



INSTITUTO
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**Strategies to lead outsourced teams:
insights into management of the biotech value chain**

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Master in Applied Management

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Department of Marketing, Operations and General
Management

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Dedication and acknowledgements

À minha mãe, que apesar de ausente em corpo, sempre presente em alma.

*Que a memória não nos falhe e consigamos recordar para sempre,
o som da gargalhada, a ternura do olhar, o calor do abraço, o sabor dos
cozinhados e o cheiro do perfume daqueles que amamos.*

À minha família, amigos e colegas, com o seu apoio incondicional, partilha de conhecimento, aprendizagens e crescimento pessoal.

À minha orientadora, Alexandra O'Neill, pela sua paciência, dedicação e exemplar liderança.

Ao ISCTE Executive Education, por tornar a aprendizagem tão didática e prazeroza.

Resumo

Reconhecendo que a cadeia de valor do sector da biotecnologia é apoiada em estruturas complexas de subcontratação e a necessidade de expandir para o sector da biotecnologia as medidas previamente identificadas, neste estudo os autores pretendem compreender e propor estratégias de gestão de uma cadeia de valor baseada na subcontratação e de liderança de equipas subcontratadas. Para tal, os autores realizaram revisão bibliográfica e um questionário desenvolvido para o estudo e direccionado para o sector da biotecnologia. Utilizando dados secundários e primários, pesquisas qualitativas e quantitativas, foram realizadas análises e comparações das fontes, e apresentadas propostas, como resultado da pesquisa realizada. As descobertas sugerem que o acesso a funções especializadas é o principal aspecto considerado pelo sector da biotecnologia para conferir vantagem estratégica na subcontratação de funções e a exigente gestão de recursos humanos e de operações é proposta como a principal preocupação no contexto de subcontratação e o fator crítico de sucesso na gestão de uma cadeia de valor subcontratada. Estes resultados fortalecem a visão da relevância de estratégias para gerir uma cadeia de valor baseada na subcontratação e liderar equipas subcontratadas. Concluindo, os autores propõem que as empresas de biotecnologia expandam para as áreas relevantes do conhecimento através da subcontratação. Devem também reconhecer a importância da gestão de recursos humanos e investir em mecanismos para regular e promover a absorção de conhecimento. Devem ainda desenhar uma estrutura de governação de relações e instrumentos que permitam boas práticas de liderança de equipas subcontratadas e promovam partilha de conhecimento.

Palavras chave: Liderança, Subcontratação, Estratégias de gestão, Biotecnologia, Cadeia de valor

JEL Classification codes: *L24*, Contracting Out, Joint Ventures, Technology Licensing; *M10*, General Business Administration

Abstract

Comprehending that the biotech value chain is supported by outsourced structures and the need to expand findings to drug discovery biotech, in the current study the authors aim to understand and propose effective strategies to manage an outsourced-based value chain and lead outsourced teams. To do so, the authors conducted a literature review and a research survey developed for the present study and focused on the biotech sector. Using secondary and primary data, qualitative and quantitative research, the analysis and comparison of the sources were performed, and proposals were presented, as a result of the conducted research. The findings suggest that access to specialized functions was the main aspect considered by biotech to confer strategic advantage to outsourcing business functions and that demanding HR and operations management are proposed as the main concern of outsourcing and the critical factor of success when managing an outsourced-based value chain. Additionally, communication and good leadership practices are proposed as the most relevant aspects of effectively promoting motivation of outsourced teams. These results strengthen the view of the relevance of effective strategies to manage an outsourced-based value chain and lead outsourced teams in biotech. The resulting findings also propose that drug discovery biotech must expand to the relevant areas of knowledge, considering complementary and synergetic specialties through outsourcing, while taking careful consideration of HR management and investing in mechanisms to regulate and promote knowledge absorption, as well as designing strong relationships governance structure and instruments to successfully manage outsourced teams and share generated knowledge.

Keywords: Leadership, Outsourcing, Management strategies, Biotech, Value chain

JEL Classification codes: *L24*, Contracting Out, Joint Ventures, Technology Licensing; *M10*, General Business Administration

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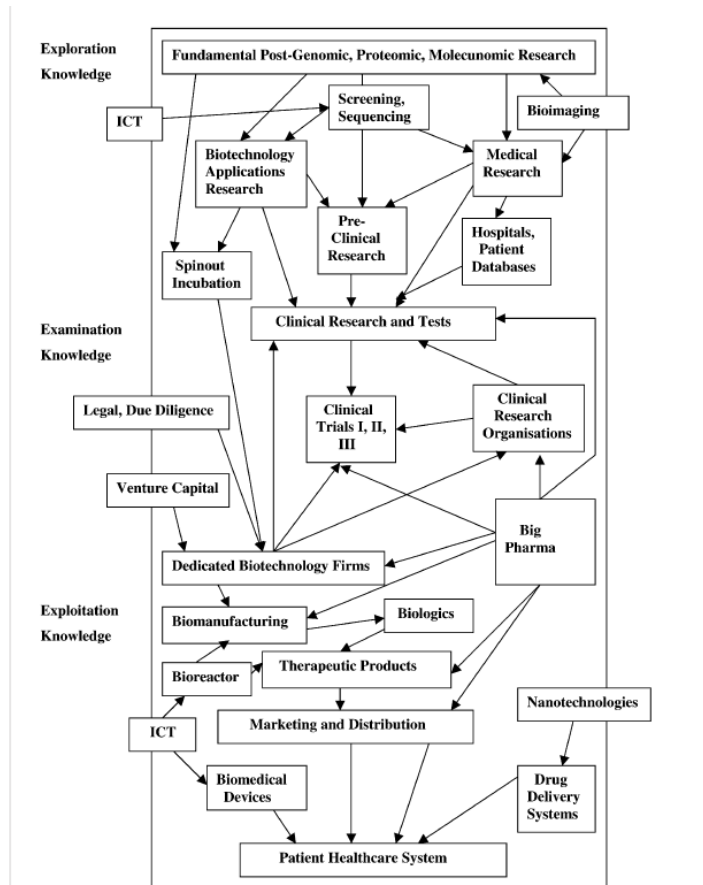
1. Introduction

The pharmaceutical industry has been significantly growing over the last years. The pharmaceutical R&D expenditure has increased from around \$18 billion in 2000 to \$42 billion in 2020 (efpia, 2022) and this increase has been accompanied by a growth of the total pharmaceutical market, which increased from \$89 billion to \$255,000 billion in the same period. Despite this trend, the number of novel drugs approved in the last 20 years has not been increasing as much (CDER Drug Approvals U.S. 2008-2023 | Statista, 2024). In 2023, 55 new drugs were approved, as compared to 59 in 2018 and 27 in

2013. Whereas there is a significant increase of the number of approved new drugs between 2013 and 2018, the same trend is not verified from 2018 to present. The need to expand the R&D efforts and the increase of R&D costs led the pharmaceutical sector to revisit their strategy and to shift from fully in-house developed programs to strategic partnerships with biotech and contract research and manufacturing businesses (Tufféry, 2015).

Currently the sector of pharmaceutical companies has a portfolio with close to 50% externally generated projects (Tufféry, 2015). The trend of outsourcing business functions has also expanded to the biotech sector, where an increase of outsourcing is also noticeable. Currently there is an intricate network behind R&D and novel drugs commercialization. Cooke et al. (2006), conceptualized this network as shown in Figure 1.1., depicting the complexity behind bioscientific and biotechnological value chain. Considering the challenges of value chain management in creating inventive solutions to generate competitive advantage in such a complex network, namely for businesses that operate in highly innovative and volatile

Figure 1.1. Conceptual model of the biosciences and biotechnological value chain (Cooke et al., 2006).



industries, such as biotech, the present research aims to understand the drivers and barriers of outsourcing operations, particularly proposing interventions to overcome the hurdles and explore opportunities of outsourcing in the biotech sector.

In the present section, we will further contextualize and describe the research question and clarify its importance and relevance. After identifying the research questions, we will describe the research methods and the dissertation structure. Analyzing value chain management methodologies in the biotech sector and identifying changes and current tendencies, should provide a vision of the success factors to achieve business milestones. These framework aims intrinsically relate to the main objective of the conducted research, regarding the understanding of the strategies to lead outsourced teams, enabling insights into management of the biotech value chain.

Pharmaceutical is a highly specialized and innovative industry, with a high risk of failure and long break-even timelines. Out of every 10,000 substances synthesized in laboratories, on average one or two successfully pass all the stages to become a marketable product (efpia, 2022). In the early days pharmaceutical companies ran under the paradigm of fully operationalizing their programs in-house. With the market competitiveness increasing, stagnation in R&D productivity, patent expirations, increased regulatory pressures, increased cost of R&D activities, and increasing involvement of investors, these companies had to accept to shift some of the R&D externally (Carlson, 2008; DeCorte, 2020). In the past two decades R&D activities are increasingly carried out by biotech companies, initially with limited economic support, but with knowledge capacity (Howells, 2012). This new network model has enabled newcomers to enter the pharmaceutical industry and offer their expertise (B. S. Piachaud, 2002). Cost, time, and innovation are the levers to improve research performance, and outsourcing gives the mentioned levers a positive impact (Festel et al., 2014). Several discussions around the more effective strategies to lead programs with outsourced components arose with the increase of outsourcing practices in this industry. Challenges including knowledge management, IP management and loss of technical know-how, as well as the need for sophisticated relationship management teams have been highlighted by the pharmaceutical sector (Lowman et al., 2012). The management of knowledge activity and innovation processes are critical to keep innovation as a core competence of a business and ultimately a key competitive advantage that influences its success.

Sourcing knowledge, research and technology inputs externally is different from other types of outsourcing activities. It has been emphasized that the uncertain nature of research activities, combined with incomplete knowledge on a given project and limited market for specialized research services can be an obstacle on the effectiveness of the research service

contracts (Doctor et al., 2001; Mowery, 1984). Also, the tacit nature of know-how exchange underlies the difficulty of assuring it within a research services contract (Cavusgil et al., 2003). Additionally, there should exist a joint production of knowledge between customer and supplier, but research and technology should form part of the core competencies and capabilities of the customer (Alchian & Demsetz, 1972; Ford & Farmer, 1986). How can companies transmit the need of joint production of knowledge and sense of ownership to the services provider for a greater success? Aspects related to services complexity, efficiency, cooperation and communication, cost and intellectual property, flexibility and quality and exclusivity and secrecy should be explored with the best practice approach by the research services contracts (Festel, 2011).

Among others, the difficulties encountered when managing teams with a diverse set of specialized skills and in an increasingly international context were highlighted as one of the most relevant critical factors of success (Howells, 2012). Additionally, dependence on external suppliers can increase the risk of project disruptions (Tufféry, 2015). Since access to these skills is competitive and laborious, we must understand what strategies are more effective to lead these teams in the biotech value chain, considering the need of effective application of leadership styles, and its dynamic choice and development, dependent on the context, type, and stage of team development. The performance implications of outsourcing in the discovery and development of new drugs are still largely unexplored and a topic with several unknowns (Lowman et al., 2012). There is still a significant lack of literature on understanding drug discovery biotech perspective about the relevant aspects of outsourcing.

It is expected that the present research enables insightful information for these and, thereof, deepens the trends and critical mechanisms of outsourcing decisions in the biotech sector. Value chain management is considered as amongst the most relevant challenges of c-suite leaders when it comes to creating inventive solutions to generate competitive advantage. The focus is inevitably increased in businesses that operate in highly innovative and volatile industries, such as biotech, with a contextual recurring utilization of outsourced teams. Under this umbrella, and in the context of understanding the advantages and challenges of fully outsourcing operations, we posed the following questions, as they illustrate the critical factors involved in fully outsourcing operations in the biotech industry: Does outsourcing biotech specialized teams facilitate biotech growth? What are the associated risks with outsourcing biotech teams? Do common value chain management methodologies apply in this context? What are the critical supporting activities for outsourcing biotech teams? In which component of the value chain the investment should be higher? Is outsourcing biotech teams financially advantageous? Does outsourcing biotech teams require a particular financial model/ structure? Does outsourcing biotech teams allow us to accelerate the business timelines? Does

outsourcing biotech teams increase the probability of milestones achievement? Does outsourcing biotech teams increase innovation opportunities? Are there any special management processes required to manage outsourcing biotech teams? Does outsourcing biotech teams require special leadership skills?

Thus, considering the significance and relevance of these factors for the success of the outsourcing-intensive biotech sector, the present research aims to propose strategies to lead outsourced teams, proposing insights into management of the biotech value chain, deepening management proposals for this challenging context. To do so, we conducted an online survey directed at the biotech companies, to collect data from players in the field. For a more systematic and in-depth organizational case study research, we suggest further investigation, with a broader time span to accomplish deeper consolidated proposals. Therefore, the research design applied in this study is emergent at this stage. The survey was composed of a total of 32 questions, 21 closed questions and 11 open questions, which were thought to allow collecting data around management practices of value chain business functions and leadership methodologies for outsourced teams. Thus, the questionnaire was organized in 5 main sections – data on the respondents' context and the respondents' companies' context and outsourcing practices was collected, a section dedicated to explore the value chain management aspects of outsourcing, the HR management and leadership features needed for outsourcing were analyzed in another section, and, finally, the future trends of outsourcing was also evaluated.

