How Technology-based Organizations Successfully Drive Intrapreneurship by Harnessing their Engineers' Capabilities

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PhD

University of York

Electronic Engineering

August 2022

ABSTRACT

Intrapreneurship is a relatively modern research field that is widely recognized as an effective business strategy to influence an intrapreneurial culture and drive innovation within an organization and build a competitive advantage. In today's complex and rapidly changing business environment, technology organizations, particularly Small and Medium-sized Enterprises (SMEs), face increasing challenges. They not only have to monitor and keep up with the changes in the technology market, but they also have to find ways to develop successful innovative products and technologies to sustain their position. In such firms, engineers are expected to be experts in the areas of technology, contribute significantly to the innovation process, and bring real values to the marketplace. Hence, technology firms today have engineering roles that go beyond the stereotypical. They expect their engineers to engage actively with intrapreneurship and help work toward the organizational vision and values. Compared to large organizations, SMEs have several limitations. They have to utilize their resources more efficiently, and one of the ways is to tap into their engineers' intrapreneurial potential. However, in the literature so far, how technology organizations can be more intrapreneurial through their engineers has received very little scholarly attention. It is one of the main research gaps in the fields of intrapreneurship and engineering.

This research addresses these gaps through an exploratory study using a multiple case study methodology to investigate the main organizational factors that harness and nurture engineers' intrapreneurial capabilities. A sample of four leading and successful technology-based SMEs have been selected from different technological sectors in the UK. These firms are engineering intensive and have successful reputations for introducing innovative products and solutions over the years. A semi-structured interview approach was utilized to collect data from different participants within the organization, including managers from different roles and at different hierarchical levels, as well as engineers at the operation level, thereby providing a more comprehensive perspective of their intrapreneurship activities at the firm level.

The findings show different strategies and approaches followed in the four cases to facilitate intrapreneurship. Different driving factors emerged for each firm based on their distinct setup and characteristics. These factors are mainly clustered under three main groups; developing a supportive culture for intrapreneurship that is integrated and complemented with leadership and management support for intrapreneurial activities and a set of related strategies that are oriented toward developing organizational intrapreneurship. The underlying subfactors include several common aspects but were managed differently and had different importance and focuses in the cases. A list of recommendations has been proposed as a framework for organizations willing to embrace and develop intrapreneurship by utilizing their engineers' intrapreneurial capabilities.

The findings from this study will help academics and organizations to get a deeper understanding of the benefits of intrapreneurship in technology firms. It will help in understanding how an organization can unleash the intrapreneurial capabilities of their engineers, thus making better use of their potential. This research holds practical significance for both leaders and engineers. Leaders can facilitate a supportive environment to promote intrapreneurship and drive innovation. Engineers will see the benefits of getting involved in intrapreneurial projects/activities, increasing job satisfaction, and getting access to resources to pursue their initiatives.

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ACKNOWLEDGEMENT

I would like to praise and thank God, the almighty, for granting me the knowledge, patience, blessings, and capacity to complete this thesis.

Pursuing this PhD has been a transformative experience in my life, and it would not have been possible without the encouragement and direction of several people. First and foremost, I would like to express sincere appreciation and gratitude to my supervisors Dr Bidyut Baruah and Prof Tony Ward. Your academic advice, guidance, feedback, and continuous support have been invaluable throughout this journey.

Thank you, Bidyut, for your great support as both a supervisor and a friend in every step and moment of my PhD journey. I always leave our meetings feeling encouraged, motivated, and charged to work hard toward this challenging journey. Thank you for being such an inspiration.

I want to express my gratitude to my Thesis Advisory Panel members, Deborah Roberts, Beatrice D'Ippolito, Noel Jackson, and Hamed Ahmadi, for their advice, suggestions, and support. I would also like to thank my viva examiners; Noel Jackson and Boyka Simeonova for their comments on my research, constructive feedback, and professional conversation during the viva.

I want to convey my appreciation to the University of York, especially the Electronic Engineering department. I extend my gratitude to the academic members, colleagues, and friends from the Engineering Management research group. Many thanks to my friends in the UK for their support and for sharing with me the ups and downs of this journey. I would also like to send special thanks to all the participants and representatives from the organizations involved in my research.

I want to express my most profound appreciation to my wonderful family, to my wife Roza, who always stands beside me and to embark on this journey in the first place to achieve my dreams, and to my son Suleiman and daughter Ireen for being with me along the way and for their endless patience throughout the years. I am extremely glad for our baby, Sara, who by virtue of her birth, drove me to prioritize better and devote more time to completing my thesis. I love you all and want to say ‘thanks for everything!’.

