the production or supply chain), or laterally (between firms operating in different sectors or with diverse organizational types). In certain sectors, such as biotechnology, healthcare, and pharmaceuticals, there is a recognized coexistence of both competition and cooperation, a phenomenon referred to as co-opetition (Brandenburger & Nalebuff, 2011). Co-opetition depends on both the specific context and the nature of the activities involved. As a result, IORs can take a variety of forms, primarily shaped by the strategic needs and degree of horizontal integration among participating biotech and non-biotech firms.

Key issues related to IORs include, of course, the objectives behind the formation of strategic IORs, but also the factors that support the creation of IORs, the barriers that hinder their development, and, finally, the governance mechanisms and typologies that influence the structure of IORs. Compared to Gulati's perspective (Gulati, Wohlgezogen & Zhelyazkov, 2012) of collaboration as an umbrella term encompassing both cooperation and coordination, more recent

CHAPTER 3

Managing Innovation: Business Models and Strategic Configurations in Biotech Firms

Abstract: This chapter examines the strategic management of innovation in biotechnology firms, focusing on how scientific knowledge is translated into viable business models and technological opportunities. In highly knowledge-intensive environments characterized by scientific uncertainty and long development cycles, firms must design organizational configurations that integrate research activities, intellectual property management, and collaborative networks. The chapter analyzes the main business model configurations observed in the biotechnology sector, including dedicated biotech firms, integrated biotech firms, fully integrated firms, and hybrid models such as platform-based and service-oriented approaches. Through comparative observations across Italy, Spain, the United Kingdom, and South Korea, the analysis highlights how institutional environments, innovation policies, and scientific clusters shape firms' strategic choices and innovation trajectories. Particular attention is devoted to the role of collaborative ecosystems, open innovation practices, and emerging digital technologies in supporting the transformation of scientific discoveries into scalable solutions. The chapter demonstrates that strategic innovation in biotechnology requires aligning scientific capabilities, organizational structures, and innovation networks to create sustainable competitive advantage.

Keywords: AI, Biotech business models, Innovation management, Innovation ecosystems, Knowledge-intensive firms, Strategic innovation.

INTRODUCTION

The preceding chapters have highlighted how the biotech sector is characterized by a profound interdependence between science, technology, market dynamics, and regulatory frameworks, making a dynamic strategic approach and the ability to establish collaborative networks essential. In more detail, Chapter 1 has shown how the external context profoundly influences the strategic decisions of European biotech firms, while Chapter 2 has illustrated how IORs represent key strategic alternatives to respond to the needs of a rapidly evolving sector, in which the search for new therapeutic, industrial, or environmental solutions necessitates the sharing of expertise, knowledge, costs, and risks.

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Building on these considerations, this chapter focuses on the strategic management of innovation within biotech firms. In knowledge-intensive industries such as biotechnology, firms do not merely exploit scientific discoveries; rather, they must integrate them into coherent business models that transform research outcomes into valuable products, services, or technological platforms. The ability to design and manage appropriate innovation strategies, therefore, represents a critical success factor for firms operating in highly uncertain and regulated environments.

Unlike many traditional industries, where barriers to entry are mainly economic or technological, biotechnology is characterized by a unique combination of scientific complexity, regulatory constraints, and substantial investments in research and development. Firms must therefore adopt flexible organizational configurations and strategic approaches capable of supporting long development cycles and managing high levels of uncertainty.

Within this context, the chapter analyzes the main business models adopted by firms operating in the biotech sector and examines how they organize research activities, manage intellectual property, and develop collaborative networks with universities, research institutions, and industrial partners. Attention is devoted to the strategic configurations through which biotech firms structure their innovation processes and position themselves within broader scientific and technological ecosystems (Onetti & Zucchella, 2014; Eudaric & Pellegrin, 2026).

Through analysis of different national contexts, the chapter highlights how innovation pathways may differ across institutional environments while converging on a common objective: maximizing the value generated by scientific knowledge and transforming it into high-impact solutions for the economy and society. In this perspective, strategic innovation emerges as a key mechanism through which biotech firms translate scientific capabilities into competitive advantage.