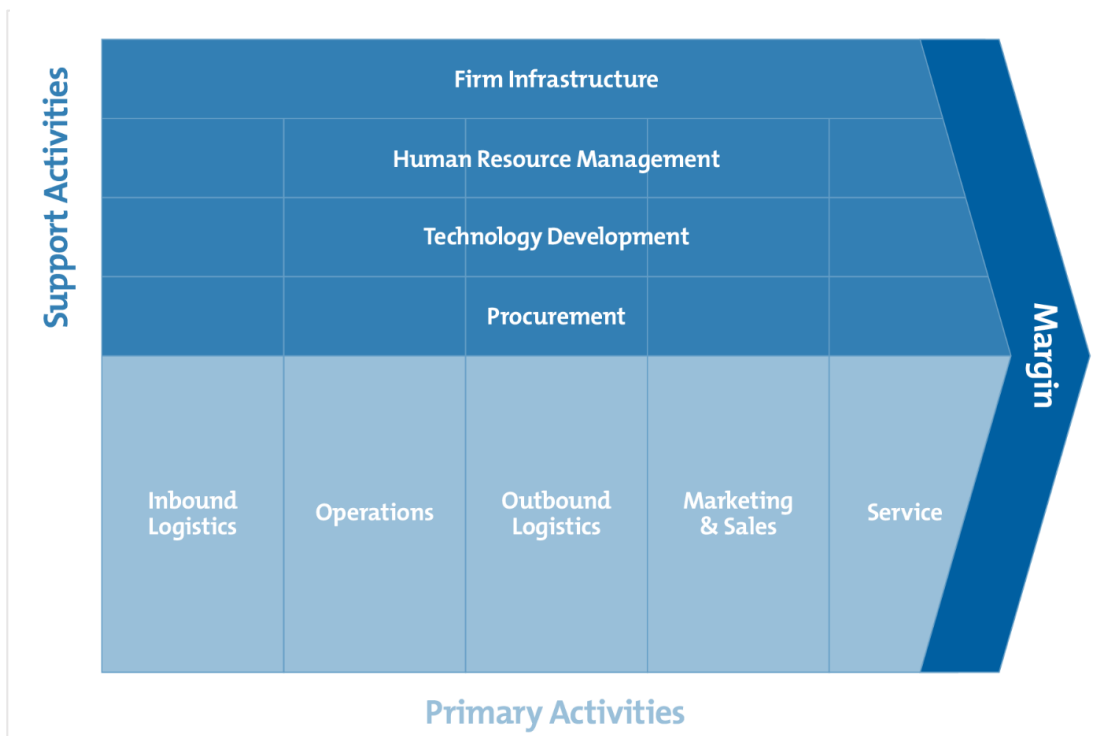
To achieve the enumerated objectives and discuss the expected results, the following structure was adopted for the present study. In the current section, we present the contextualization and definition of the research question, clarify its importance and relevance, and state the research questions and objectives. Following this introductory section, the secondary research data is presented, in the form of a literature review, to frame the aim of this study. This review includes a description of the biotech sector framework, as well as the main literature approaches regarding leadership, team management and outsourced operations management in general and in the specific context of the biotech sector.

The third section aims to explain the conducted methodology, including the research approach, and data collection and analysis used to perform the current investigation. This is followed by the results, findings and discussion section, where the obtained results, the research findings, contributions to existing theory and implications for practice are presented. Lastly, the conclusions and recommendations section includes the study limitations disclosure and suggestions for future research.

2. Literature Review

To deepen our understanding of the most effective strategies to lead outsourced teams, as well as benefits and challenges of outsourcing, and enable proposals and insights into management of the biotech value chain, a theoretical, literature framework is essential. In this sense, in the present section, we present the main aspects of characterization of the sector, but also, present and relate these factors to the fundamental pillars of leadership and team management, exploring the progress and current methods of value chain management and the researched dynamics of managing outsourced teams. The components of the value chain as introduced by Michael E. Porter will be analyzed from a biotech-type business perspective. This will be complemented by a resume of the state of the art of leadership and management methodologies, followed by a more comprehensive analysis of these methodologies in the biotech Industry, as well as in outsourcing.

Figure 2.1. Business functions of the value chain (Porter's Value Chain, 2022).



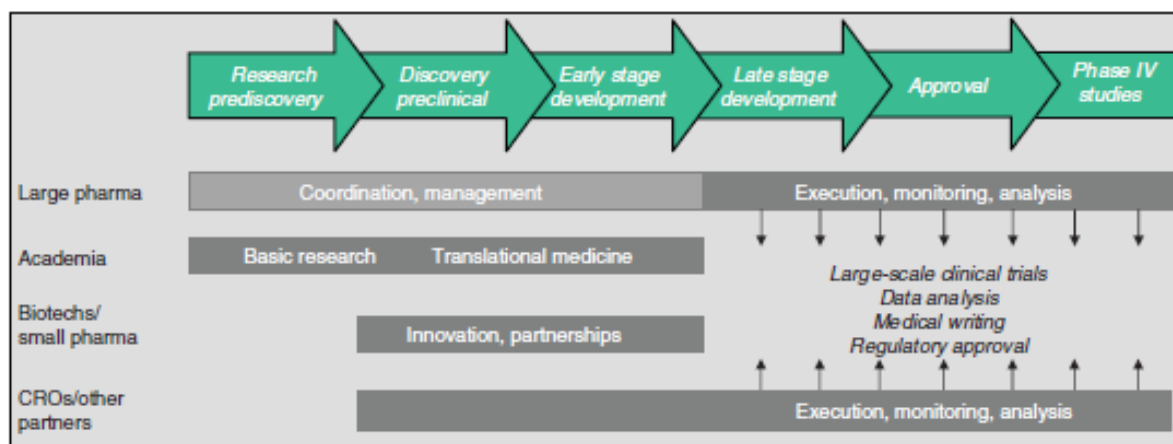
Porter defines the value chain theory as a tool for strategic competitive analysis, beyond the willingness of customers to pay for a good or service offered by a company (Porter, 1998). The value chain allows a holistic view of the business, linking its activities to provide a product or service (Figure 2.1.). The concept has expanded over time and the value chain currently encompasses the internal and external activities of a business, as a recognition that businesses must develop relationships with other companies to thrive.

Additionally, it contemplates the schematization of the planning, coordination, controlling and continuous improvement of such activities, as well as, R&D, patenting and other value creating activities. The value chain theory permits businesses to evaluate competitiveness, value-adding and innovation of its products or services, aligned with the industrial policy's goals.

The biotech sector is divided into different areas of activity that are distributed through a color index (Santos et al., 2023). The red sector, focused on health, medical and diagnostics biotech, is the largest, with a reported global growth rate of 1.3% between 2015 and 2020, and estimated increased growth in the following 5 years (Martin et al., 2021). Within the red sector, products derive from research aiming to improve peoples' lives and go through a demanding added value evaluation process. Innovation and cutting-edge technology development is a must for businesses success and new knowledge is constantly being created. Particularly the pharmaceutical industry, encompassing four sectors, biotechnology, pharmaceuticals, medical devices, and medical equipment, is characterized by intensive R&D practices (Romasanta et al., 2020). The biotech sector is considered one of the critical technologies in the XXI century for the creation of knowledge, goods or services, and a natural successor of information technology post dot.com boom period (Uecke, 2012). Technological innovation is of key importance to biotech companies. But health biotech is different from other scientific areas in fundamental ways, and technology transfer from science is more complex and ultimately less obvious. It utilizes data mining and trial end error methods to create knowledge, a demanding process as compared to digital innovation. In similar lines, it has extended timelines, with an average timing for product development of not less than 8 years (Brown et al., 2022). Additionally, it is highly dependent on expensive hardware and consumables, and requires highly qualified personnel.

Hand in hand, the pharmaceutical industry is particularly expensive, and highly dependent on private funding. Estimated spends for a product development in the US are around 750 million USD (Scoones, 2002). Intellectual property protection and regulatory procedures are extremely important and demanding. Biotech companies require articulation, persuasive entrepreneurs, good ideas and branding, highly qualified senior staff and good initial staff, strong business, academia and policy connections and regular funding to support their development. A trend for decrease of public funding and increase of private investments is evident, however venture capital financing remains averse to the risky nature of biotech product development. With few or none fully de-risked options, angel investors remain key for biotech companies early and prove of concept stages.

Figure 2.2. A FIPNet (fully integrated pharmaceutical network) model of drug development, in which the core capabilities of different stakeholders in the R&D process are leveraged (CRO, contract research organization) (Kaitin, 2010).



On the other hand, biotech science or business, are characterized as an heterogeneous ecosystem (Festel et al., 2014; Scoones, 2002). Different teams, utilizing diverse instruments, methods and scientific approaches exist, with different networks, impacting the way science and biotech relate to policy and business.

Universities and public research institutes contribute significantly to this industry, where several start-up companies are derived from. The link between academia and business has long been conventional, and different transactions occur with established national or multinational companies. Multidisciplinary interactions and an extended network within public, private and governmental organizations are critical for success. The pharmaceutical industry is gradually embracing functional services, provider relationships and alliances. This shared model of innovation has been referred to as fully integrated pharmaceutical network (Figure 2.2.) and melds the complementary and integrated competencies of each of the stakeholder in the R&D process to leverage capabilities, enhance efficiency, and boost milestones achievement (Kaitin, 2010).

Biotech value chain management includes several fundamental variables, involving drop-in vs new functionalities needed, volumes and type of instruments and services needed, economies of scale, among others. Nevertheless, the value chain approach in biotech is a recent topic, and not widely studied. Moreover, the authors were faced with lack of publications diving into the early stages of a health biotech product and the biotech start-ups business models remain widely unknown. The impact of more recent technologies such as Blockchain or Internet of Things on biotech value chain management is still to be explored, but it is widely recognized that can boost business performance and deliver better economic, social, and environmental outcomes.

As an outsourcing dependent business operation, the capacity of the managers to lead the outsourced teams and simultaneously strategically invest in the business value chain, may influence the performance of the health biotech sector. Thus, a relevant framework for the aimed research is understanding the main concepts relating to this challenge, namely the leadership concept and approaches, that will be explored in the next subsection.

2.1. Leadership approaches, concept and development

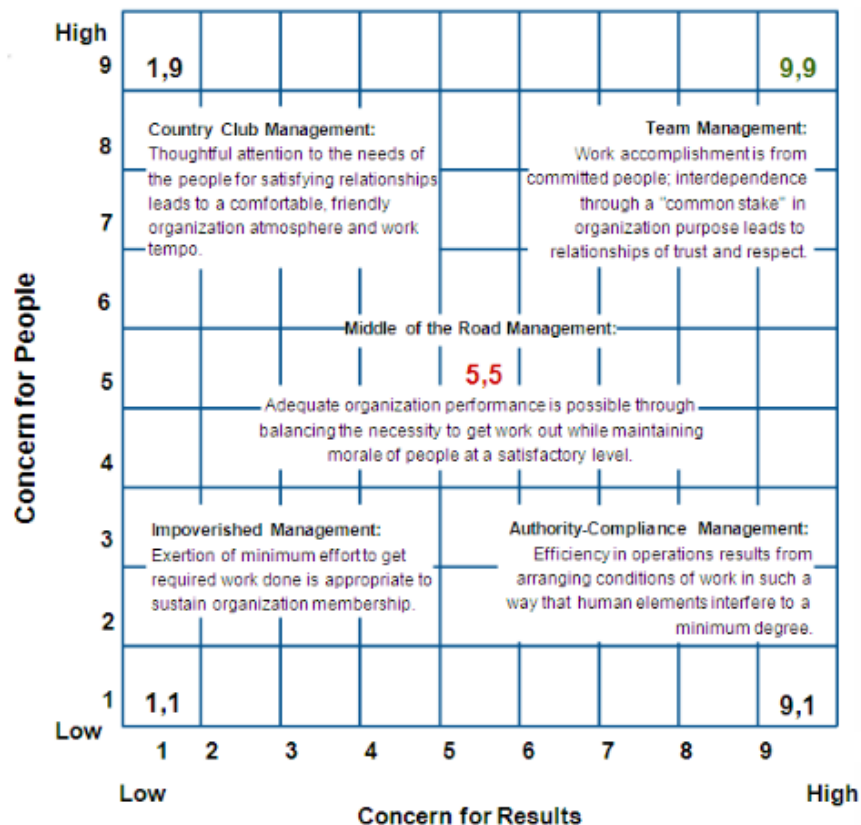
The terms leadership and management have evolved over the years. Literature relates management with the activities that regard the process of maintaining and controlling, whereas leadership is linked with the art of influencing and motivating teams to achieve a common goal (Samosudova, 2017). Leadership is considered in literature as a process that increases the opportunities for growth and performance but is intrinsically related with management in the corporate context. Both management and leadership, in the corporate context, supported by a strong and clear awareness of the business strategy, are considered critical for the success and growth of a business in literature.

Considering the development of the Leadership approaches, the Trait theory of leadership was considered by some authors as the foundation of recruitment, hiring and promotion methods (Samosudova, 2017). This theory, based on the idea that leaders are born with a set of certain qualities that enable them to outperform their organizational skills, implied that, the set of necessary traits for the leader could vary depending on the type of team, circumstances, business and strategy (Swan, 2018). This theory was considered by some authors as the basis meta-analysis, that permitted the perspective that leaders may emerge from various contexts and characteristics, evolving from the perspective that individuals are born leaders (Great Man theory). This approach set the foundation for the following perspectives on leadership, namely the approach regarding behavioral models. This approach considers a necessary behavioral style, which entails the recognition and adaptation to the context, team, circumstances, and organization. In this context, described three leadership styles back in 1939: authoritarian, democratic and laissez-faire (Lewin & Lippitt, 1938). The authoritarian leader, also described as autocratic, centralizes all the decisions on himself. Strict rules, high supervision, and goal-orientation are the focus. On the other hand, the democratic leader is focused on the methods of goal achievement. Democratic leadership entails team discussion and achieving a consensus for a final decision. It is based on trust and collective decision-making. Finally, the Laissez-faire style confers complete power to the team on decision making and goal

achievements. Each individual goal is devoted to the team goals, which in turn is also aligned with the business strategy.

25 years later, the managerial grid model was created by (Blake & Mouton, 1964). The American management theoreticians described five leadership styles that were dependent on the level of concern either for the people or for the goals. Analyzing the proposed grid (Figure 2.3.), the

Figure 2.3. Blake-Mouton Managerial Grid (Taucean et al., 2016).



(1,1) position, consisted of minimal concern by people or goals, whereas the opposite (9,9) management style entailed high concern for both people and goals, (5,5) management was based on a balanced and moderate focus on both people and goals. Finally, (1,9) management put all the concern for people, whilst (9,1) put all concern on goals.

Alongside the behavioral theory, the Situational theory also arose as a development to the Trait theory (Samosudova, 2017). This approach suggests that different traits are needed for different contexts. The leader should adjust the behavior, regarding communication, decision making, involvement, etc., to the diverse contexts, timing, type of decision, characteristics of that team and other factors regarded in the specific leadership process. Specifically, the authoritarian style is proposed in this approach as suitable, for example, in situations where time is scarce for the decision-making process, or the issue does not permit democratic participation. The Laissez-faire style is characterized for the autonomy and accountability permitted for team contribution to decision making, proposed for example for highly committed and skilled teams, where the type of decision and time for decision making is compatible. Samosudova (2017), also describe that the leadership style may be contingent to the situation, selecting the right leader for the right context. From this belief, four contingency leadership

theories are proposed by the author, the Fiedler contingency model, Vroom-Yetton decision model, the Path-goal theory, and the Hersey-Blanchard situational theory.