Furthermore, I would like to express my gratitude to my father and mother for always believing in me and instilling in me the love to learn. Thank you, my brothers and sisters, and all the extended family, for your unconditional support and encouragement throughout this journey. Special thanks must also go to all my friends in Jordan and Saudi Arabia and colleagues from my previous work at Ericsson for their encouragement and motivation.

DECLARATION

I declare that this thesis entitled "How Technology-based Organizations successfully drive intrapreneurship by harnessing their engineers' capabilities" is a presentation of original work and I am the sole author. This research has been composed by myself and has not previously been presented for an award at this, or any other University other than the Doctor of Philosophy at the University of York. All sources have been clearly specified and acknowledged by explicit references.

Parts of this thesis have been published:

- **Alzyadat, M., Baruah, B. and Ward, A. (2020).** How can organizations harness the intrapreneurial capabilities of their engineers and facilitate innovation? *In: Proceedings of the European Conference on Innovation and Entrepreneurship, ECIE2020*. 2020. Roma, Italy. pp.715–722.

- **Alzyadat, M., Baruah, B. and Ward, A. (2021).** How to drive innovation by tapping into the intrapreneurial capabilities of engineers?: A case study of a fintech SME. *In: Proceedings of the European Conference on Innovation and Entrepreneurship, ECIE 2021*. 2021. Lisbon, Portugal. pp.1105–1113.

- **Alzyadat, M., Baruah, B. and Ward, A. (2021).** The Role of Managers in Stimulating Engineers' Intrapreneurial Capabilities - A Case Study of Technology-based SMEs. *Athens Journal of Technology and Engineering,* 8 (4), pp.311–330.

CHAPTER 1: INTRODUCTION

Today, globalization and fast economic changes in the market and industry have impacted the competitive nature of different companies (Bang and Markeset, 2012), resulting in a business environment that has become increasingly complex, dynamic, and uncertain (Hayton (2005), Delić et al. (2016)). These changes are driven by the revolutionary development in technologies and the growing customer demands, which creates fierce market competition among organizations. Hence, companies need to innovate and think outside the box to keep up with these changes. Intrapreneurship is seen by many scholars and practitioners as one of the main solutions for globalization challenges that can give organizations grounds for competitive advantage and achieve superior results with their business performance in terms of organizational growth, profitability, renewal, and success (Antoncic and Antoncic (2011), Moriano et al. (2014), Baruah and Ward (2015a), Falola et al. (2018), Antoncic et al. (2018)).

Given the complexities in today's market, organizations will struggle to survive without tapping into the benefits of innovation in their business models. Therefore, there is a crucial need for organizations to take advantage of emerging opportunities and create, implement and maintain innovation in an efficient and sustainable manner. Intrapreneurship is conceived as a strategic approach to address today's business challenges and comply with the dramatic changes in the market through driving innovation from within the organization (Seshadri and Tripathy, 2006) by pushing existing products and services, technologies, orientations, or operations into new successful directions (Antoncic and Hisrich, 2003). Thus, intrapreneurship offers the framework, structure, and proper organizational culture necessary to encourage and support innovation in order to achieve significant results.

Today more than ever, technology firms are considered the driving force of the economy in terms of growth, revitalization, productivity, innovativeness, and performance, which have created a platform for new technological developments, new corporate entrepreneurship and innovative industries, and advanced products and services (Grinstein and Goldman (2006), Newbert et al. (2008), Bolívar-Ramos et al. (2012), Martín-Rojas et al. (2013)). The UK technology sector is booming and becoming more important for the UK economy. The relevant statistics from the Tech Nation Report 2021 (Tech Nation, 2021) show that the UK technology sector has witnessed a massive expansion since 2010, evidenced by the tenfold increase in venture capital investment and the number of unicorn[1] businesses. According to the report from Tech Nation, in 2020, the UK technology venture capital investment hit a record high of $15bn, placing it third in the world behind the USA and China. The UK also ranks third in the world for its number of unicorns, reaching 80 in 2020. The report also highlighted the massive contribution of this sector to the UK economy, which is on the rise. The GVA (Gross Value Added) has increased

[1] A unicorn company is startup and privately-owned business with a value of over $1 billion

on an average of 7% per year since 2016 (Tech Nation, 2021). The number of technology jobs in the technology sector is about three million, which outweighed France (1.9 times) and Spain (1.6 times). Building on these statistics, it is clear that the technology sector is key to the UK economy and is expected to continue in the future. Therefore, the influence of the success or failure of technology firms can be substantial to the UK economy, emphasizing the significance of their competitiveness, sustainability, and ability to innovate. Intrapreneurship could play a very effective and integral role in driving innovation in these firms and maintaining their continuation and survival.