BUSINESS MODELS FOR INNOVATION MANAGEMENT

The strategic management of innovation in biotech firms involves a continuous, complex process of translating scientific outcomes into products and/or services that can be deployed across multiple subsectors, including healthcare, environmental applications, agriculture, and industry. This process must take place within the confines of regulatory frameworks that are often highly stringent and constantly evolving. In such a complex environment, the business model assumes a central role. It defines how the firm creates, delivers, and captures value from knowledge, whether developed internally or acquired through IORs (Pisano, 2006; Pires & Ferreira, 2025; Sorrentino & Garraffo, 2012).

The distinctive strategic features of the biotech sector, such as intensive capital requirements, the protracted duration of R&D cycles, and the high probability of project failure, generate corporate behaviors and strategic choices that differ markedly from those observed in more traditional sectors, such as manufacturing or services. Therefore, it is important to explore the fundamental components that shape the business models of biotech firms, analyzing how firms strategically integrate scientific research, partnership configurations, and the valorization of IP to sustain innovation trajectories and build competitive advantage (Bianchi *et al*., 2011; Bigliardi, Nosella & Verbano, 2005).

The Architecture of the Business Model in Biotech Firms

The business model defines how a firm creates, delivers, and captures value. In concrete terms, it describes how the firm generates economic, social, and environmental value by offering specific products or services to targeted customer segments, while optimally organizing the resources and activities required to do so. A clearly defined business model supports strategic decision-making, facilitates differentiation from competitors, and enables rapid adaptation to changes in the competitive environment (Niosi & McKelvey, 2018; Osterwalder & Pigneur, 2010; Shafer, Smith & Linder, 2005; Teece, 2018).

Table 5. Canvas business model articulation (own elaboration).

-	Who/What are They?	Why are Important
Key partnerships	The network of suppliers, distributors, and external partners that support the firm through various IORs.	They make it possible to acquire skills, resources, or channels that the firm does not possess internally, reducing costs and risks while accelerating innovation.
Key activities	The key activities the firm must carry out to make the business model work.	They allow the firm to focus on activities that generate real value for the customer and differentiate it from the competition.
Value propositions	The set of benefits and solutions that the firm offers to satisfy customer needs or solve their problems.	They represent the main reason why customers choose one offering over another; they clarify the very purpose of the firm's existence.
Customer relationships	The type of relationship established with each customer segment.	Defining how to interact with customers influences loyalty, satisfaction, and ultimately the firm's sales and reputation.
Customer segments	Distinct groups of individuals, firms, or institutions to which the firm directs its offering.	Precisely defining customer segments means focusing marketing efforts on the real needs of those who will benefit from the products or services.
Key resources	The key assets the company must own or acquire to create and deliver the value proposition.	Without the right resources it is impossible to implement the desired business model.

CHAPTER 4

Value-Generating Activities and Strategic Resources in Biotech Firms

Abstract: This chapter analyzes the internal processes through which biotechnology firms generate and organize value along their innovation and production activities. Using the value chain framework as the main analytical lens, the chapter examines how primary and support activities interact to transform scientific discoveries into marketable products and services. Attention is devoted to the role of organizational resources and competencies in sustaining long-term competitive advantage. In biotechnology, tangible resources such as laboratories and research infrastructure interact closely with intangible assets, including scientific knowledge, technological platforms, intellectual capital, and relational networks. The chapter highlights how integrating these elements enables firms to manage complex innovation processes, coordinate regulatory and technological requirements, and sustain the long development cycles typical of the sector. By examining the interdependence between value-generating activities and strategic resources, the chapter demonstrates that competitive advantage in biotechnology depends not only on scientific breakthroughs but also on the organizational capacity to coordinate resources, competencies, and operational processes in highly uncertain environments.

Keywords: Core competencies, Organizational capabilities, Resource-based view, Dtrategic resources, Value chain.

INTRODUCTION

While the previous chapter has examined the strategic configurations through which biotech firms manage innovation and design their business models, the present chapter shifts the focus to the internal mechanisms through which scientific knowledge is transformed into economic and organizational value. In highly knowledge-intensive sectors such as biotechnology, innovation outcomes depend not only on the quality of research activities but also on the effective coordination of the multiple activities involved in development, production, and commercialization processes.

To analyze these dynamics, the chapter adopts the value chain framework originally proposed by Porter (1985), which enables the systematic examination of the set of activities through which firms create value for their stakeholders.