In this context, the Fiedler contingency model propose that there is no ideal leader and that two leadership orientations exist to fit specific situations (Fiedler, 1964). Individuals that develop good relationships with the group to achieve a goal are relationship-oriented, while those who focus on getting a task completed are task-oriented. Extremely favorable or unfavorable situations may require a task-oriented leader, while relationship-oriented individuals are best performers in intermediate favorability situations. In turn, Vroom-Yetton decision model identified five different leadership styles that follow a decision tree (Vroom & Jago, 2007). The individual must answer seven questions that will help identify the best decision-making process, ranging from autocratic, consultative to group-based decisions. Based on this theory, the psychologist R. House described the path-goal theory of leadership in 1971 (House, 1971). While the first two theorists explain the situation as a driver to leadership style adoption, R. House highlights the adoption of a leadership style as the driver to influence a group of individuals to achieve a specific goal. Four leadership behaviors were described under the path-goal theory: (1) directive, (2) supportive, (3) participative and (4) achievement-oriented. These behaviors are self-explanatory and range from (1) exactly defining the instructions and expected results, (2) giving attention to the team needs, (3) involving the team in problem solving or (4) setting the goals to be achieved by the team. Each behavior was to be applied in the different stages of work. Finally, Hersey and Blanchard added a layer to the situational theory and described that leadership behavior should be dependent on the follower's education and experience, willingness to be accountable and motivation to achieve the company's goals (Hersey & Blanchard, 1982). Under these premises, styles 1 to 4 were described: in the "*Telling*" style, the leader exactly defines the roles of the individuals and the group. This style is mostly needed when employees lack the skills to perform the job and are unable or unwilling to take responsibility for it. The "*Selling*" style is directive, while influences the individual and group to buy into the process. The employees are willing to work on the task but cannot take responsibility for it. On the "*Participating*" style, the decision-making on how the tasks are accomplished is shared between the group. Individuals must be experienced, independent but lack the confidence or the willingness to take on responsibility. Lastly, the "*Delegating*" style passes on the process and responsibility of decisions to the individual or group, while maintaining involvement to monitor progress. The individuals are experienced, confident to make decisions and take responsibility for it. Overall, the different dimensions, are considered relevant by literature, individually and in connection to each other (Table 2.1.).

Personal attributes, mostly known nowadays as soft skills, behavioral models, and a strong and reliable perception of the situation and the team players, all connected by a flexible and adaptable process, describe a very complex concept. In line with this, the Integrated Psychological Theory of Leadership was developed by the British leadership theorist and author John Scouller in 2011 as an attempt to connect the strengths of former theories (i.e. trait theory, behavioral theory, situational theory, and contingency theory) and introduce a 5th dimension: the learning and development of leadership presence (Scouller, 2011). The theory is also known as Scouller's Three Levels of Leadership model or 3P model: two outer levels (Public and Private leadership) and one inner level (Personal leadership). The three levels encompass how leaders can bring leadership to their organization (outer levels), alongside developing themselves, technical and psychological leadership behaviors (inner level). Public and Private leadership are about the leaders' behavior and skills used to influence a group or in one-to-one relationships, respectively. Whilst Personal leadership is about leaders' mindset, how they manage themselves and their emotions. This last piece addresses a leader's psychology, trying to limit beliefs and raising authenticity. This theory provides a holistic view of leadership and can be a useful framework for understanding and developing leadership skills. It emphasizes not only the behaviors and skills necessary for effective leadership but also the importance of self-awareness and personal development. It sets the foundation for the philosophy of servant leadership and authentic leadership, two popular styles in recent years.

According to this approach, authentic leaders remain loyal to their values, beliefs and motivations while attentively listening to others with an open mind. They are focused on personal growth and development, consistently striving to become the best version of themselves. Integrity and transparency are highly appreciated by these leaders. On the other hand, servant leadership is the philosophy of leading by serving others with motivation. Servant leaders focus on team development and growth, seeking to help others reach their full potential. These leaders highly value compassion and empathy, applying it as a model. While it is clear that authentic leaders emphasize personal growth and servant leaders focus on others growth, both styles aim for relationships of trust, respect and mutuality.

Table 2.1. Summary of leadership theories and models.

THEORY PROPOSED DIMENSION	AND LEADERSHIP MODELS	DESCRIPTION
TRAIT THEORY		<i>Leaders are born with a complex of special qualities.</i>
First dimension – Personal attributes		
BEHAVIORAL THEORY		<i>Leadership regarded as a set of behavioral models, instead of a set of attributes.</i>
Second dimension – behavioral models		
	Authoritarian, Democratic and Laissez-faire	Decision making centralized in the leader, resulting from team consensus, or handed off to employees, respectively.
	Managerial grid model	Five leadership styles dependent on the focus on the people or on the goals.
SITUATIONAL THEORY		<i>Leadership behavior depends on the situation. Situation is driver to leadership style.</i>
Third dimension – situation		
	Fiedler contingency model	Relationship-oriented vs Task-oriented leadership styles.
	Vroom-Yetton decision model	Connected situational variables with different leadership styles.
CONTINGENCY THEORY		<i>Leadership behavior depends on the situation, but the leadership style is the driver to influence the team.</i>
Fourth dimension – Team players		
	the Path-goal theory	Leadership style to influence followers to achieve a specific goal.
	the Hersey-Blanchard theory	Leadership behavior to depend on the follower maturity level.
INTEGRATED PSYCHOLOGICAL THEORY		<i>Three levels of leadership must be developed: Public, Private and Personal.</i>
Fifth dimension – Learning and progress		
	Servant and authentic leadership	

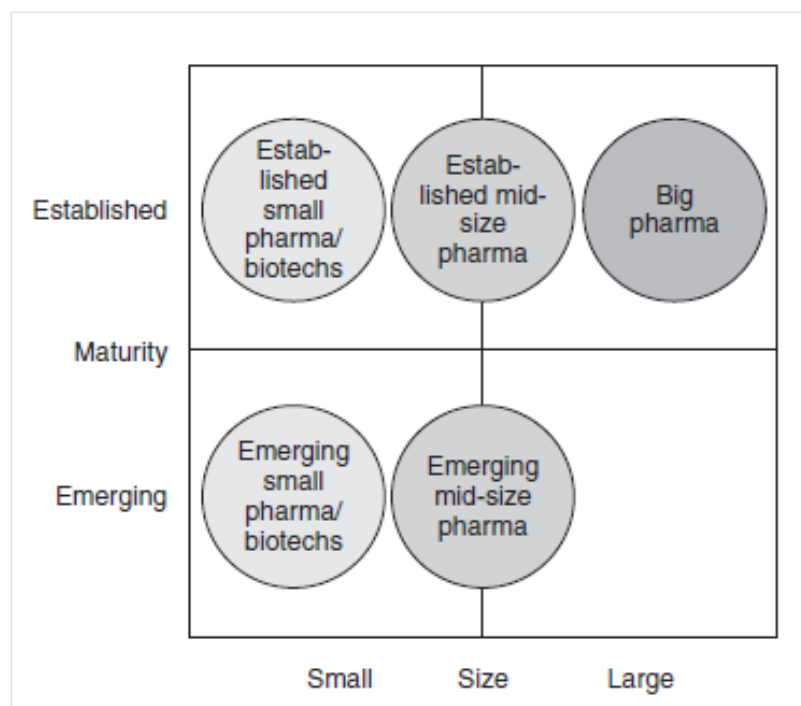
Having the framework of the concept and approaches to leadership, and its development in a summarized form, to better understand the unique challenges of the biotech sector, in the next subsection we need to discuss how leadership and management methodologies are applied in this industry, considering factors such as regulatory compliance, product development, intellectual property rights, and managing the value chain of a biotech company.

2.2. Evolving Needs in Biotech Leading and Managing Outsourced Operations

The health biotech sector has been growing and attracting high investment (efpia, 2022). As biotech companies attract fresh investment, they need to consider how they can scale up and what is required, to deliver on their promise of providing innovative medicines to patients (Föller, 2002). These requirements will depend on the size and maturity of the companies, among other factors (Festel, 2013). To help with the analysis Festel divided companies in the pharmaceutical industry into 5 different groups: *Emerging small pharma/ biotech*, *Established small pharma/ biotech*, *Emerging mid-size pharma*, *Established mid-size pharma*, and *Big pharma* (Figure 2.4.). In alignment, Föller (2002) explains the various needs for each of the stages of the biotech growth, which is further described herein.

Early in the life cycle, a biotech company's management team typically grows the business through a few core assets and limited programs, focusing its resources where the most value can be gained such as differentiation in manufacturing, understanding of disease and biology, or drug chemistry. At this stage the effects of management decisions

Figure 2.4. Different company types regarding size and maturity of the companies (Festel, 2013).



are immediate since the resources are limited. As the business grows, biotech leaders face different challenges, and will need different leadership approaches.

Generally, leaders in biotech need to develop the traits that apply to good managers of all companies in all industries, but also the attributes that are specifically relevant in biotech and that will differ depending on the company maturity. Integrity, goal and fact-oriented, demanding, group dynamics awareness, reliability and motivational are key attributes of a leader and are not exception for biotech managers. Besides this, biotech managers face the challenge of needing to foster the transition of team thinking and action from science-oriented to commerce-oriented. They will need to show that the company is able to translate research results into revenue and to clearly communicate that with all stakeholders. They will need to create a successful operational organization and how they manage change and pressure is key to defining the fate of the business. Individuals sensitive to the environment, with strategic thinking and passionate about goal achievement should strive as leaders in a startup biotech.

At business *early stage*, the level of management sophistication is low, and managers are mostly focused on internal aspects of the business and with hands on most of the tasks (Föller, 2002). Executive managers are often not perceived as necessary. The transition to commercialization stage is the first big leap and needs new leadership strategies. When *commercialization stage* starts, the company needs to turn the idea into a business. The company strategy and market dynamics should be understood by the whole team and concrete actions must be developed to achieve product commercialization. In parallel, managers must make sure to keep the flexibility to respond to scientific trends and advances and to be prepared to alter the strategy if needed. At this stage, managers also need to ensure sufficient funding to take the project to each of its milestones and ultimately to product commercialization. The development of a robust business plan, operational processes and organizational structures should help pursue the business goals. The first controlling and budgeting processes will be needed. First outside hires will occur and a shift to professionalism is critical. To implement this complex structure, experienced executive managers will be needed. After this organizational change, the *operational stage* starts. Business costs significantly increase and, therefore, revenue and cost management are increasingly important, supported by a strong growth strategy. A clear hierarchy, communication channels and roles should have been defined by the management team, which now is more focused on transaction than on projects. At this stage, executive management must have grown to be result-oriented, precise, and efficient. Lastly, at the *expansion stage*, besides keeping the implemented structure and processes, the business will need to feed into its pipeline with new projects, while aligning it with the market's expectations. Executive managers will face the choice of keeping all functions under the business umbrella or handing off the project at a certain stage, or the countries where

business will have a presence. Ultimately, having all processes implemented and optimized, the managers will be able to draw their attention to research and development pipeline, identifying leads, transforming them into products and selling or licensing them to other companies.

Besides all the above-mentioned factors, one should also consider the constantly evolving nature of the concept *work*, where we come from and to where we are planning to go. In an article published by Harvard Business Review about the Future of Work, the authors defend that we live in an era of generation-defining political, economic, societal, and environmental crisis, which inevitably will impact our work lives (Howard-Grenville & Empson, 2023). Companies will have to adapt to the rapid progress of digitalization, growth of hybrid work, the changing priorities of new generations and raising awareness of social and environmental responsibility. These will become internships of increasing commitment to leadership, sustainability, and organizational good practices. And leaders will need to understand and adapt to the future of workers (*who*), of working (*what*) and of work itself (*why*). More people question the importance of work in their lives and prefer to bring more of themselves to work. Additionally, differences in peoples' values, aspirations and choices are deepening. Flexible work is a must have and levels of remote work remain much higher than before the pandemic. On the other hand, AI and digitalization must shape the work environment and employees' responsibilities, whereas supply-chain disruptions are becoming more frequent. Down the road, there will be a redefinition of businesses' role in society and of what society considers how good businesses look like. Ultimately, this massive change relies on each one of us and how we lead collectively through uncertainty. Collective leadership is key for the success of future work and the complexity of current challenges will need to be addressed by different stakeholders that together shall bring up insights for the organization's success. The management of emotions will be a critical factor of success and a balance between individual's needs and organization's goals will need to be found. Leaders should revisit historical facts, to reaffirm organizational culture and shape the future, while accommodating the ambiguity of change rather than resisting it.

Globalization adds complexity to the '*who*', '*what*' and '*why*' and has brought foreign participation in projects and an increasing trend of strategic alliances including joint ventures, consortia, merges and acquisitions, partnering relationships or outsourcing. This allows for companies to strive on different functions and gives them room to face an unstable industry, with low buffer to economic challenges, technological challenges such as continued innovation, legal challenges, including freedom to operate or even ESG challenges. Ultimately, and one of the hurdles of most of the highly specialized industries, the capture of talent needs nowadays to be one of the focus areas of biotech companies. Having explored the leadership

methodologies landscape and focusing on the specific leadership and management requirements in the biotech sector, it is now important to understand these methodologies in the context of outsourcing and further explain the concept and understand the practices in the biotech sector.

To explore the dynamics of managing outsourced teams, the advantages and disadvantages of outsourcing compared to insourcing, need to be comprehended. Variables for this framework include communication, performance management, goals commitment, and other relevant aspects. Outsourcing is a business practice in which services or job functions are hired out to a third party on a contract or ongoing basis. The benefits of outsourcing are numerous: it can reduce costs, provide access to specialized skills, and increase efficiency. However, outsourcing also comes with its risks, including language and cultural barriers, time zone differences, and the possibility of miscommunication.

Bacea and Borza (2015) state that for a company to be able to offer products and services at the highest standards, the company must focus on the core activities – which allows a company to differentiate itself from the competitors. Accordingly, outsourcing of organizational functions has become a popular practice amongst organizations, being one of the best ways of reshaping management and promoted as one of the most powerful trends in management (Bacea & Borza, 2015). Outsourcing involves an externalization of a certain process and function that could be performed internally to an outsider company. This involves two parties, the customer (*outsourcee*), who outsources a specific constituent of its business, and the supplier (*outsourcer*), who provides the service or consumable. According to Mella and Pellicelli (2012) anything can be outsourced, except business and managerial and leadership activities.