Among the capabilities of the workforce, the Tech Nation Report (2021) also highlights the high demand from the technology sector for engineers with technological and digital skills, which outweighs the current supply. This is evidenced by the increasing number of job adverts seeking to recruit engineers with relevant skills. Engineering roles were among the most advertised jobs in 2019, with a total number of 75683 job adverts (Tech Nation, 2021). Employers' demands for engineers to take technology roles in this sector increased by 15% from 2017 to 2019. These figures show the high expectation for engineers to play important roles within technology firms and the significance of their contribution to creativity and innovation in driving their employers' business success. However, technology firms in the UK struggle to recruit potential engineers with the proper skills and competencies to handle the industry's emerging roles. According to the skills and demand report in the UK industry published by the Institution of Engineering and Technology[2] (IET, 2021), over one-third of employers in the UK have increased their engineering and technology workforce over recent years. Analyzing the statistics from the IET report from 2019 to 2021, including a sample of 1039 engineering employers, the results show that 62% of the engineering and technology firms consider recruiting engineering and technical staff with the right skills as the largest anticipated impediment to achieving business objectives (IET, 2021). The skills gap analysis in the IET (2021) report explains that the traditional roles of engineers are not sufficient for tackling today's business challenges. Half of the firms surveyed acknowledged encountering difficulties with engineers' skills, where 96% of these considered the lack of these skills to impact their business. The skills gap is also reported for non-technical skills; almost one-third of the firms who reported a skills gap mentioned they are experiencing gaps in skills like time/project management (52%), business knowledge and how the organization work (50%), leadership skills (40%), sales/customer skills and teamwork (30%). The response from these firms in addressing the skills gap of engineers is to recruit new staff (46%) or upskills/retain existing employees (62%).

[2] The Institution of Engineering and Technology (IET) is one of the world's largest engineering institutions with over 169,000 members in 150 countries. The IET aims to lead in the advancement of engineering and technology by facilitating the exchange of knowledge and ideas at a local and global level. The IET helps to ensure that its members are equipped to meet the needs of today's changing world and also offers professional recognition through its Chartered Engineer, Incorporated Engineer and Engineering Technician qualifications.

The skills needed by today's engineers go beyond their technical expertise to be actively involved in innovation activities, explore new opportunities, and take more intrapreneurial roles. Such skills are discussed by Williamson et al. (2013, p.164), *"Organizations seeking engineers suited for intrapreneurial roles should try to recruit and select individuals who are more extraverted, teamwork-oriented, open to new learning, and optimistic, customer-oriented, and visionary than those who have traditionally been filling engineering positions".*

Intrapreneurs are often regarded as critical drivers of innovation and strategic renewal within an organization (Rigtering and Weitzel (2013), Neessen et al. (2019)), where their intrapreneurial activities are fundamental for achieving and sustaining intrapreneurship at the organizational level (Mustafa et al., 2018). Leading and well-established technology-based large firms such as 3M, Apple, Google, Sony, ORACLE, Facebook, and LinkedIn have successfully adopted intrapreneurship as part of their business strategy to foster the commercialization of technologies in their industrial sectors, which empowered employees to generate advanced technological product and developments. Many successful innovations in these firms were initiated, developed, and implemented by their engineers.

Recently, the adoption of intrapreneurship has been seen as equally important in SMEs (Antoncic and Hisrich (2003), Nason et al. (2015)). Carrier (1994) was one of the first researchers who emphasized the importance of applying and studying intrapreneurship in SMEs despite having different structural contexts and strategic processes from those in large firms. However, SMEs face certain challenges while embracing intrapreneurship as they run on limited resources and innovative capabilities compared to large firms. Despite that SMEs are characterized by flexibility and a dynamic environment, they are not all the same, and it is essential to avoid oversimplification by grouping them into one single category (Bouchard and Basso, 2011). Technology-based SMEs mainly operate in very fast-changing technological industries associated with the rapid diffusion of new products and technology features. They are under constant pressure to integrate and reconfigure their skills, knowledge, and capabilities that drive innovation (Bolívar-Ramos et al., 2012). Hence, they may benefit a lot from intrapreneurship to revitalize the business and increase their competitiveness in the market. Intrapreneurship can help in successfully maintaining continuous innovation and sustaining the creation and development of products, technologies, solutions, and services to remain competitive and profitable.

Relevant SME studies revealed the importance of investing in the creation of an environment conducive to intrapreneurship in which the innovative capabilities of employees are unleashed, stimulated, and encouraged (Aygün et al. (2010), Van Der Sijde et al. (2013), Hughes and Mustafa (2017)). It is the organization responsible for creating an infrastructure that supports engineers and provides them the strategy, resources, and culture to empower their initiatives and stimulate them to engage with intrapreneurship. In this context, the following questions reflect the overall research field and scope of the study: How can technology-based SMEs embrace intrapreneurship from within? How technology-

based SMEs can encourage and empower their engineers to engage with intrapreneurship? What intrapreneurial culture is suitable for engineers to engage with innovative activities? What role do leaders and managers play in supporting intrapreneurship and facilitating their engineers' innovative initiatives? How can engineers be involved with the organization's strategies and vision? Accordingly, this study addresses these questions and explores the tech-oriented intrapreneurial organizations and the role engineers play in enabling the firm to be more innovative. This suggests that it is crucial to explore the factors by which organizations can facilitate intrapreneurship among their employees. Although a variety of internal and external factors influence intrapreneurship, this research will concentrate primarily on those internal factors that the organization may directly influence and within the control of their management.