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Within biotech firms, value-generating activities span the management of research inputs and laboratory operations, regulatory interactions, production processes, and market access strategies. Each of these stages requires integrating specialized competencies, technological infrastructures, and organizational routines that support long, complex development cycles.

Attention is devoted to the role of strategic resources and organizational competencies in sustaining competitive advantage. In biotechnology, tangible assets such as laboratories, research infrastructures, and production facilities interact with intangible resources including scientific know-how, intellectual capital, technological platforms, and relational networks. The effective integration of these resources enables firms to coordinate complex innovation processes and to manage the high levels of uncertainty that characterize the sector.

By examining both primary and support activities, the chapter highlights how biotech firms organize their internal processes to convert scientific discoveries into viable technological solutions and market opportunities. In doing so, it emphasizes the strategic importance of aligning value-generating activities with the firm's innovation strategy and long-term competitive positioning.

MANAGEMENT OF VALUE-GENERATING ACTIVITIES

The management of value-generating activities within the biotech sector constitutes a complex process involving multiple players, resources, competencies, and development phases (Grant & Phene, 2022). The breadth and heterogeneity of biotechnological innovation, ranging from fundamental scientific discoveries to the market launch of products or services, require a sequence of interrelated activities, namely research, experimentation, development, production, IP protection, marketing, and distribution. In a highly competitive environment where development timelines can extend beyond a decade, and the risks associated with experimental failure or regulatory shifts are significant, biotech firms must exercise rigorous oversight over each activity of this process to maximize value creation and optimize resource allocation (Porter, 1985; Teece, 2018).

The primary analytical framework for examining value-creating activities within firms is the value chain, as introduced by Porter (1985). The value chain is a strategic construct that describes the full range of activities undertaken by a firm, which, when integrated effectively, contributes to the creation of value for the end customer. This analytical tool enables a detailed examination of a firm's internal operations and facilitates the identification of sources of sustainable competitive advantage. According to Porter, the value chain consists of two principal categories of activities (Fig. **16**), called primary activities and support activities.

Primary activities are directly involved in the creation, production, delivery, and distribution of the product or service. These include inbound logistics, production operations, outbound logistics, marketing and sales, and post-sale services. Support activities, on the other hand, include procurement management, technology development, human resource management, and corporate infrastructure. These activities provide essential support to the primary activities.

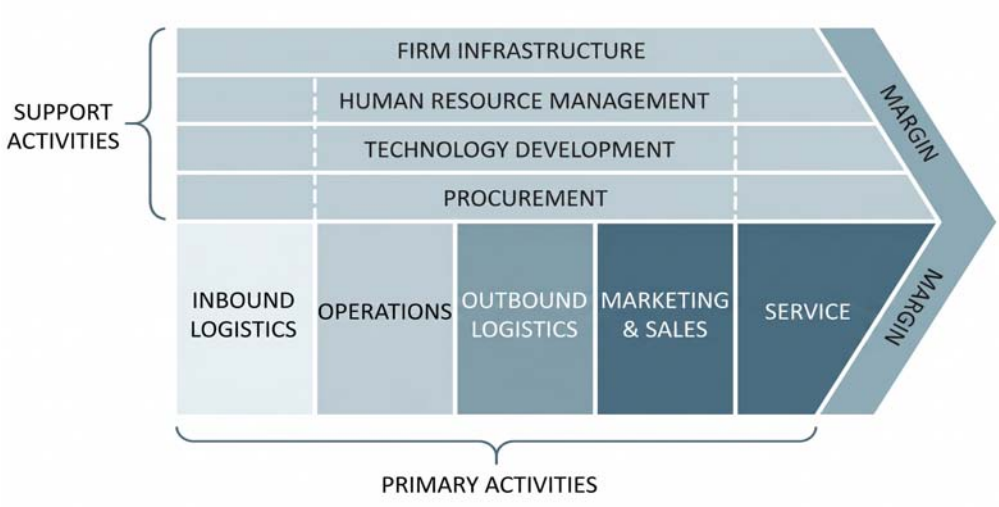

Fig. (16). Value chain tool (Porter, 1985).

In biotech firms, support activities play a decisive role in enabling primary activities to generate sustainable competitive advantage (Finegold & Frenkel, 2006). The academic literature on the value chain framework clearly indicates that excellence in primary activities depends heavily on the quality and efficiency of supporting managerial processes (Enginoğlu & Arikan, 2016; Porter, 1985).