Literature describes numerous concepts related to outsourcing, including offshore outsourcing, nearshoring, offshoring, sub-contracting, body shopping and staffing (Saraiva, 2018). The offshore outsourcing concept is the focus of this study and constitutes the international trade of goods and/ or services (Varadarajan, 2009). The outsourcing terms can be differentiated by various properties: the degree of formality (formal contracting vs collaborative contacting), the extent of functions transferred to an external source (selective vs total), the maturity of the outsourced functions and availability of providers (mature vs immature), the duration of the relationship (long vs short), the number of providers for each function (multiple vs single) and the nature of the outsourced functions (core vs non-core) (Bhattacharya et al., 2013). Depending on the functions and business, different types of outsourcing strategies can be followed to achieve strategic differentiation. And it should be an option that all businesses should consider. Organizations should invest in activities with

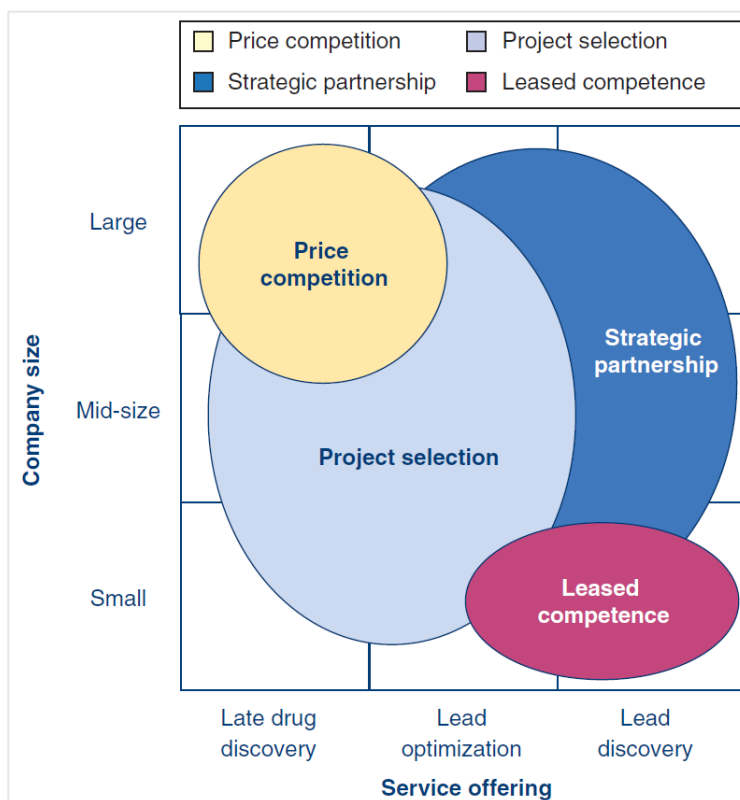
sustainable competitive advantage and externalize those that are not differentiating, have low strategic importance and risk (Bacea & Borza, 2015; Dolgui & Proth, 2013). Functions that can be completed faster, cheaper and/ or better by another entity, for instance, should be considered to outsource (Lankford & Parsa, 1999). Very specialized functions, where competent HR are hard to find and demanding to train, or rapidly changing technologies are also interesting to outsource (Oshri et al., 2009). Nonetheless, here lies the risk of undiversified offer and increased costs. Activities that require confidentiality, strategic decision making, and specific management knowledge should rarely be outsourced (Caruth et al., 2013). There should be a reasonable balance between the advantages and the risks of outsourcing, as it adds complexity to operations and costs depending on the function, scale of the process, the service offer diversity, the service metrics and how feasible it is to manage it when outsourced.

According to Bhattacharya et al. (2013), the buyer vendor relationship is key for outsourcing. The terms of the relationship should be well defined in the outsourcing contract and include the scope of the service, how and when the service will be provided and delivered, an explicit list of deliverables, the payment terms and the obligations of each party (Webb & Laborde, 2005). Zhou and Jiang (2012) highlighted flexibility as one important component of service agreements. This should allow an effective cooperation between parties and freedom to adjust the scope of the agreement to the needs of the study. Nonetheless, flexibility and freedom should be always hand in hand with rich information exchange, clear communication, continuous interaction and mutual trust and commitment (Kaipia & Turkulainen, 2017; Zhou & Jiang, 2012). Outsourcing relationships are highly complex and should be managed as carefully as any other component of a business.

Aligned with the practice of outsourcing, the concept of open innovation arose back in 2000, where a flexible model that originates a new product from internal and external ideas is assumed (Bogers et al., 2018). Later, Hätönen and Eriksson (2009) provide a comprehensive analysis of the evolution of outsourcing from its start with practices based solely on 'make or buy', to the 90's with practices focused on cost cutting and strategic importance and lastly to the new millennium with practices though to gear organizational transformation and network competences. Accordingly, the pharmaceutical industry was initially motivated to outsource to reduce costs but soon recognized the complexity of drug discovery and expanded its outsourcing practices as a strategy to access breakthrough innovation and close the gap between basic research and clinical research (DeCorte, 2020; Gassmann et al., 2010; Jones, 2000). Pharmaceutical companies started to shift some of the R&D externally through collaborations (Tufféry, 2015). Currently the sector of pharmaceutical companies has a portfolio with close to 50% externally generated projects.

Taking a closer look at the pharmaceutical industry and chemical synthesis outsourcing as an example, three typical cooperation models have been proposed: *Price competition*, where a long list of service providers is systematically put into competition to secure the lowest purchasing prices; *Project selection*, in which the selection of service providers is based on a project-by-project basis from a core list of pre-selected service providers; and *Strategic partnership*, where a handful of preferred service providers are given the preferential right of first refusal (Festel, 2011). The relevance of each of these models varies depending on the stage of the outsourced R&D activities. For example, at the discovery preclinical stage the strategic model is the preferred,

Figure 2.5. Used cooperation models within chemical synthesis outsourcing depending on service offering and company size of the customer (Festel, 2011).



whereas the project selection model is the ideal at late-stage development (Figure 2.5.). The author also describes an emerging cooperation model, *leased competence*, that is only seen in small companies focused on discovery preclinical stage, and entails the integration of external experts into internal R&D teams for a defined period to support ad-hoc needs. In another study, DeCorte (2020) describes 3 business models and 3 operational models when partnering within pharmaceutical R&D. The business models can range from short term, *fee-for service (FFS)*-based arrangements, to more strategic full *time-equivalent (FTE)*-based collaborations, or even *risk-sharing* relationships. Whereas, the operational models encompass *decentralized partnerships*, where the client maintains full control of the scientific activities that are performed; *integrated partnerships*, in which the client prefers to partner with an integrated drug discovery organization that offers all the required expertise; and the *hybrid partnership*, that entails a single intermediary partner with expertise in a particular area and responsible for subcontracting out any additional activities needed.

The presented literature framework analysis suggests that outsourcing operations may allow health biotech to achieve milestones faster and decrease risk by increasing opportunities

to innovate, but also that careful decisions should be made when considering the different options of outsourcing business functions. These factors and context imply that it also requires a cumbersome financial model and particular leadership style. Under this research scope, we propose to investigate the following hypothesis under this work:

- (1) Biotech regards outsourcing opportunities as a strategic advantage to grow, because it facilitates access to specialized functions.*
- (2) Outsourcing the majority of the business functions requires different value chain management methodologies, particularly financial governance.*
- (3) Leadership strategies to manage outsourced teams should be tailored and it is a critical factor of programs' success.*
- (4) Outsourcing of R&D activities by biotech is a trend that will be maintained in the upcoming years, and therefore, companies should consider the management methodologies to best explore it.*

To better explore these proposals, primary research data was collected and analyzed. The methodology, obtained results, findings and discussion will be described in the sections further presented.

3. Methodology

In the previous sections, the authors contextualized and defined the research questions, clarified the importance and relevance of the research topic to the field, and stated the objectives of the research study. Additionally, a secondary research data referenced was summarized in the form of literature review, including the biotech industry framework, as well as the main literature approaches regarding leadership, team management and leading and managing outsourced operations. In the present section, the authors aim to explain the conducted methodology, the research approach, and data collection and analysis methods used to perform the current investigation.

To understand the advantages and disadvantages of outsourcing and propose effective strategies to manage biotech value chain and lead outsourced teams, the authors collected primary research, using an online survey. A survey considering 21 closed questions, complemented by 11 open questions to verify beliefs regarding best practices in biotech value chain management and outsourced teams management was designed. The survey was carried out between November and December of 2023, using Microsoft forms, and distributed to specific individuals acting in the biotech sector, by electronic mail and professional social media. The survey was divided in 4 different sections:

- (1) Context – This section encompassed 10 (ten) questions aiming to understand the background of the respondent. The drug discovery field, drug discovery stage, role, and number of years in current organization of the respondents were assessed. In this section data about the respondent's company was also collected. The company's headcount, headquarters, and the number of countries the operations are present were collected. Finally, the outsourcing practices of the respondent's company were also enquired about and the details of the percentage of outsourced functions, geographic relevance of outsourced functions and periodicity of search for outsourcing services was addressed. The questions listed in Table 3.1. allowed to infer the representativeness of the sampling, and guarantee that the respondents are working in drug discovery biotech. It also allowed to collect the current practices of outsourcing of the respondent's companies.

Table 3.1. List of 10 questions and respective answering possibilities drawn under the Context section.

Section 1 - Context
1. Which drug discovery field do you work in? (a) Small molecules; (b) Antibodies; (c) Gene therapy; (d) Cell therapy; (e) Vaccines; (f) Other

2. In which drug discovery stage are you currently working? (a) Research; (b) Development; (c) Clinical; (d) Other
3. What is your role within your organization? (a) Owner/ Founder; (b) CEO/Executive; (c) Manager; (d) Scientist; (e) Technical; (f) Other
4. How long have you been working in your organization? (a) <1 year; (b) 1 to 5 years; (c) 6 to 10 years; (d) 11 to 15 years; (e) > 15 years
5. How many collaborators does your company have at the moment? (a) <10 people; (b) 11-50 people; (c) 51-250 people; (d) >250 people
6. Where is your company headquarters? (a) Europe; (b) North America; (c) South America; (d) Asia; (e) Oceania
7. Considering all the value chain, in how many countries is the company present? (a) 1; (b) 2-5; (c) 6-10; (d) >10
8. What kind of outsourcing services does the company outsource? (a) Nothing, all functions are guaranteed internally; (b) Only consumables and inventory items; (c) up to 20% of business functions; (d) between 20% and 80% of business functions; (e) more than 80% of business functions
9. To which continent(s) does your company outsource the most? (a) Europe; (b) North America; (c) South America; (d) Asia; (e) Oceania
10. How periodically does your company look for new service providers? (a) <i>Very often: always looking for new collaboration opportunities</i> ; (b) <i>Often: do not actively search, but keep up to date with available options</i> ; (c) <i>Sometimes: mostly when need a new service, or current supplier does not meet expectations</i> ; (d) <i>Rarely</i>

(2) Outsourcing – The goal of this section was to collect relevant data and opinions of key opinion leaders about the strategic advantages of outsourcing and relevant management methods of a value chain with significant outsourced functions in biotech. It consisted of eleven (11) questions in total and respective answering options are listed in Table 3.2. The respondents were asked to name the advantages and disadvantages of outsourcing specialized functions. The impact of outsourcing specialized functions in biotech growth was also questioned. In the context of outsourcing more than 80% of business functions, it was addressed if respondents considered that common value chain management methodologies would apply and what were the special requirements applicable. The investment requirements and outsourcing strategy in the different functions of the value chain were also addressed. The respondents were asked which function of the value chain they would invest in the most and which function they would not outsource. The financial impact of outsourcing more than 80% of the business functions was attended and it was asked if a particular financial structure would be required. Finally, it was directly asked to the respondents what they considered to be the most relevant strategic advantage of outsourcing. With these questions, the authors aim to test the hypothesis stated in the

introduction section, namely if special management methods of the value chain would be needed when significantly outsourcing specialized functions in biotech.

Table 3.2. List of 11 questions and respective answering possibilities drawn under the Outsourcing section.

Section 2 – Outsourcing
1. Please name the advantages of Outsourcing HR functions.
2. Please name the risks/ disadvantages of Outsourcing HR functions.
3. In your opinion, does outsourcing function specialized teams facilitate biotech growth? (a) Yes, I totally agree; (b) Maybe; (c) No, I don't agree
4. Do you think that common value chain management methodologies apply in the context of outsourcing more than 80% of business functions? (a) Yes, it should be very similar; (b) No, it needs adjustments customized to the outsourced functions; (c) No, value chain management should be totally customized
5. If you answered "No" in previous question, please specify any special process required.
6. In the context of outsourcing more than 80% of business functions, in which function of the value chain the investment should be higher? (a) Infrastructures; (b) HR management; (c) Tech development; (d) Procurement; (e) Primary activities
7. What would you <u>not</u> outsource in the value chain? (a) Infrastructures; (b) HR management; (c) Tech development; (d) Procurement; (e) Primary activities; (f) Any of the value chain functions can be outsourced
8. In your opinion, is it financially advantageous to outsource more than 80% of business functions? (a) Totally; (b) Maybe; (c) Not at all
9. If you answered "Depends" in the previous question, please explain.
10. Do you think that outsourcing more than 80% of business functions require a particular financial model/ structure? Please explain.
11. Please rank from most relevant to least relevant, how does your company achieve competitive advantage through outsourcing? (a) Access to specialized services; (b) Access to cheaper HR services; (c) Accelerated timelines; (d) Increase innovation opportunities; (e) Increased probability of milestone achievement

(3) HR and talent – In this section, the authors looked to assess the relevant leadership methodologies of outsourced human resources in biotech. Nine (9) questions were posed, which can be found in Table 3.3., along with respective answering options. It was asked the respondents if outsourcing facilitates the search for specialized functions, and if special leadership skills should be considered. The leadership style and methods to motivate outsourced teams were addressed. The depth of involvement of the company in

guaranteeing good leadership practices by the outsourcer was also researched. Particularly, the respondents were asked if the company should guarantee that the outsourcer invests in training and career development of collaborators and if the HR rotation levels of the outsourcer should be a concern to consider. This section should allow the author to analyze and discuss if key opinion leaders in biotech consider and adapt leadership methodologies to manage outsourced functions.

Table 3.3. List of 9 questions and respective answering possibilities drawn under the HR and talent section.

Section 3 – HR and talent
1. Do you consider that it is easier to find specialized functions by outsourcing it? (a) Yes, totally; (b) Depends on the function; (c) No, should be similar to looking for specialized HR
2. If you answered "Depends on the function" in the previous question, please explain.
3. When outsourcing more than 80% of business functions, are there any special leadership skills required? Please specify.
4. What do you consider to be the main leadership style required to manage an outsourced team?
5. How do you work on motivation of outsourced teams?
6. Do you consider that you should guarantee that your suppliers will invest in training and career development for collaborators? (a) Yes, that should be part of the negotiation terms; (b) Yes, but depends on the supplied function; (c) No, that is not of my business, as long as supplier delivers
7. If you answered "Yes, but depends on the supplied function" in the previous question, please explain.
8. Do you worry about the HR rotation levels of your suppliers? (a) Yes, it is a topic we discuss with our suppliers; (b) Yes, but depends on the supplied function; (c) No, that is not of my business, as long as supplier delivers
9. If you answered "Yes, but depends on the supplied function" in the previous question, please explain.