1.1 The main focus of the research

Kuratko and Hodgetts (1995) affirm that organizations should encourage intrapreneurship to avoid stagnation, business fall, and employee turnover. Organizations that promote intrapreneurship are more competitive and outperform their counterparts that do not (Moriano et al., 2014). On the other side, organizations that are less prepared for intrapreneurship or little receptive to renewal or responding actively to continuously changing environments will lose competitiveness (Lages et al., 2017). Companies need to consider the whole organization while integrating intrapreneurship (Christensen, 2005).

Today, engineers are considered one of the main assets in technology firms that have the potential to drive innovation by taking more intrapreneurial roles. In technology-based SMEs, there are increasing demands for engineers to improve product quality and develop new products (Jones, 2013), where their intrapreneurial contribution is significant for their employers' success. According to Alam et al. (2020, p.8), *"Engineer's skills and ideas are a great source of technological development in existing companies"*. In such firms, engineers are anticipated to perform beyond their defined stereological responsibilities and operate in a more intrapreneurial role (Williamson et al. (2013), Alam et al. (2020)). Menzel et al. (2007) confirmed that engineers must function in an intrapreneurial role and should foster innovation, continuous revitalization, and improvement in any organization. They proposed the new role of engineers as 'technology intrapreneurs', in which they are viewed as a key driver for technological innovation. Nowadays, the customer market is evolving very fast, as witnessed by the increasing adoption of modern technologies such as Artificial Intelligence, robotics, and automation among global industries. Engineers are at the heart of this transformation where their roles are evolving, requiring them to actively embrace change and industry evolution, and continuously develop and learn new skills.

Management within an organization has to support their employees and encourage them to challenge, explore, generate and implement new ideas (Bagheri, 2017). Employees' innovation and creativity are not generated or developed automatically. Without an intrapreneurial environment that encourages, empowers, and supports the development of creative ideas, some employees looking for motivation and challenges may eventually think of leaving the firm and establishing their own business. This imposes further uncertainty and challenges on SMEs as they cannot afford to lose such talented employees. This, therefore, implies the importance of intrapreneurship and creating an environment that supports, attracts, and retains these intrapreneurs and keeps them motivated in their roles.

The focus of studying intrapreneurship in technology-based SMEs to empower engineers has received considerably less attention. The literature shows that organizations can make the most out of their engineers by adopting intrapreneurship and making better use of their potential. There is an evident lack of empirical studies regarding how engineers' intrapreneurial actions contribute to enriching innovation and achieving organizational success. There is still a considerable amount of ambiguity about what intrapreneurial organizational factors can facilitate the emergence of ideas and innovative initiatives from engineers. This remains a major gap in the field of engineering and intrapreneurship as there are insufficient research efforts so far addressing these areas. According to Alam et al. (2020, p.2), *"Research on intrapreneurship for engineers and its impacts on engineering firms is still in its evolutionary phase and directions on various aspects in terms of exploration and testing of the phenomenon are rare"*. It is crucial for these organizations to explore the talents of their engineers and unleash their intrapreneurial skills and capabilities. Therefore, the objective of this research is to empirically explore the intrapreneurial enabling factors that can facilitate engineers to undertake intrapreneurial roles in technology-based SMEs. In particular, this research addresses the following main research question:

- **How can technology-based SMEs drive intrapreneurship and nurture innovation by harnessing the intrapreneurial capabilities of their engineers?**

This exploratory research is executed through qualitative multiple case studies. Four leading technology-based SMEs operating in heterogeneous technological industries in the UK (Fintech, pharmaceutical, aerospace and automation, and energy) were purposefully selected for an in-depth study. The focus is on understanding the phenomenon of intrapreneurship under different organizational contexts and setups. Therefore, the emphasis is on the uniqueness of individual cases (within the case study) rather than on cross-case analysis. Primary data were collected through semi-structured interviews utilized from different participants in these firms, including head management, managers, and engineers from a wide range of roles and functions. Data were also utilized from other sources of internal and online documents to triangulate the structure of the case studies. The results of this research indicate three main areas that cluster the intrapreneurial factors in these technology-based SMEs;

intrapreneurial culture, leadership and management continuous support, and vision and strategic alignment. These factors, with their underlying subcategories, were summarized and demonstrated in a table (see Table 10.11) that represents a framework of practical recommendations for organizations seeking intrapreneurship to guide them in their route to nurture intrapreneurship among their engineers. This study further enables us to understand the interaction between these factors to push intrapreneurship forward.