Infrastructure Activities

Infrastructure activities primarily concern corporate governance, strategic and marketing planning, sustainability policies, management control systems, administration, financial management, institutional relations, and legal affairs. In biotech firms, corporate governance is often structured around integrating strategic and marketing planning processes with sustainability-related decisions and policies. This alignment is crucial to ensure that the research pipeline, which is typically capital-intensive, remains coherent with the firm's strategic objectives and with the ethical and environmental standards demanded by institutional stakeholders. At the same time, a formalized system of planning and management control, supported by administrative, financial, institutional, and legal functions,

CHAPTER 5

Strategic Marketing, Intellectual Property, and Sustainable Value Creation

Abstract: This chapter explores how biotechnology firms translate scientific innovation into sustainable economic and societal value through strategic marketing and effective intellectual property management. In knowledge-intensive sectors, marketing serves as a governance function, supporting technology transfer, stakeholder communication, and the positioning of innovation within complex scientific and industrial ecosystems. The chapter examines how intellectual property portfolios strengthen firms' competitive advantage by protecting technological discoveries while enabling licensing agreements, collaborative development projects, and strategic alliances. It also highlights the growing importance of stakeholder engagement and transparent communication with investors, regulatory authorities, research institutions, and healthcare organizations. Finally, the chapter analyzes the contribution of biotechnology firms to sustainable development, emphasizing their role in addressing global challenges related to health, environmental protection, agriculture, and industrial transformation. By integrating innovation management, marketing strategies, and sustainability-oriented governance, biotech firms demonstrate how economic performance and societal value creation can reinforce each other in the knowledge economy.

Keywords: Intellectual property, Strategic marketing, Stakeholder engagement, Sustainable innovation, SDGs, Technology transfer.

INTRODUCTION

Building upon the analysis of innovation processes and value-generating activities presented in the previous chapters, this chapter explores how biotech firms translate scientific and technological capabilities into sustainable market value. In knowledge-intensive industries, the commercialization of innovation requires not only strong research capabilities and efficient organizational processes but also effective strategies for intellectual property management, stakeholder engagement, and market positioning.

In the biotech sector, marketing assumes a distinctive strategic role. Rather than being limited to promotional activities, it operates as a governance function that

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supports the communication of scientific value, facilitates technology transfer processes, and strengthens relationships with a wide range of stakeholders, including investors, research institutions, healthcare organizations, regulatory authorities, and industrial partners.

Within this perspective, intellectual property represents one of the most critical strategic assets for biotech firms. Patents, proprietary technologies, and specialized know-how not only protect innovation outcomes but also create opportunities for licensing agreements, collaborative development projects, and strategic alliances. The management and valorization of intellectual property, therefore, become central elements in the broader process of innovation commercialization.

Finally, the chapter examines the growing relevance of sustainability and social responsibility within the strategic orientation of biotech firms. By developing solutions to global challenges in healthcare, agriculture, environmental protection, and industrial processes, the biotech sector directly contributes to several Sustainable Development Goals (SDGs). In this context, integrating innovation management, marketing strategies, and sustainability-oriented governance enables biotech firms to generate economic value while simultaneously fostering broader societal and environmental benefits.

STRATEGIC MARKETING FOR INNOVATION: CREATION, MANAGEMENT, AND VALORIZATION OF INTELLECTUAL PROPERTY

Today, marketing represents a core business function that plays a pivotal role in establishing and sustaining competitive advantage across many sectors. For a biotech firm, irrespective of the specific subsector, recognizing R&D as the fundamental business activity requires framing marketing as a governance function, including knowledge management, corporate reputation, and technology transfer processes, rather than limiting it to a set of promotional and distribution tactics.