(4) Future trends – This final section was intended to understand the trend of outsourcing specialized functions in biotech in the next 5 to 10 years. Two (2) questions were posed, addressing if the respondent's company would increase, maintain or decrease outsourced functions and, in the case of increase or decrease, which of the value chain functions would be the most impacted (Table 3.4.).

Table 3.4. List of 2 questions and respective answering possibilities drawn under the Future trends section.

Section 4 – Future trends	
1. How do you see your company in 5/10 year, when it comes to outsourcing?	(a) Outsourcing should increase; (b) Outsourcing should be maintained; (c) Outsourcing should decrease
2. If you answered “Outsourcing should increase/ decrease” which of the value chain functions do you foresee changing?	(a) Infrastructures; (b) HR management; (c) Tech development; (d) Procurement; (e) Primary activities

The collection of the respective primary quantitative and qualitative data was accomplished using the Export Excel function. The qualitative approach encompassed a content analysis of the open questions. Content analysis is the research technique for objective and systematic descriptive research of the content of communication (Gummesson, 2000). This methodology consists in comprehending human communication, and including objectivity, intersubjectivity, validity and replicability in the data analysis. For the qualitative analysis a closed codification was used, and the unit of analysis was sentences and words. Furthermore, the methodology includes contextualization, codification of the text, and division in categorized sections of the open question's answers and quantitative statistical analysis of the closed question's answers.

For the open questions of the survey, the obtained answers were classified in six categories which the contents are presented in Table 3.5. Subsequently, a classification and a combination of answers was performed considering the established categories. These categories were drawn having Porter's value chain business functions management in mind (Porter, 1998). An additional category was considered, when it was not possible to determine in which of the other categories the respondent's answers would fit in.

Table 3.5. Categories defined to analyze answers for open questions of the survey.

Category	Description	Example	Item	Subcategory
Finance (A)	Aspects related to finance decisions	<i>"Saving operations costs..."</i>	1	A1. Cost-benefit analysis
			2	A2. Cost monitoring
			3	A3. Monetary
HR management (B)	Aspects related to HR management	<i>"...opportunity to work with high quality and reliable scientists..."</i>	4	B1. Communication and leadership
			5	B2. Organizational culture
			6	B3. Management skills

Operations management (C)	Aspects related to management of primary activities	<i>"Streamlined process..."</i>	7	C1. Timelines
			8	C2. Processes
			9	C3. Strategic alignment
Knowledge development (D)	Aspect related to knowledge, innovation and intellectual property	<i>"...it allows to take advantage of..."</i>	10	D1. Access to specialized knowledge
			11	D2. Intellectual property considerations
			12	D3. Innovation
Infrastructures (E)	Aspects related to infrastructures	<i>"No need of laboratories."</i>	13	E1. Specilized spaces
			14	E2. Technologies
Relevance (F)	Aspects related to the outcome, advantages or impact	<i>"Dependency on a third party."</i>	15	F1. Advantages
			16	F2. Impacts
			17	F3. Benefits

The authors observed 32 individual answers, constituted by 62% respondents from companies within the field of antibody discovery, 18% within small molecule discovery, 4% within gene and cell therapy, 4% within the field of vaccines discovery and 11% on other drug discovery biotech. On the other hand, as far as the discovery stage is concerned, 40% of the respondents were working in Research stage, 10% in the Development stage and 7% were within the Clinical stage. 27% of the respondents indicated that they are currently working in companies that cover Research and Development, 10% in companies focused on Development and Clinical stages and, finally, 7% of respondents work within biotech companies that cover all drug discovery stages. Overall, the sampling was deviated to biotech doing antibody discovery, but had a good representation of all drug discovery fields. On the other hand, the sample collected was homogeneously distributed through the different drug discovery stages. The sample size was in line with other similar studies (Festel, 2011; Lowman et al., 2012).

Answers from respondents from biotech companies with different sizes were observed. 19% of the respondents worked in a biotech with less than 10 people, 47% with 11 to 50 peoples, 25% with 51 to 250 people and 9% within biotech with more than 250 people. Geographically, considering the respondents framework in the biotech value chain, the company's headquarters ranged between North America, with 47% of respondents, Europe, with 47%, and Asia and Oceania with 3% each of respondents. No respondents from biotech companies based in South America were observed. This data shows that the sampling was representative in headcount, as well as geographically. Data on the average number of employees in the drug discovery biotech is difficult to find, since most of these companies have less than 100 employees and are not publicly traded, leaving them out of yearly reporting obligations. Additionally, geographically, the biggest biotech hubs are located in North America, more precisely USA, and Europe, including Denmark, UK, Netherlands and

Switzerland (Rota, 2023). Considering company's operational presence, 16% of the respondents indicated that the present company they are working at acts in only 1 country, 63% were from companies present in 2 to 5 countries, 13% in companies with presence in 6 to 10 countries and, finally, 9% in companies present in more than 10 countries. This indicates that the majority of drug discovery biotech have their operational efforts distributed in different sites.

In terms of corporate responsibilities, the respondents are characterized in 3% Owner/Founder, 38% CEO/Executive, 34% Manager, 19% Scientist and 6% Other staff. Regarding the time that the respondents have been working in the organization, 34% have been working for <1 year, 59% for 1 to 5 years, 3% for 6 to 10 years and 3% for more than 15 years. This data confirms the homogeneous distribution of the sampling in terms of the respondent's role in their organization. It also gives visibility to the high HR rotation rate within drug discovery biotech, with the grand majority of the respondents being in the current company for less than 5 years.

Lastly, considering the respondent's companies outsourcing habits, 6% only outsourced consumables and inventory, 19% outsourced up to 20% of the business functions, 47% outsourced between 20 and 80% of business functions and 28% outsourced more than 80% of business functions. None of the respondents were from companies with no outsourced services. Geographically, 45% of the respondents were currently in a biotech company that outsources services to Europe, 21% to North America and 34% outsourced business functions to Asia. The respondents did not include South America or Oceania as continents where business functions were being outsourced. Finally, as far as how periodically the companies look for service providers, 34% of the respondents indicated that the company they are currently working in very often and actively looks for new collaboration opportunities, 38% do not actively search, but keep up to date with available options, 25% only when need a new service, or current supplier does not meet expectations and 3% rarely look for new service providers. Considering the answers provided when it comes to outsourcing habits, it is a common practice in drug discovery biotech, with none of the respondents being from a company with no outsourced services. It is also noteworthy to note that only a minority of the respondents mentioned only to outsource consumables and inventory. Moreover, the data shows that the majority of the respondents' companies do have regular habits of looking for outsourced services. On the other hand, most of the services are outsourced to Europe, with Asia having an important relevance too. This is in line with the significant growth of the contract research, development and manufacturing organization market in Asia (efpia, 2022).

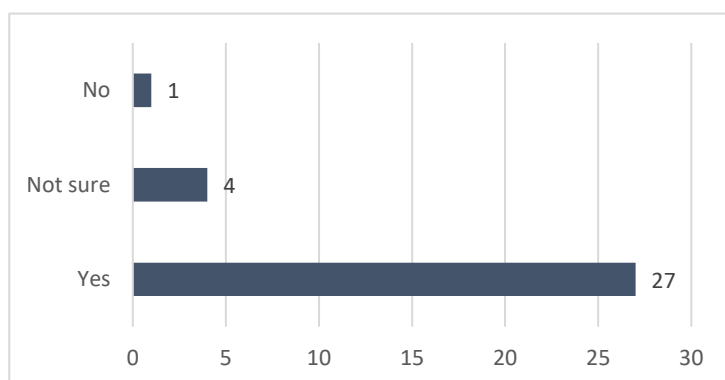
In the presentation of results, the quantitative analysis is represented as percentage of acceptance of each answer to the survey. Besides, a content analysis was performed, and respective results are presented and further discussed considering the hypothesis in research. The hypothesis in analysis encompasses the understanding of the competitive advantage of outsourcing and relevance of effective strategies to lead outsourced teams in the biotech sector.

As the methodology conducted was presented in the current chapter, in the following section the results obtained, findings and discussion, including contributions to existing theory and implications for practice are discussed.

4. Results, findings and discussion

The present section consists of the presentation, and analysis of the obtained results, findings and discussion, including contributions to existing theory and implications for practice are discussed. After data collection, the data analysis resolved around exploring our four hypotheses and was organized accordingly. Based on the survey results, an overview was created in the format of graphical representation for the closed questions and table summary for the open questions to facilitate the analysis of frequency of occurrences for each of the topics. Then, based on the data overview, trends for management decision making in outsourcing by biotech were identified and implications for practice were proposed. Finally, throughout literature on the topic was consulted for purposes of comparing and further understanding the main findings.

Figure 4.1 Number of respondents that consider that outsourcing function specialized teams facilitates drug discovery biotech growth.



Revisiting our first hypothesis, the research aims to further understand the strategic reasons of biotech to outsource, as well as, what these companies consider to be the main advantages and disadvantages of doing so. 84% of the respondents believe that biotech growth is positively

impacted by outsourcing of specialized functions (Figure 4.1.). This result was significantly higher compared to the remaining 16% of the respondents who did not consider or were not sure that outsourcing specialized functions facilitates biotech growth. We then explored the main reasons behind this narrative and asked for the advantages and disadvantages of outsourcing to be listed. More than 50% of the respondents listed aspects related to finance and knowledge management, as the main advantage of outsourcing. Particularly, converting fixed costs into variable costs and access to specialized knowledge were more frequently described (Table 4.1.). Additionally, flexibility was mentioned by 18% of the respondents, with no particular area of the business functions being nominated. Other reasons were listed, including leveraging economies of scale, shorter timelines, administrative efficiency and increased focus on core business, but to a lower extent.

On the other hand, the main disadvantages of outsourcing mostly lie on HR management, with 64% of the respondents considering the main hurdles of outsourcing to be aspects related

to the management of people (Table 4.2.). Less access to the day-to-day progress and limited control of the work, ultimately leading to a decrease of confidence in the team, were pointed out as the main concern of outsourcing (46%). Moreover, 15% of the respondents named the lack of connection of the outsourcer with the customer culture the main disadvantage of outsourcing. With less frequency, the slowness to anticipate issues and reduction of work quality, among other reasons related to cost and timelines management, were also brought up as concerns to outsourcing.

Table 4.1. Matrix of categorization of the respondents' answers to outsourcing advantages.

Category	Number of occur.	Percent	Item	Subcategory	Number of occur.	Percent
Finance (A)	11	25%	1	A1. Cost-benefit analysis	11	25%
			2	A2. Cost monitoring	0	0%
			3	A3. Monetary	0	0%
HR management (B)	0	0%	4	B1. Communication and leadership	0	0%
			5	B2. Organizational culture	0	0%
			6	B3. Management	0	0%
Operations management (C)	6	14%	7	C1. Timelines	3	7%
			8	C2. Processes	3	7%
			9	C3. Strategic alignment	0	0%
Knownlege development (D)	11	25%	10	D1. Access to specialized knowledge	11	25%
			11	D2. Intellectual property considerations	0	0%
			12	D3. Innovation	0	0%
Infrastructures (E)	3	7%	13	E1. Specilized spaces	1	2%
			14	E2. Technologies	2	5%
Relevance (F)	13	30%	15	F1. Advantages	10	23%
			16	F2. Impacts	0	0%
			17	F3. Benefits	3	7%

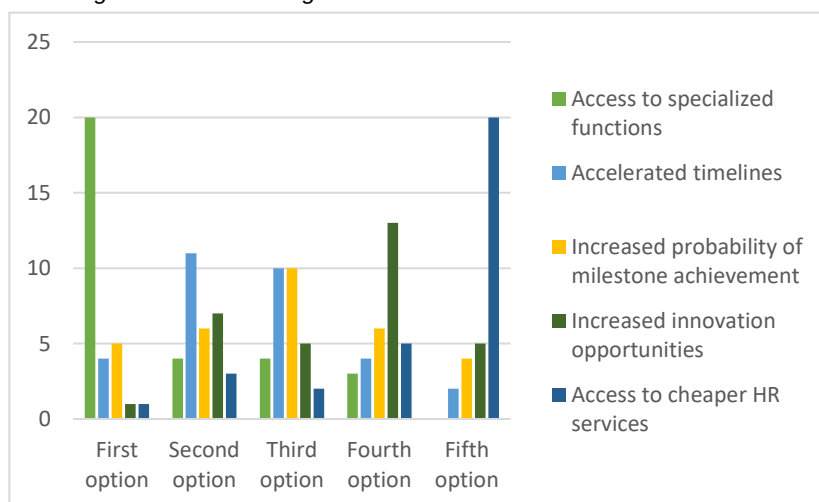
When asked about the competitive advantage of outsourcing business functions, the access to specialized roles was considered by 65% of the respondents as the main contributor (Figure 4.2.). This was followed by accelerated timelines, where 35% of respondents ranked it as the second factor of advantage. Increased probability of milestone achievement and increased innovation opportunities were ranked in third and fourth place, respectively. The access to cheaper HR services was ranked last in the list of contributors to competitive advantage, with 65% of the respondents ranking it as the least relevant.

Table 4.2. Matrix of categorization of the respondents' answers to outsourcing disadvantages.