Personal motivation for this research

The researcher's biggest motivation for undertaking this PhD project is the love of knowledge, learning, and academic life. It has been an old dream since his primary school days to achieve this level of an academic degree. There are different reasons behind taking this particular research in the domain of intrapreneurship and engineering.

One is related to the background and professional experience of the researcher. He worked as a telecom engineer in one of the large and pioneering international Information and Communication Technology (ICT) firms, specializing in developing and producing complex GSM technologies, products, and solutions. By the nature of his engineering role, it has evolved through his 12 years of intense experience into different responsibilities, positions, and taking other engineering roles to cope with the ever-changing technologies and network modernization. This was not the case for other engineers who stick to very narrow specializations. While working in a very large company and according to the researcher's observations, he felt that engineers could contribute better and trigger more opportunities in their engineering field if they gain new knowledge and expertise in other domains and understand what other engineering and non-engineering teams within the firm are doing so as to see the bigger picture of the firm. This is combined with high demands from top management for engineers to be more innovative, productive, and efficient in their roles due to reorganization and the frequent integration of new emerging technologies. One of the areas of interest for the researcher was the utilization of engineers' potential capabilities so as to develop new opportunities and contribute effectively to innovation within an organization.

The researcher decided to move back to academia after 12 years of industry-intensive experience. He completed an MSc degree in Engineering Management at the University of York, where he gained more knowledge through different modules and research projects on innovation and creativity, ideation, strategic and operation management, organizational culture, and SMEs. The MSc program focuses on intrapreneurial and transferrable skills for engineers, which are embedded in every module. All together and with insights from his prior practical experiences led to his initial interest in studying intrapreneurship within engineering contexts, and this helped in developing a research proposal to his supervisors in the Engineering Management research group at the University of York. The final research

topic and his research focus were further shaped during the first year of his PhD study based on his literature review.

1.2 Research objectives

This study will contribute to and extend the current theoretical and empirical analysis of intrapreneurship research, particularly for SMEs, which have received little attention (Bouchard and Basso (2011), Nason et al. (2015)). This study provides a detailed literature review on the areas of intrapreneurship and innovation from the perspective of the organization. The study results carry manifold implications for leadership and management within organizations to understand and identify different strategies and best practices to create an environment that supports engineers in their intrapreneurial route. The research findings can be utilized to improve the management practices of organizations when recruiting, training, mentoring, sponsoring, and developing their engineers' intrapreneurial capabilities.

The study alike benefits engineers by understanding the importance of their intrapreneurial roles in driving innovation within the firm and how they can engage positively with company culture, vision and strategies and interact effectively with their managers. The main objectives of this research study are twofold:

Theoretical objectives

The key theoretical objectives of this research are:

- Understand and provide an up-to-date literature review on the intrapreneurship concept and its relevance to technology organizations
- Explore the literature on the main factors that promote an intrapreneurial culture within the context of an organization
- Discuss the main empirical and conceptual models on intrapreneurship within an organization
- Add some clarity on the relation of intrapreneurship to other terminologies/concepts, such as corporate entrepreneurship, entrepreneurship, and innovation
- Develop a firm-level theoretical model of the factors that facilitates intrapreneurship within a technology-based organization

Empirical objectives

The key empirical objectives of this research are:

- Explore the factors by which an organization can promote and facilitate the engagement of their engineers with intrapreneurship

- Explore the best leadership and management support practices for empowering engineers, developing a supportive culture, and aligning specific organization strategies toward intrapreneurship
- Propose a list of guidelines that offer practical steps and recommendations to promote intrapreneurship within the context of technology organizations

1.3 Thesis structure

The thesis is structured in the following order: the literature review in Chapter 2 presents the background and development of the concept of 'intrapreneurship', including the history and evolution of the phenomenon, the spectrum of definitions, and how it is related to other surrounding terms such as entrepreneurship and corporate entrepreneurship. The chapter highlights the main challenges of today's business environment that call for adopting intrapreneurship as a core practice within an organization. The importance of intrapreneurship is discussed in this chapter, along with its implications for business performance.

Chapter 3 reviews the literature (from the intrapreneurship research field) on the environment of an intrapreneurial organization. It offers the theoretical background and review of previous research and empirical studies conducted to explore the influential intrapreneurial factors within an organization. The main and most representative models from the literature and the different streams of studies on the 'intrapreneurial firm' are discussed. These studies are related to management support, organization structure and culture, organizational resources, and intrapreneurial strategy.