Within marketing activities, a clear distinction exists between strategic dimensions, such as market segmentation, brand positioning, and brand management, and operational dimensions, which include pricing, product and service management, as well as communication and distribution channel decisions. In the context of biotech firms, strategic marketing and the management and valorization of IP should not be treated as separate disciplines, but rather as interconnected components of a value creation strategy. A well-developed IP portfolio enhances the firm's competitive positioning and bargaining power. Concurrently, effective communication about the firm's innovative

potential, supported by scientific publications and strategic partnerships, increases the appeal of the IP portfolio to key stakeholders, including investors and licensees. Consequently, developing a product and service pipeline requires a dual assessment of profitability and patent defensibility, carefully balancing research projects by their degree of innovation. Every decision, ranging from project selection and licensing of ancillary technologies to the establishment of spin-offs or joint ventures with partners, has direct implications for the firm's financial health and the value proposition presented to stakeholders (Fahy & Smithee, 1999; Varadarajan, 2010). Technology transfer is therefore a critical activity that mitigates financial risk while simultaneously fostering trust among investors, regulatory authorities, healthcare organizations, and potential licensees. Rather than awaiting the commercial phase, the firm progressively builds external validation that enhances its credibility (Grupp & Gaines-Ross, 2002; Hunt & Hansen, 2010).

Applying foundational marketing principles requires the continuous adjustment of the value proposition. This may involve promoting exit strategies to forward-thinking financiers, disseminating robust clinical evidence to industrial partners, and presenting data on therapeutic efficacy and economic, social, and ethical sustainability to reimbursement bodies (Palmatier & Crecelius, 2019). Additionally, the dynamics of the biotech macro-environment (political, institutional, technological, and legal factors outlined in Chapter 1) alongside an emphasis on collaboration, smart specialization, and the integration of environmental and social criteria in innovation projects, require that corporate reputation be strategically managed to facilitate access to public funding and establish long-term partnerships (Sheth & Parvatiyar, 2021). At the same time, strategic marketing aims to systematically convert research outcomes into viable market opportunities, building credibility through transparent, consistent communication grounded in accessible, verifiable data. For biotech firms, this often entails not merely promoting an existing product or service but highlighting the potential therapeutic, environmental, social, and ethical benefits that innovations under development promise to deliver to healthcare systems, the biotech and pharmaceutical sectors, and society. Communication strategies must be tailored to specific stakeholders. For example, the scientific community requires detailed research methodologies and protocols, investors need clear visibility on project phases and associated capital deployment, while healthcare providers seek compelling evidence of efficacy and safety.

Fig. (**17**) depicts marketing of biotech firms as an ecosystem orchestration process. The biotech firm is positioned at the center and interacts with key stakeholders, *i.e*., research institutions, hospitals, regulators, agencies, investors, patients, advocacy groups, and industry partners, through various activities

GENERAL CONCLUSION

The analyses developed throughout this volume have highlighted how the strategic management of biotechnology firms must be understood within the broader transformation of contemporary knowledge-based economies. Biotechnology represents one of the most paradigmatic sectors in which scientific discovery, technological development, and market creation are deeply interconnected. In such contexts, competitive advantage does not emerge solely from technological breakthroughs but from the firm's ability to strategically organize knowledge, resources, and collaborative networks to transform scientific potential into sustainable economic and societal value.

The first part of the book has shown how the external environment plays a decisive role in shaping the strategic trajectories of biotech firms. Political orientations, regulatory frameworks, technological infrastructures, and financial ecosystems jointly define the opportunity space within which firms operate. In knowledge-intensive sectors characterized by high uncertainty and long development cycles, firms must continuously align their strategic choices with institutional dynamics, innovation policies, and evolving technological paradigms. As a result, competitiveness increasingly depends on the capacity to navigate complex regulatory environments and to position the firm within dynamic innovation ecosystems.

The second dimension explored in this volume concerns the strategic role of interorganizational collaborations. Biotechnology firms rarely innovate in isolation. Instead, they operate within dense networks that connect universities, research centers, pharmaceutical companies, venture capital investors, and public institutions. Strategic alliances, research partnerships, and innovation networks, therefore, become essential mechanisms for accessing complementary knowledge, sharing risks, and accelerating technological development. These collaborative arrangements also represent a crucial pathway for emerging firms to scale their innovation trajectories and integrate into global value chains. Building upon this external and relational perspective, the analysis has then focused on the internal strategic architecture of biotech firms. Business models constitute a central mechanism through which firms organize innovation processes and structure the transformation of scientific discoveries into technological platforms, therapeutic applications, or industrial solutions. The diversity of business model configurations -from dedicated research-oriented firms to more integrated structures- reflects different strategic responses to the challenges of uncertainty, financing constraints, and regulatory complexity. In all cases, however, the effective alignment between scientific capabilities, organizational structures, and collaborative ecosystems emerges as a key determinant of long-term competitiveness. The examination of value-generating activities has further emphasized that the strategic performance of biotech firms depends on the effective integration of the entire value chain. From research inputs and experimental development to production, regulatory validation, and market access, each phase requires the coordination of specialized resources and organizational competencies. Tangible assets, such as laboratories and technological infrastructure, interact with intangible resources, including intellectual capital, scientific reputation, relational networks, and proprietary technologies. By integrating these elements, firms develop distinctive competencies that enable them to manage complex innovation processes and sustain competitive advantage over time.