Category	Number of occur.	Percent	Item	Subcategory	Number of occur.	Percent
Finance (A)	2	5%	1	A1. Cost-benefit analysis	0	0%
			2	A2. Cost monitoring	0	0%
			3	A3. Monetary	2	5%
HR management (B)	25	64%	4	B1. Communication and leadership	1	3%
			5	B2. Organizational culture	6	15%
			6	B3. Management	18	46%
Operations management (C)	2	5%	7	C1. Timelines	2	5%
			8	C2. Processes	0	0%
			9	C3. Strategic alignment	0	0%
Knowledge development (D)	1	3%	10	D1. Access to specialized knowledge	1	3%
			11	D2. Intellectual property considerations	0	0%
			12	D3. Innovation	0	0%
Infrastructures (E)	0	0%	13	E1. Specilized spaces	0	0%
			14	E2. Technologies	0	0%
Relevance (F)	9	23%	15	F1. Advantages	0	0%
			16	F2. Impacts	9	23%
			17	F3. Benefits	0	0%

In summary, the data confirms that biotech consider the outsourcing of specialized functions a boost to business growth and the access to specialized roles as the main factor of competitive advantage when outsourcing business functions. In line with this, knowledge management was one of the most frequently mentioned advantages of outsourcing. On the contrary, whilst financial aspects were also amongst the most frequently mentioned advantages of outsourcing, this aspect was considered the least relevant to competitive advantage when ranked with other four contributors to decision-making on outsourcing. It is

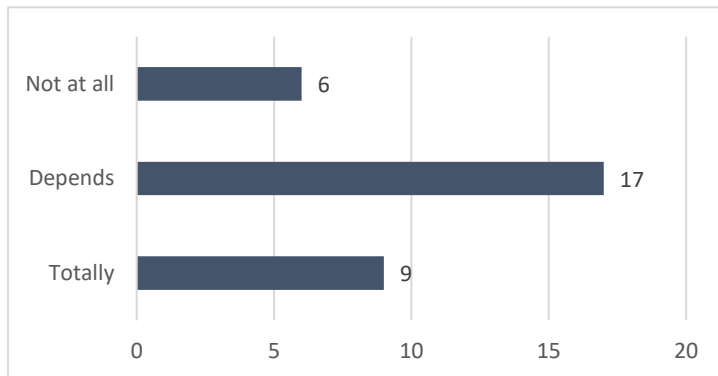
Figure 4.2. Aspects that respondents consider conferring competitive advantage when outsourcing business functions.



therefore proposed that drug discovery biotech focus on the most relevant areas of knowledge, considering complementary and synergetic specialties, and not necessarily price, when anticipating outsourcing. Noteworthy of our consideration,

aspects related to HR management were by far the most frequently mentioned as a disadvantage of outsourcing. This finding led us to also propose that managers should pay careful attention to this when outsourcing teams, and design measures, such as incentive to transparent communication, to mitigate this risk. Overall, the first hypothesis of this research work was confirmed.

Figure 4.3. Number of respondents that consider that outsourcing can be financially advantageous vs that depends vs that disagree.



The rationale behind our second hypothesis was to explore if specific value chain management methodologies are required when outsourcing more than 80% of business functions, and if financial governance aspects were given special emphasis. Under this scope, when asked if

outsourcing 80% of business functions is financially advantageous, 53% of the respondents answered “Depends” (Figure 4.3.). Further exploring the reason for these answers, 36% of the respondents described aspects related to operations management as a factor that can positively or negatively impact the financial advantage of outsourcing (Table 4.3.). Namely, timelines and processes were listed to justify their answer. With the same weight of relevance, the cost-benefit analysis was also mentioned by 14% of the respondents. Additionally, knowledge management, particularly function related aspects, was mentioned by 29% of the respondents as a contributing factor to the financial advantage of outsourcing. Alternatively, 28% and 19% of the respondents agreed and disagreed, respectively, that it is financially advantageous to outsource more than 80% of business functions.

Table 4.3. Matrix of categorization of the respondents' answers to the aspects relevant to determine if it is financially advantageous to outsource business functions.

Category	Number of occur.	Percent	Item	Subcategory	Number of occur.	Percent
Finance (A)	5	18%	1	A1. Cost-benefit analysis	4	14%
			2	A2. Cost monitoring	1	4%
			3	A3. Monetary	0	0%
HR management (B)	2	7%	4	B1. Communication and leadership	2	7%
			5	B2. Organizational culture	0	0%
			6	B3. Management	0	0%
Operations management (C)	10	36%	7	C1. Timelines	4	14%
			8	C2. Processes	4	14%
			9	C3. Strategic alignment	2	7%
Knowledge development (D)	8	29%	10	D1. Access to specialized knowledge	7	25%
			11	D2. Intellectual property considerations	1	4%
			12	D3. Innovation	0	0%
Infrastructures (E)	1	4%	13	E1. Specilized spaces	0	0%
			14	E2. Technologies	1	4%
Relevance (F)	2	7%	15	F1. Advantages	2	7%
			16	F2. Impacts	0	0%
			17	F3. Benefits	0	0%

68% of respondents believe that a special financial model/ structure is required to manage a value chain with more than 80% of outsourced business functions, as compared to 32% of the respondents who answered “Depends” or “No” (Figure 4.4. A). In this question, aspects related to operations and HR management were exclusively mentioned by 89% and 11% of respondents, respectively (Table 4.4.). Particularly, 56% of the respondents highlighted the relevance of processes when outsourcing most of the business functions, with emphasis on the need for a closer monitoring of expenses. Additionally, strategic alignment was mentioned by 33% of the respondents as another relevant aspect. Considering the value chain described by Porter (1998), Technology development is where 35% of the respondents would focus their investment, in the context of outsourcing more than 80% of business functions (Figure 4.4. B). This was followed by Primary activities and Infrastructures, selected by 26% and 16% of respondents, respectively.

Figure 4.4. (A) Number of respondents that consider that no special financial model or structure is required vs it depends vs it is required; (B) Value chain functions where respondent's would invest more, in the context of outsourcing more than 80% of business functions.

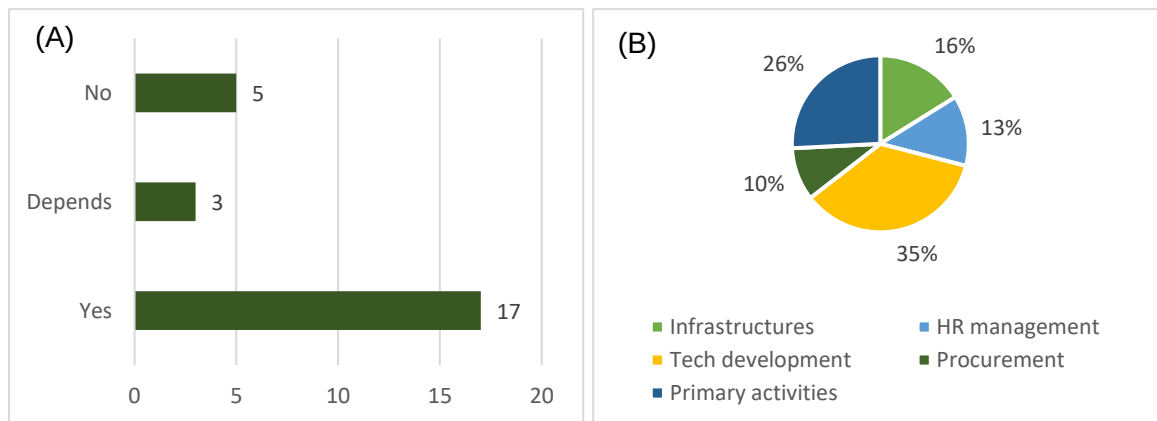


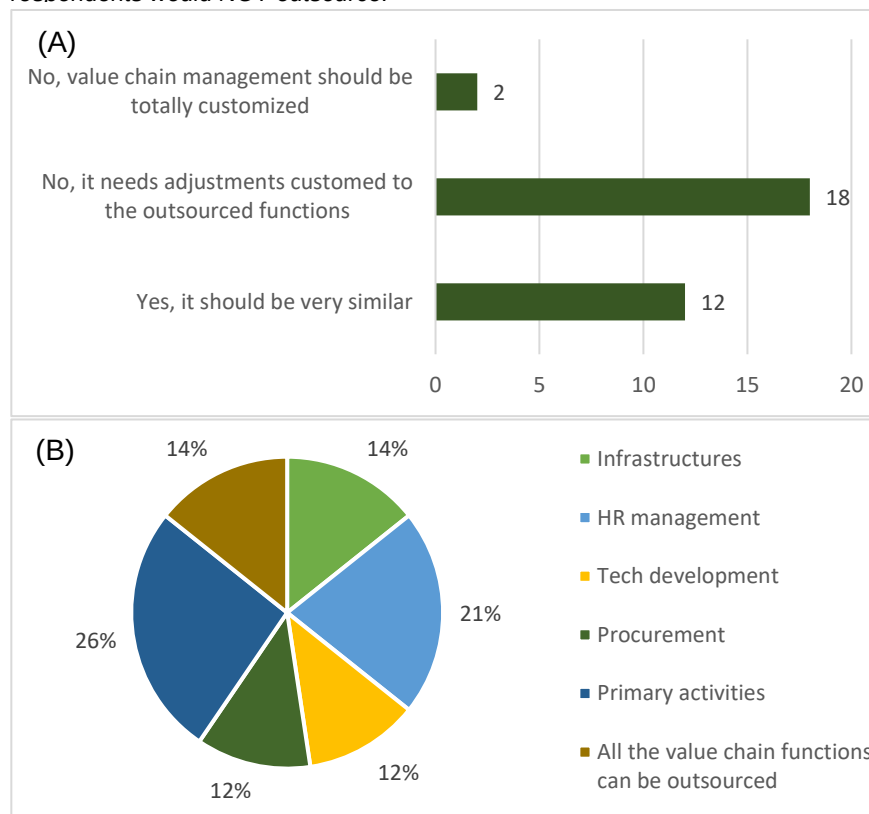
Table 4.4. Matrix of categorization of the respondents' answers to the financial requirements for a value chain with more than 80% of outsourced business functions.

Category	Number of occur.	Percent	Item	Subcategory	Number of occur.	Percent
Finance (A)	0	0%	1	A1. Cost-benefit analysis	0	0%
			2	A2. Cost monitoring	0	0%
			3	A3. Monetary	0	0%
HR management (B)	2	11%	4	B1. Communication and leadership	0	0%
			5	B2. Organizational culture	0	0%
			6	B3. Management	2	11%
Operations management (C)	16	89%	7	C1. Timelines	0	0%
			8	C2. Processes	10	56%
			9	C3. Strategic alignment	6	33%
Knowledge development (D)	0	0%	10	D1. Access to specialized knowledge	0	0%
			11	D2. Intellectual property considerations	0	0%
			12	D3. Innovation	0	0%
Infrastructures (E)	0	0%	13	E1. Specilized spaces	0	0%
			14	E2. Technologies	0	0%
Relevance (F)	0	0%	15	F1. Advantages	0	0%
			16	F2. Impacts	0	0%
			17	F3. Benefits	0	0%

As far as the adjustment of management methodologies to a value chain with more than 80% of business functions, 63% of the respondents believe these are needed, with 6% stating that the value chain management should be totally customized (Figure 4.5. A). Further analysis of this data, allowed to determine that, the most relevant factors considered encompass HR and operations management (Table 4.5.), as verified when addressing the financial model/ structure needed in the context of outsourcing more than 80% of business functions. Diving

deeper into the details, 63% of respondents highlighted communication and leadership aspects, whilst the other 38% related to timelines and processes management. Clear communication was amongst the most frequently mentioned relevant measures to manage a value chain with high levels of outsourcing.

Figure 4.5. (A) Number of respondents that consider that management methodologies should be adjusted when outsourcing more than 80% of business functions vs common methodologies apply; (B) Value chain functions that respondents would NOT outsource.



When considering the value chain business functions, the primary activities would not be outsourced by 26% of the respondents, not far from the 21% that would not outsource HR management (Figure 4.5. B). 14% of the respondents would not outsource infrastructures, and procurement and technology development was selected by 12% each to not be outsourced. On the other hand, the other

14% of the respondents consider that all value chain functions can be outsourced.

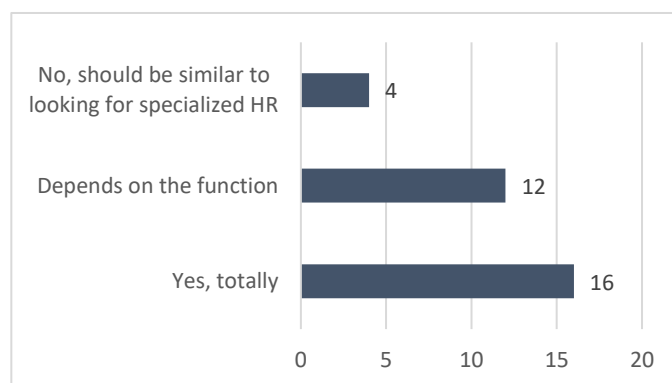
Taken together, the data reveals that HR and operations management are amongst the most relevant factors to consider when managing a value chain with more than 80% of outsourced business functions in biotech. Even when narrowing down the scope to financial governance and needs, those two aspects were brought up more frequently than any other, and even than assurance of financial capacity. This allows us to propose that careful consideration should be taken on HR and operations management when outsourcing more than 80% of business functions in biotech. Nonetheless, HR management was one of the least selected business functions for high investment. Whereas Technology development was the most frequently chosen for investment, this seems to be the function that respondents have less concerns to outsource. On the contrary, the primary activities was the business function that more respondents highlighted concern to outsource and the second choice for highly investment. The second hypothesis was partly confirmed, with some methodologies stressed

as relevant to the successful management of a biotech value chain with more than 80% of outsourced business functions, but financial governance was not amongst these.

Table 4.5. Matrix of categorization of the respondents' answers to the requirements to manage a value chain with more than 80% of outsourced business functions.

Category	Number of occur.	Percent	Item	Subcategory	Number of occur.	Percent
Finance (A)	0	0%	1	A1. Cost-benefit analysis	0	0%
			2	A2. Cost monitoring	0	0%
			3	A3. Monetary	0	0%
HR management (B)	5	63%	4	B1. Communication and leadership	5	63%
			5	B2. Organizational culture	0	0%
			6	B3. Management	0	0%
Operations management (C)	3	38%	7	C1. Timelines	1	13%
			8	C2. Processes	2	25%
			9	C3. Strategic alignment	0	0%
Knowledge development (D)	0	0%	10	D1. Access to specialized knowledge	0	0%
			11	D2. Intellectual property considerations	0	0%
			12	D3. Innovation	0	0%
Infrastructures (E)	0	0%	13	E1. Specilized spaces	0	0%
			14	E2. Technologies	0	0%
Relevance (F)	0	0%	15	F1. Advantages	0	0%
			16	F2. Impacts	0	0%
			17	F3. Benefits	0	0%

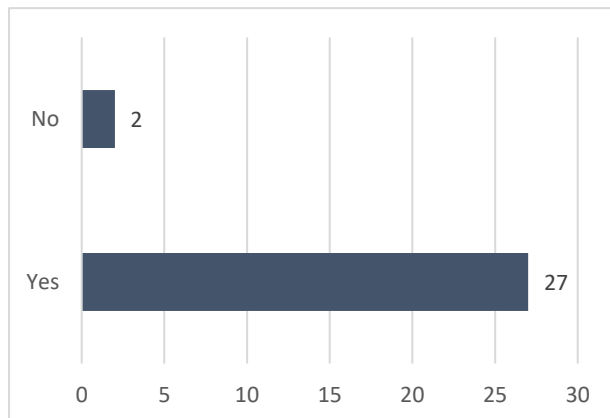
Figure 4.6. Number of respondents that consider that it should be easier to find specialized functions when outsourcing vs it depends on the function vs it should be similar to finding specialized HR.



easier to outsource than to insource specialized functions. 50% of the respondents deliberate it easier to find specialized functions when outsourcing them, whereas 38% responded that it depends (Figure 4.6.). When further exploring this last answer, the reasons provided were evenly distributed between the level of expertise and the nature of the function itself.