Chapter 4 discusses the significant contribution of engineers toward the success of their firm. It looks at the increasing need of companies to engage their engineers with intrapreneurship to foster innovation. The chapter looks at examples from existing technology organizations where engineers have successfully developed breakthrough innovative products and solutions through intrapreneurship. This chapter concludes by identifying the main research gaps in the literature related to this project.

Following the theoretical discussion of the literature, chapter 5 looks at the methodological approach used in this research. It discusses the philosophical assumptions and justifies the selection of the case study research design, and explains the procedures, data collection, and analysis methods. The chapter ends by outlining the main ethical concerns and the planned measures to ensure the validity and reliability of the study.

Chapters 6-9 present the empirical studies and illustrate the results of each individual case study (within-case analysis). Each chapter begins by providing an overview and introduction of the selected case organization, showing their business focus, innovativeness, and the significant role of engineers in driving innovation and success within the firm. The main findings from each case study are then

presented. An in-depth analysis of the cultural, managerial, and strategic intrapreneurial factors for the cases is provided, highlighting the distinctive organizational characteristics for each case.

Chapter 10 discusses the main findings and results from individual case chapters by showing the main similarities and differences through cross-case analysis. This chapter also sheds light on the evolving roles of engineers in today's business environment. It also highlights how the selected firms adapted their business and responded to the COVID-19 circumstances and how they minimized the impact on their engineers to stay motivated and innovative during this critical period. The chapter ends by providing a theoretical model and proposing some recommendations for organizations to adopt intrapreneurship so as to effectively harness the intrapreneurial capabilities of their engineers and build a competitive advantage as an organization.

The final chapter summarizes this research study, discussing the main practical implications for organizations, management, and engineers and the main contributions to the literature. The chapter ends by proposing further studies and works following this research study.

CHAPTER 2: INTRAPRENEURSHIP CONCEPT AND BACKGROUND

2.1 Today's challenges that are driving organizations to adopt intrapreneurship

The necessity for organizations to adopt intrapreneurship is attributed to different challenges and pressing issues associated with the market and economic environment. Carrier (1996) asserts that organizations seeking to grow are under pressure from the existing volatile markets, free trade, technological complexity, and the inflexibility of traditional management approaches. Scholars such as Lages et al. (2017) and Baruah and Ward (2015a) affirm that organizations today face increasing obstacles as a result of market globalization, fast technological advancement, and changes in customer expectations for higher quality products and services. The market can be unpredictable, as evidenced by the challenges brought in by COVID-19. The pandemic led to severe economic impacts, business struggles, and new challenges related to social distancing, remote working, and employees' well-being (Chanana and Sangeeta (2021), Gerards et al. (2021)). Situations like these increase market uncertainty and thus result in a more competitive and challenging economic environment for businesses. According to Pinchot and Soltanifar (2021, p.259), *"As the COVID-19 pandemic has shown, the world does not always progress smoothly. Occasionally, we face startling discontinuities. These sudden changes favor resilient firms. A firm's capacity for responding to big changes resiliently resides in the intrapreneurs who are empowered to make all the innovations necessary for the company to adapt and create a culture to support them".*

Today, many companies struggle to continuously react and respond to the fast changes and development in technology (Bierwerth et al., 2015). As a result, there is a growing demand for faster product development, integration of more features into smaller products, higher and consistent quality and stability, and delivery with less time than competitors and at lower prices (Oden (1997), Christensen (2004)). This is combined with the improvement in the marketplace and economy that push organizations to change and transform from a bureaucratic style associated with weakness in management practices and high turnover of innovative employees to be more innovative (Aloulou and Fayolle, 2005). Organizations need to stay one step ahead of their competitors to survive, thrive, and compete effectively in global markets (Kuratko et al., 2014). Jones (2013) notes that when organizations age, they tend to become more conservative, less flexible and innovative, and hence may fail to capture new opportunities to develop new products. Being active in fostering employees' engagement with innovation inside the organization is very important, particularly for mature organizations, as they often grow at a slower rate than younger ones (Antoncic and Antoncic, 2011).

To survive and sustain in today's economic environment, many companies are constantly looking for new ways of managing innovation, generating competitive advantage, and thinking about how to redefine their businesses and effectively utilize their human resources (Kuratko et al. (2005), Blanka (2019), Galván-Vela et al. (2021)). Organizations, particularly in a bureaucratic environment, find it more challenging to initiate and integrate intrapreneurship, organize their structure, and provide adequate management plans that allow innovation to occur (Christensen (2004), Christensen (2005)). To facilitate intrapreneurship, many organizations lack some guidelines to direct their resources toward establishing an effective intrapreneurial environment. Many organizations struggle to find the proper strategies to promote innovative activities among their employees (Kuratko et al. (1990), Kuratko and Morris (2018)). *"Organizational structures, processes, and culture often hinder rather than encourage intrapreneurship; making it challenging for employees to convert new ideas into new products or to develop new processes to improve organization efficiency"* (Moriano et al., 2014, p.104). Therefore, it is critical for organizations to understand how they can effectively develop and manage their intrapreneurial capabilities in order to transform their business successfully.