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Finally, the analysis has highlighted that the commercialization of biotechnology innovation increasingly requires integrating strategic marketing, intellectual property management, and stakeholder engagement. In knowledge-intensive industries, marketing functions extend far beyond traditional product promotion. Instead, they operate as governance mechanisms that support technology transfer, facilitate communication with investors and regulators, and position innovation within broader scientific and industrial ecosystems. Intellectual property portfolios represent a strategic asset that allows firms to protect discoveries while simultaneously enabling licensing strategies, collaborative agreements, and new forms of technological diffusion.

Taken together, the different dimensions analyzed in this book suggest that biotechnology firms operate at the intersection of science, strategy, and societal transformation. The capacity to integrate research excellence, organizational capabilities, and collaborative governance determines not only the success of individual firms but also the broader evolution of innovation ecosystems in which they are embedded.

From a managerial perspective, the findings underline the importance of adopting integrated strategic approaches that combine innovation management, resource orchestration, and collaborative governance. Managers operating in biotechnology firms must develop capabilities not only in scientific and technological domains but also in alliance management, regulatory navigation, and strategic communication with diverse stakeholder groups. In such environments, competitive advantage increasingly depends on the ability to coordinate interdisciplinary knowledge and to structure innovation processes capable of sustaining long-term development trajectories.

The different dimensions examined throughout this volume also highlight the increasingly central role played by biotechnology innovation ecosystems. Biotech firms rarely operate as isolated entities; rather, they are embedded in complex, evolving systems of relationships that connect universities, research centers, pharmaceutical and technology companies, venture capital investors, healthcare institutions, and public authorities. Within these ecosystems, knowledge circulates across organizational and disciplinary boundaries, enabling the recombination of scientific discoveries, technological capabilities, and entrepreneurial initiatives. Strategic positioning within such ecosystems, therefore, becomes a critical determinant of long-term competitiveness. Firms that can orchestrate collaborative networks, access distributed knowledge sources, and actively participate in innovation clusters are better positioned to accelerate discovery and translate research outcomes into scalable technological solutions.

Looking ahead, the future trajectory of biotechnology is likely to be shaped by several transformative dynamics. First, the rapid integration of AI and advanced data analytics into research processes is redefining the discovery and development paradigms of the life sciences. Data-driven experimentation, machine learning models applied to genomic and clinical datasets, and digital platforms that integrate biological and computational knowledge are progressively transforming how innovation is generated and managed. Second, the increasing availability of large-scale biological data -from genomics and proteomics to real-world clinical evidence- is reinforcing the strategic importance of data governance and interdisciplinary competencies combining biology, informatics, and engineering. At the same time, biotechnology is expected to play an increasingly strategic role in addressing some of

the most pressing global challenges. Advances in biomedical research, sustainable agriculture, bio-based industrial processes, and environmental biotechnology offer significant opportunities to improve global health, mitigate climate change, and support the transition to more sustainable production systems. In this context, the alignment between scientific innovation, sustainability objectives, and responsible governance is likely to become a defining feature of the sector's future evolution.

For both managers and policy makers, these transformations imply the need to rethink traditional approaches to innovation and industrial strategy. Strengthening research infrastructures, facilitating interdisciplinary collaboration, supporting technology transfer mechanisms, and fostering international partnerships will be essential to fully exploit the potential of biotechnology innovation. Ultimately, the future of the sector will depend on the capacity of firms, institutions, and societies to collectively govern the complex interactions between science, technology, markets, and public interests, ensuring that the extraordinary potential of biotechnology contributes not only to economic competitiveness but also to broader societal well-being.

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