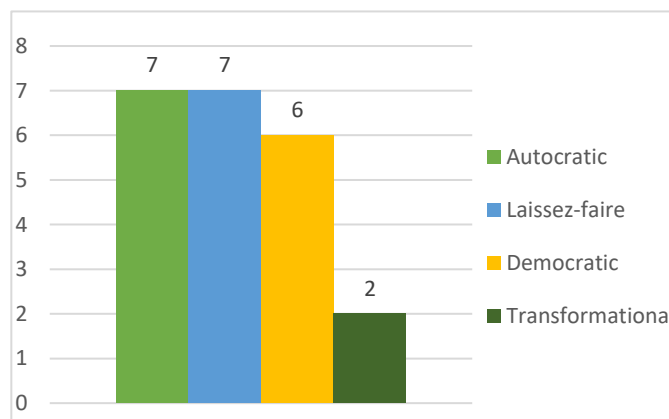
Returning to the third hypothesis, and in line with the findings of the previous one, the authors wanted to address the main leadership methodologies relevant for outsourced teams and how managers motivate what is a scarce and very valuable asset of biotech sector, specialized human resources. First, it was addressed if respondents considered it to be

Figure 4.8. Number of respondents that consider that special leadership skills are required to manage outsourced teams vs common skills apply.



managers (Table 4.6.). Communication and soft skills were mentioned by 51% of the respondents. Communication was the most frequently mentioned skill, followed by agility. Hard skills, namely programs' planning, monitoring and reporting, were described by 38% of the respondents as critical skills for managers of outsourced teams. Additionally, a strong strategic alignment was also mentioned by 10% of the respondents as a critical leadership skill for outsourced teams' managers.

Figure 4.7. Leadership style that respondents consider more adequate for outsourced teams.



behavioral theory (Lewin & Lippitt, 1938). Aspects related to the autocratic and laissez-faire leadership styles were each described by 32% of the respondents, whereas 27% of the respondents named behaviors related to the democratic leadership style (Figure 4.8.). Transformational leadership was mentioned by 9% of the respondents as the main leadership style to manage outsourced teams. Without further explanation, it is not clear if this last style fits best under the contingency theory of Vroom and Jago (2007) or the integrated psychological theory (Scouller, 2011).

Regarding the question if the management of outsourced teams requires special leadership skills, the majority of the respondents, more precisely 93%, answered yes (Figure 4.7.). When asked to explain, the respondents highlighted aspects related to HR and operations management. In this case, 90% of the respondents considered HR management as a preponderant skill for outsourced teams'

The answers to the question on what the best leadership style for outsourced teams are, either mentioned control driven, accountability driven, or partnership driven behaviors. To facilitate interpretation, we considered each of those respectively, the autocratic, laissez-faire, and democratic leadership styles described by the

Table 4.6. Matrix of categorization of the respondents' answers to the leadership skills required to manage outsourced teams.

Category	Number of occur.	Percent	Item	Subcategory	Number of occur.	Percent
Finance (A)	0	0%	1	A1. Cost-benefit analysis	0	0%
			2	A2. Cost monitoring	0	0%
			3	A3. Monetary	0	0%
HR management (B)	35	90%	4	B1. Communication and leadership	20	51%
			5	B2. Organizational culture	0	0%
			6	B3. Management	15	38%
Operations management (C)	4	10%	7	C1. Timelines	0	0%
			8	C2. Processes	0	0%
			9	C3. Strategic alignment	4	10%
Knowledge development (D)	0	0%	10	D1. Access to specialized knowledge	0	0%
			11	D2. Intellectual property considerations	0	0%
			12	D3. Innovation	0	0%
Infrastructures (E)	0	0%	13	E1. Specilized spaces	0	0%
			14	E2. Technologies	0	0%
Relevance (F)	0	0%	15	F1. Advantages	0	0%
			16	F2. Impacts	0	0%
			17	F3. Benefits	0	0%

To understand what motivates outsourced teams in biotech, the most relevant factors of motivation were explored. 81% of the respondents named HR management as an important aspect, with communication and leadership being mentioned by 67% of the respondents (Table 4.7.). Namely, 44% of respondents mentioned permanent feedback, 13% highlighted strategy share and 10% described the set of clear goals as the most relevant features to work on outsourced teams' motivation. On the other hand, 14% of the respondents mentioned aspects related to program management and strategic alignment as a contributing factor to motivation of outsourced teams. Lastly, a minority of the respondents (5%) nominated monetary incentives.

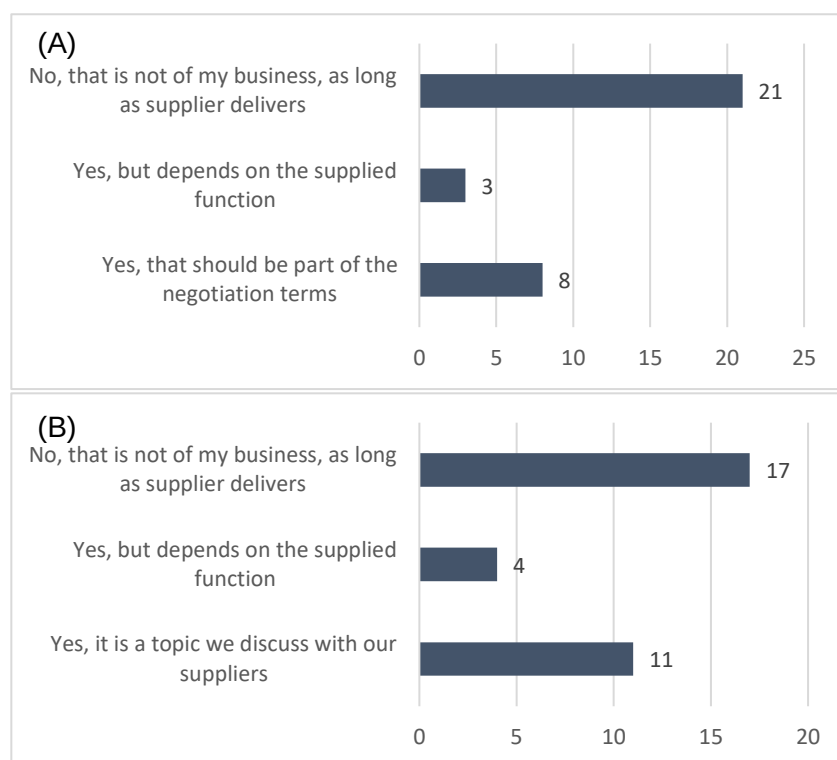
As part of the belief that motivation of the outsourced team should be a relevant consideration for program's success, the authors wanted to further understand the relevance this is given by the biotech industry when choosing and negotiating service terms with outsourcers. To do so, suppliers training and career development practices were considered a good reflect of outsourcers investment on teams' motivation and HR rotation levels a good measure to take in consideration when addressing the level of motivation of the teams.

Table 4.7. Matrix of categorization of the respondents' answers to the aspects more relevant to work on motivation of outsourced teams.

Category	Number of occur.	Percent	Item	Subcategory	Number of occur.	Percent
Finance (A)	2	5%	1	A1. Cost-benefit analysis	0	0%
			2	A2. Cost monitoring	0	0%
			3	A3. Monetary	2	5%
HR management (B)	35	81%	4	B1. Communication and leadership	29	67%
			5	B2. Organizational culture	0	0%
			6	B3. Management	6	14%
Operations management (C)	6	14%	7	C1. Timelines	0	0%
			8	C2. Processes	0	0%
			9	C3. Strategic alignment	6	14%
Knowledge development (D)	0	0%	10	D1. Access to specialized knowledge	0	0%
			11	D2. Intellectual property considerations	0	0%
			12	D3. Innovation	0	0%
Infrastructures (E)	0	0%	13	E1. Specilized spaces	0	0%
			14	E2. Technologies	0	0%
Relevance (F)	0	0%	15	F1. Advantages	0	0%
			16	F2. Impacts	0	0%
			17	F3. Benefits	0	0%

Most of the respondents did not consider these two aspects to be relevant when starting a relationship with a new supplier (Figure 4.9. A and B). Particularly, there was less interest demonstrated regarding the suppliers' training and career development practices (66%), than to the suppliers HR rotation levels (53%). Alternatively, the respondents that considered it relevant to discuss these factors with the suppliers, gave more relevance to HR rotation levels (34%) than to suppliers' training and career development practices (25%). Lastly, the function nature and complexity were mentioned as the main contributor for the respondents to consider these two factors when negotiating outsourcing services.

Figure 4.9. Relevance given by respondents to (A) HR training and career development practices and (B) HR rotation levels of suppliers when outsourcing teams.



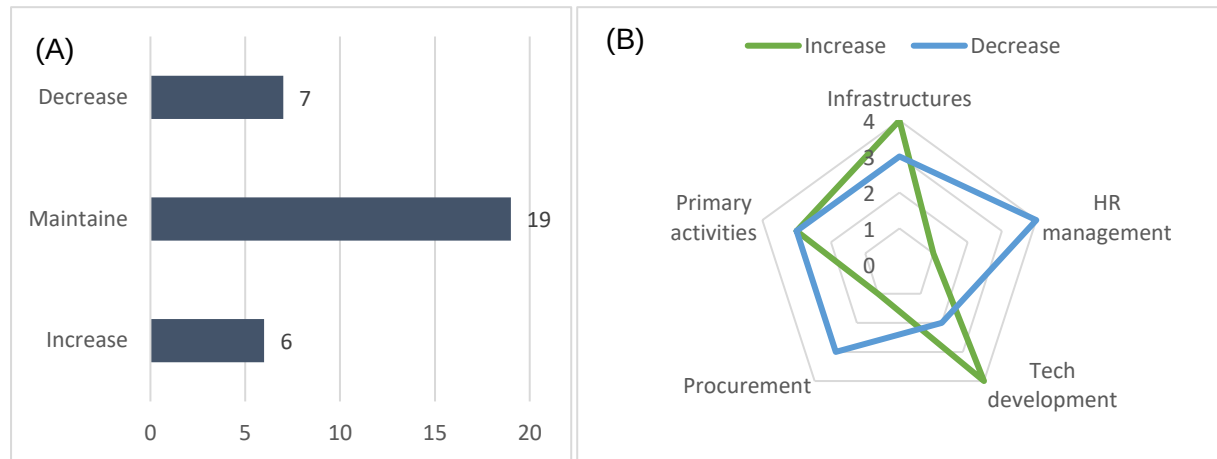
Overall, the data analysis proposes that biotech resource to outsourcing services to facilitate the finding of specialized functions. We also suggest that the management of outsourced teams require careful consideration. Communication and good leadership practices were the most relevant aspects on effectively promoting motivation of outsourced teams. Furthermore, this would need to be complemented with strong

program management skills. On the best leadership style to work with outsourced teams, the answers were evenly distributed between autocratic, laissez-faire and democratic leadership styles, requiring further investigation to consolidate the hypothesis. Even though there is a consensus on the importance of good leadership practices to manage outsourced teams, this is not a common subject of discussion between biotech and outsourcer. Most of the respondents considered this not to be part of their obligations. Therefore, we propose leadership programs as part of biotech basic training, including the development of alliance management skills amongst their program leads. Further, the creation of face-to-face events could help foster the outsourcee and outsourcer relationship and significantly improve communication and mitigate cultural gaps. The third hypothesis was confirmed.

To challenge the belief that R&D outsourcing will remain a trend of biotech and the relevance of this study, we proposed the fourth and final hypothesis that states that outsourcing will remain a trend in the near future and that the findings described in this report are relevant to establish good value chain managing and outsourced teams' leadership practices. 78% of the respondents stated that the outsourcing practices of their companies will either be maintained or increased (Figure 4.10. A). The business functions where outsourcing will grow the most are anticipated to be infrastructures and technology development (Figure 4.10. B). On the contrary, HR management was the business function where a decrease of outsourcing

practices is predicted to be more frequent. Thus, we believe the proposals here developed will be relevant measures for biotech companies who are planning to outsource.

Figure 4.10. Respondents' beliefs to (A) the changes of outsourcing in their current companies and (B) the business functions that will be impacted.



The present research aimed to understand the value chain management trends and leadership methodologies of outsourced teams regarded as best practices by biotech. The study then explored four hypotheses related to those topics and revealed that biotech consider the outsourcing of specialized functions a boost to business growth and the access to specialized roles as the main factor of competitive advantage when outsourcing business functions. This is in line with published data that state that R&D outsourcing in the pharmaceutical industry started to be geared towards sourcing knowledge, research and technology synergies (Festel, 2011; Howells, 2012). Also supporting outsourcing of specialized functions as a competitive advantage is the study published by Oshri et al. (2009) who defends those specialized functions, where competent HR are hard to find and demanding to train, or rapidly changing technologies are also interesting to outsource. Furthermore, in several studies, Bogers et al. (2018) argues that the process of innovation has shifted to a mode of open systems involving several players in the supply chain. On the other hand, it goes on the opposite direction of several other studies where it has been described that organizations should invest in activities with sustainable competitive advantage and externalize those that are not differentiating, have low strategic importance and risk (Bacea & Borza, 2015; Dolgui & Proth, 2013). Back in 2009, Sen and MacPherson (2009) reported that outsourcing strategic activities was declining and non-core activities were outsourced at an accelerated pace, but this does not seem the case currently in the biotech sector as evidenced through the data collected in the current research.

Whilst financial aspects were also amongst the most frequently mentioned advantages of outsourcing, this aspect was considered the least relevant to competitive advantage when ranked with other four contributors to decision-making on outsourcing. Howells (2012), hypothesized that R&D outsourcing depends on the size of the company and that larger companies, with bigger turnover are more likely to outsource their R&D. In their analysis, they could not see a correlation between the size of the business and the likelihood of outsourcing, though. Here even though financial aspects are mentioned as one of the main advantages of outsourcing, it is not regarded as the most relevant to confer competitive advantage. Biotech companies seek knowledge in outsourcing as a strategy of differentiation. In the study of Piachaud (2005), the cost-benefit analysis of outsourcing appears to be outweighed by access to external expertise and resources. Thus, on a more detailed analysis, where we correlated the respondent's company headcount with the level of outsourcing, a trend towards smaller companies reporting higher levels of outsourcing is clearly visible.