2.2 Intrapreneurship benefits: evidence from empirical studies

Intrapreneurship has positive effects on any kind of organization and is considered by many scholars as a vital element for achieving organizational growth, success and a way of managing innovation and generating competitive advantage (Kuratko et al. (2004), Nicolaidis and Kosta (2011), Moriano et al. (2014), Gupta (2016), Falola et al. (2018), Blanka (2019)). Intrapreneurship is a necessary activity that can improve the overall business performance and establish long-term conditions for profitability and development (Antoncic (2007), Ağca et al. (2012), Brigić and Muzafer (2015)). According to Antoncic and Hisrich (2001, p.504), *"Organizations that engage in intrapreneurial activities are expected to achieve higher levels of growth and profitability than organizations that do not".* Intrapreneurship is attributed to enhancing business productivity, achieving business sustainability, and anticipating and responding proactively to environmental changes (Zahra (1991), Staub et al. (2019), Huang et al. (2021)). The benefits of intrapreneurship are also extended beyond the organization's boundaries, where the improved organizational performance through intrapreneurship is linked to positive influences on the country's economy by creating new values, decreasing unemployment levels, increasing the country's wealth, and thereby the global economic welfare (Toksöz, 2021).

Intrapreneurship can also lead to non-financial benefits. The advantages are extended to the internal organization's overall system that supports enhancing the innovative abilities of employees (Kuratko et al., 1990) and stimulating the creativity, talent, and ideas of employees (Babic and Zaric, 2017). Intrapreneurship improves the morale of employees, fosters teamwork, and enables a creative working environment (Hayton, 2005), as well as enhances job satisfaction of the employees and customer satisfaction (Mokaya, 2012). It enables organizations to identify potential talents and establish

mechanisms to foster innovation (Shah et al., 2015). Therefore, avoiding employees' dissatisfaction and frustration resulted in reducing competent employee turnover (Toftoy and Chatterjee, 2004).

Many authors believe that intrapreneurship is essential in today's globalization context and is the best principle for guiding businesses toward better organizational performance. Pinchot's first example of a firm that embraces intrapreneurship is 3M, which focuses on encouraging employees to create their own projects and realize their ideas (Pinchot, 1985). Any employee within 3M can suggest a new idea and is awarded when the company decides to launch the product they proposed. This enables 3M to develop a wide range of market-changing products and solutions, expand to new brands outside the core business portfolio, and maintain sustainable innovation.

Numerous empirical studies demonstrate a positive impact of intrapreneurship on both financial and non-financial organizational performance. Authors such as Fitzsimmons et al. (2005) have studied the potential benefits of intrapreneurship in terms of profitability and growth using a random sample of Australian firms. They selected a sample of 350 firms from a wide range of sectors with 100 employees or more. The findings highlight the impact of intrapreneurship on the growth and profitability (financial performance) of selected firms by using four dimensions of intrapreneurship in the study (new business venturing, innovativeness, proactiveness, and self-renewal). The findings show that profitability was positively related to organizational support and negatively related to self-renewal, which is associated with the incremental cost of the self-renewal activity. On the other hand, growth was significantly related to new venturing, proactiveness, and environmental goodwill.

Another study was conducted by Daryani and Karimi (2017) to explore the impact of intrapreneurship on agriculture SMEs in Iran. They found that intrapreneurship (represented by innovativeness, strategic renewal, risk-taking, new business venturing, and proactiveness) positively affects the firm's performance in terms of efficiency, growth, and profit (Daryani and Karimi, 2017). Agˇca et al. (2012) studied manufacturing firms in Turkey. They examined the relationship between intrapreneurship (innovativeness, new business venturing, and self-renewal) and objective performance (profitability and growth) as well as subjective performance (perceived customer and employee satisfaction). The findings of this study suggested that intrapreneurship activities within existing organizations often increase firms' financial performance (growth and profitability) and non-financial aspects (customer and employee satisfaction). From a business strategy perspective, intrapreneurship can be utilized to address concerns imposed by hostile environments.

Using a sample of 217 medium-sized Portuguese companies, Felício et al. (2012) studied the effect of intrapreneurship on corporate performance. They found that intrapreneurship (represented by the factors of innovation, risk/uncertainty, risk/challenges, competitive energy, proactivity, and autonomy) has a positive influence on financial performance, productivity and growth, and improvement of firms.