Additionally, the leverage of economies of scale is mentioned as an advantage of outsourcing by 7% of the respondents. It has been previously reported that the intensity of R&D activities within an organization correlates directly with the likelihood of outsourcing, and that businesses with higher internal knowledge more actively pursue external collaborations (Arora & Gambardella, 1990). Even though this may be the case for pharmaceutical companies, according to our data this is not amongst the main reasons for biotech to outsource. In fact, the same study states that newer models, with sophisticated portfolio management but low R&D intensity were already emerging back in 2012 (Howells, 2012). It also argues that larger projects are easier to modulate and therefore the greater the likelihood of being outsourced. In the present research, the size of the project or project density was not brought up as a relevant aspect to any of the topics assessed. Festel (2011), also reports that price competition is mainly used by pharmaceutical companies and that for mid-sized companies the most important cooperation models are project selection and strategic partnerships. Price competition also applies more frequently to clinical stage companies than to research biotech (Festel, 2011). This may have contributed to the outcome of our data, since 68% of the respondents were from companies at the research stage.

Bacea and Borza (2015) state that for a company to be able to offer products and services at the highest standards, the company must focus on the core activities. Here we find that this aspect was considered by a minority of the respondents (7%) as an advantage of outsourcing. In fact, the reported trend in biotech is to outsource beyond the supporting activities to seek flexibility and know-how (Festel, 2011; Lowman et al., 2012). Calantone and Stanko (2007) have argued that outsourcing, and mostly innovation outsourcing, is favored by the need for flexibility in situations with higher technological uncertainty. This was brought by 18% of the

respondents of the current study as an advantage of outsourcing. Timelines were also occasionally referred to by 7% of the respondents as an advantage of outsourcing. Previous studies support the concept that the time required to reach the market can be reduced by innovation outsourcing (Chatterji, 1996; Quinn, 2000). Notwithstanding, it has been argued that demands of time, cost and quality within projects are regarded as performance indicators rather than strategic drivers of outsourcing (Lowman et al., 2012). This aligns with our findings, where timelines, increased probability of milestones achievement and access to cheaper HR services were ranked after the access to specialized functions as a competitive advantage.

Aspects related to HR management were by far the most frequently mentioned as a disadvantage of outsourcing. Moreover, the data reveals that HR and operations management are amongst the most relevant factors to consider when managing a value chain with more than 80% of outsourced business functions in biotech. In the past, it has been reported that difficulties in managing outsourced innovation processes were deferring firms from outsourcing more (Zirpoli & Becker, 2011) and technological uncertainty at the project level was referred to as a concern (Lowman et al., 2012).

Even when narrowing down the scope to financial governance and needs, HR and operations management aspects were brought up more frequently than any other. 4% of the respondents emphasized the existence of unforeseen costs a relevant consideration when financially managing outsourced business functions. In line with this, Barthélemy (2001) identifies several hidden costs of outsourcing in his study. Besides, 25% of the respondents of the current study related the outsourced function itself to the financial advantage of outsourcing. Potential problems in selecting the service providers, as suggested by Earl (1996), could underly this feedback. On the other hand, the risk of supplier dependency was mentioned by 5% of the respondents, also highlighted in a previous study as a potential disadvantage of outsourcing (Alexander & Young, 1996).

HR management was one of the least selected business functions for high investment. Whereas Technology development was the most frequently chosen for investment, this seems to be the function that respondents have less concerns to outsource. On the contrary, the primary activities was the business function that more respondents highlighted concern to outsource and the second choice for highly investment. However, care needs to be taken at interpreting such data, as biotech primary functions can be considered technology development. The pharmaceutical industry lives of technology development in regard to constant innovation pursue and novelty generation. In line with this, Hoecht and Trott (2006) draw attention to the increased intellectual property risk when biotech and pharmaceutical companies outsource knowledge. Additionally, the authors highlight the loss of internal

knowledge a disadvantage of outsourcing R&D activities and are supported by other studies (Lowman et al., 2012). Caruth et al. (2013) describe that activities that require confidentiality, strategic decision making, and specific management knowledge should rarely be outsourced. In the current research, we identify that these concerns were brought up by 4% of the respondents. Notwithstanding, 46% of the respondents highlighted limited access and control as a disadvantage of outsourcing, which indirectly could be regarded as loss of knowledge, as well as, reduced control on confidentiality and strategic decision making. Calantone and Stanko (2007) showcases the many uncertainties of the performance implications of outsourcing and the literature on outsourcing innovation defends that outsourcing is higher when the outputs of the activities are more straightforward to monitor and assess, and intellectual property can be well protected (Howells et al., 2008; Lowman et al., 2012; Robertson & Gatignon, 1998).

Communication and good leadership practices were the most relevant aspects on effectively promoting motivation of outsourced teams. Furthermore, this would need to be complemented with strong program management skills. In the studies of Festel (2011); Howells (2012); Weeks and Thomason (2011) the authors highlight the existence of strong alliance management teams as an important factor for the success of R&D outsourcing in pharmaceutical companies. Lowman et al. (2012), suggest direct access between the different parties' experts and strong relationship governance structure and instruments should carefully be designed. Other studies about outsourcing also support this idea. According to Bhattacharya et al. (2013), the buyer vendor relationship is key for outsourcing. Rich information exchange, clear communication, continuous interaction and mutual trust and commitment are described as critical aspects to foster that relationship (Kaipia & Turkulainen, 2017; Subramaniam & Dugar, 2012; Zhou & Jiang, 2012). Additionally, the innovation management literature focuses on the capacity to absorb and transfer knowledge, and the ability to learn through interaction as crucial factors of success in innovation (Lowman et al., 2012). It is argued that innovation is located in networks rather than individual firms and proposed that integration mechanisms that allow knowledge absorptive capacity are implemented and maintained by companies. Even so, the authors describe that an understanding of the key processes on each side was not felt to be an important factor for the success of the partnership and that problems emerge when outsourcers lack scientific knowledge. 13% of the respondents of our survey consider this a motivational factor for the outsourced teams, though.

Zhou and Jiang (2012) also highlight flexibility and freedom as an important component of the outsourcer and outsourcee relationship. This aspect was mentioned by 4% of the respondents of the current study, when asked how to work motivation of outsourced teams. In

the study of Howells (2012), the author highlights the importance of effective knowledge management. We found that aspects related to relationships and project management were given more relevance by our survey respondents when considering leadership skills to manage outsourced teams.

The data analysis proposes that motivation read-outs were not amongst the subjects discussed by most of the biotech with suppliers. Nevertheless, significant problems with employee turnover in outsourcers has been recognized by pharmaceutical industry informants before (Lowman et al., 2012).

On the best leadership style to work with outsourced teams, the answers were evenly distributed between autocratic, laissez-faire and democratic leadership styles, requiring further investigation to allow any conclusions. Even though, no data on this subject was retrieved from the literature review performed, this finding aligns with the paper from Föller (2002), that describes the need of different management styles in biotech with different maturity stages.

The primary data analysis proposes that most of the respondents expect their businesses to maintain or increase outsourcing in the near future. This supports the trend already reported by Howells (2012), that described that 57% of the businesses surveyed outsourced some of its business functions in 1998 and that this had grown for 72.4% in 2003. Considering our sampling, currently, 94% of the respondents' businesses outsource some of their business functions. Noteworthy to mention though that, even though it does not contradict the findings, the sampling of Howells (2012) study is restricted to UK companies, whilst the sampling of the present study is global.

Overall, based on these findings we propose a few guidelines as best practices for value chain management and leadership methodologies of outsourced teams:

- (1) Drug discovery biotech should focus on the most relevant areas of knowledge, considering complementary and synergetic specialties, and not necessarily price, when anticipating outsourcing.
- (2) Biotech managers should design mechanisms for management of outsourced human resources, that allow transparent communication and foster knowledge share and absorption.
- (3) We propose leadership programs as part of biotech basic training, including the development of alliance management skills amongst their program leads. Further, the creation of face-to-face events could help foster the outsourcee and outsourcer relationship and significantly improve communication and mitigate cultural gaps.

While the importance of this study and relevance of its proposals may be inferred from the visible trend of biotech to maintain or increase outsourcing of their business functions, we suggest further systematic analysis of the topic. In the next chapter, we summarize our findings, linking them to our hypothesis, whilst discussing the limitations of this study and suggesting future research.

5. Conclusions and Recommendations

The current study aimed to tackle the value chain management methodologies and best leadership practices to manage outsourced teams. To do so, we proposed 4 hypotheses for a better and structured thinking on the subject and to propose practical implications to business management. In the current section, we will explore the research conclusions regarding the hypotheses and the practical relevance of the proposed actions. We will further discuss the limitations inherent to this study and suggest future research.

The first hypothesis aimed to further understand the strategic reasons of biotech to outsource, as well as, what these companies consider to be the main advantages and disadvantages of doing so. We propose that access to specialized functions was the main aspect considered to confer strategic advantage to outsourcing business functions. This was in line with previous research that reported the increased trend of the pharmaceutical industry to outsource know-how and innovation. Additionally, the financial and timeline-related aspects were considered secondary aspects for the strategic decision to outsource. We strengthened our hypothesis and proposed as a relevant action to drug discovery biotech to invest on the relevant areas of knowledge, considering complementary and synergetic specialties.

Demanding HR and operations management were considered the main disadvantage of outsourcing and the critical factor of success when managing a value chain with more than 80% of outsourced business functions. Acknowledging this relevance, HR management was one of the business functions that most of the respondents would not outsource. Notwithstanding, this was not related to a higher investment in this function. On the contrary, this was one of the business functions where respondents would invest the least. Moreover, even though through an indirect assumption, we suggest that the data reveal that technology development is a concern of the majority of the respondents when outsourcing more than 80% of business functions. Here we considered that the majority of the respondents highlighted limited access and control as a regard to loss of knowledge, as well as, reduced control on confidentiality and strategic decision making. Together with this, technology development was the most frequently chosen business function for higher investment. Therefore, we propose that drug discovery biotech that plan to outsource a good percentage of their business functions to take careful consideration on HR management and invest in mechanisms to regulate and promote knowledge share and absorption. Considering these findings our second hypothesis was partially rejected, since the authors had considered the focus management needs on financial governance.

After a thorough analysis of the critical factors of success in value chain management, the conducted research aimed to explore the best practices to lead outsourced teams. Under this goal and in connection with the previous hypothesis, the authors aimed to validate the third hypothesis, which defended that leadership strategies to manage outsourced teams should be tailored and it is a critical factor of programs' success. The data collected aligned well with this hypothesis and allowed the authors to confirm it. Communication and good leadership practices were the most relevant aspects of effectively promoting motivation of outsourced teams. Strong program management skills were named alongside as one of the most important competences of managers of outsourced teams. On the other hand, we observed that the majority of the biotech companies implement internal strategies to motivate outsourced teams and neglect the role of the outsourcer as an employer itself. Our findings lead us to propose that strong relationship governance structure and instruments should carefully be designed by drug discovery biotech to successfully manage outsourced teams and retain generated knowledge.

Supporting the relevance of our proposals to the future practices in drug discovery biotech, we strengthen our fourth hypothesis, which stated that outsourcing of business functions by biotech is a trend that will be maintained in the upcoming years, and therefore, companies should consider the management methodologies to best explore it.

While reaching relevant and important conclusions on the subject brought for discussion by this study, its limitations and potential future research are discussed. One of the major concerns that arose from literature review was the fact that most of the data historically collected and, therefore, reported and discussed was from pharmaceutical companies. The differences between these and drug discovery biotech were explained in the literature review section and, even though the authors consider comparable the data collected in the current research and in previous studies, it is also important to highlight this as a factor that may have influenced the discussion of the results. With the growth of biotech share in the pharmaceutical industry, we expect that more studies will be focused on aspects related to management of drug discovery biotech and that the current research can enrich the discussion around it.

In alignment with the previous paragraph, the existence of a small quantity of public data about biotech financial performance, since many of these companies are too small to be public, the data collected from this environment is typically based on the opinion of key players on the field and not on quantifiable and precise measures, which is also the case of this study. That data can be prone to the influence of public perception, due to the lack of instruments to challenge it and exclude biased outcomes. Therefore, we believe that the higher the sample size the more precise are the conclusions, since these factors may be diluted by mass opinion.

This is also one of the limitations of our study, as sample size was restricted to 31 respondents. Even though aligned with the sampling size described in previous studies, and enriched by roles relevant for the topic discussed, the sample was not representative of the population aimed to reach under this study. Furthermore, it was restricted to the network of the authors, although disseminated in public platforms. This limits the discussion around the results obtained.

Another limitation that was brought to our attention was the lack of control over the respondents. The survey was disseminated online and accessible to everyone. Since we wanted to collect data from a specific population under the pharmaceutical industry, the drug discovery biotech, we made as clear as possible our target population under the introduction section of the survey. Nonetheless, this may not have been enough to prevent collection of data from respondents outside our target population. On the other hand, we also lacked control on respondents' interest while going through the questionnaire and mostly to open questions. These questions were more prone to vague answers or even lack of response. Additionally, since we tried to keep the questionnaire anonymous to prevent concerns about providing feedback, it is not clear if the sample has a good representation of different companies, or if there was a bias to certain organizations.

Considering all the abovementioned aspects, it would be valuable to expand this research to more respondents, aiming to have at least 100 opinions, and to switch the data collection method to interview-based. This method would be more laborious and time consuming but would allow us to have better control of the representativeness of the collected data of the target population. Moreover, we would also recommend expanding the target population to understand outsourcers perspective, who may also have valuable and pertinent insights on how drug discovery biotech can leverage outsourcing. For example, to understand the contributing factors of motivation and what drives outsourcers alliances would provide important hints on the best methods to lead and motivate outsourced teams.

It would also be very important to collect quantifiable and precise data to enrich and increase robustness of the conclusions reached in this research. A meta-analysis of some of the explored variables under this study, such as understanding correlation between outsourcing and market share growth, or level of investment in the different business functions and successful accomplishment of businesses goals, or leadership practices and number of patents or publications per year as a measurement of knowledge creation, would provide more insights on the best practices of value chain management and leadership of outsourced teams.

Finally, and aiming to challenge our proposals, it would be considerably helpful to understand the outcome of implementing the measures suggested under this study.

Longitudinal research looking for the practical impacts of some of the guidelines here suggested on drug discovery biotech businesses management, as well as on the motivation of the outsourced teams would help recognize the relevance of the measures, broaden the understanding of the subject and propose new improvements. Besides, aligned with the future trends, it would be helpful to understand the impact of artificial intelligence-based technologies on our findings and how these can be leveraged to promote drug discovery biotech growth. Given the extended timelines of the R&D in biotech, this is a long term research and could take up to 20 years to be accomplished.

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