Another study conducted by Brigić and Muzafer (2015), using a sample from 50 major production companies in the Federation of Bosnia and Herzegovina, proved that implementing intrapreneurial activities had a positive effect on the development and growth of these organizations in terms of the value of property/assets, the value of the profit and the value of incomes.

In a comparison study, Antoncic (2007) examined the level of relationships between intrapreneurship and firm growth and profitability across two countries and among different economic contexts (the USA and Slovenia), utilizing data from 192 respondents in large firms. The results indicate that intrapreneurship has positive effects on the firm profitability and growth in both countries (Antoncic, 2007). Also, the findings concluded that firms that nurture organizational structures and values conducive to intrapreneurial activities, as well as those with intrapreneurial orientations, are more likely to achieve higher growth and profitability than those that lack these features.

The results from these studies show the advantages of intrapreneurship for organizations of any size, industry, and location.

2.3 Background and development of the intrapreneurship concept

Intrapreneurship is a relatively new phenomenon compared to entrepreneurship and has only evolved over the last 40 years. According to Fayolle and Basso (2010), intrapreneurship was first coined by Macrae (1976) in 'The Economist' in his article about the 'coming entrepreneurial revolution'. Gifford and Elizabeth Pinchot have adopted the concept, wrote the first draft on intrapreneurship, and discussed the term for the first time in their paper titled 'Intra-Corporate Entrepreneurship' (Pinchot and Pinchot, 1978).

Intrapreneurship was established and popularized as a unique research topic by Gifford Pinchot III in 1985 in his book 'Intrapreneuring: Why you do not have to leave the corporation to become an entrepreneur' recognizing the role of individuals who take the initiative and transform the business of their employer by generating innovation (Pinchot, 1985). He described the concept of intrapreneurship 'as entrepreneurship within existing organizations', which is now widely accepted and used as a default definition in most of the literature. In the 1990s, intrapreneurship evolved and became more focused on exploring and commercializing innovative ideas strongly associated with entrepreneurial strategies for developing a new business (Galván-Vela et al., 2021). One of the major paradigm shifts that took place in 1992 was when the American Heritage Dictionary of the English Language added the word 'intrapreneur' to their database and defined it as *"A person within a large corporation who takes direct responsibility for turning an idea into a profitable finished product through assertive risk-taking and innovation"* (American Heritage Dictionary, 2022).

Babic and Zaric (2017) have classified the development of the research conducted in intrapreneurship since the formulation of the concept into three main phases:

- Early studies focused on the theoretical works that pointed out the positive impact of innovation, risk-taking, and managers' support to employees, organizational renewal, and the company's revitalization.
- In the second stage, studies focused on analyzing intrapreneurial behavior in large USA companies such as IBM, Xerox, General Electric, and others. In the 1990s, the term 'intrapreneurship' began to be used to describe the process of exploring innovative ideas within established organizations. It was strongly related to applying a set of entrepreneurial strategies for developing the business or creating a proactive vision.
- In the third phase of studies, which covers the period from the year 2000 onwards, the concept has further expanded beyond the American experience to different cultures, countries, and company sizes. There is more empirical focus on studying the different factors of intrapreneurship and its influence on organizational performance.

2.4 Spectrums of the definition of intrapreneurship

Since the term 'intrapreneurship' was established, it has evolved into different research areas and studied at different levels within the organization. Researchers in the field of intrapreneurship have developed different models trying to classify and facilitate the concept of intrapreneurship. In this regard, this has resulted in various interpretations of the term where there is no single or consistent conceptualization considered. Instead, there are varying degrees of agreement among scholars about different conceptualizations demonstrated by a variety of research spectrums and diverse theoretical approaches. Among these, there are different elements involved from different research domains to understand the concept, such as from management, organization, strategy, and culture areas, resulting in a multi-approach to the phenomenon. Therefore, ambiguity, inconsistency, and lack of clarity continue in this field, where the term remains a multidimensional phenomenon (Åmo and Kolvereid (2005), Baruah and Ward (2015b)).

The literature has an extensive and considerable amount of published studies detailing the phenomenon of intrapreneurship. Authors used a variety of terminology to refer to different aspects of intrapreneurship, including 'intrapreneuring' (Pinchot (1985), Pinchot and Pellman (1999)); 'corporate entrepreneurship' (Burgelman (1983b), Guth and Ginsberg (1990), Hornsby et al. (2002), Antoncic and Hisrich (2004), Hornsby et al. (2013), Urbano and Turró (2013)); 'internal corporate entrepreneurship' (Lumpkin and Dess, 1996); 'corporate venturing' (Burgelman (1983a), Macmillan et al. (1986), Block and MacMillan (1993), Antoncic and Hisrich (2003)), 'strategic renewal' (Guth and Ginsberg (1990), Glaser et al. (2015)), and 'strategic entrepreneurship' (Hitt et al., 2011). Management literature uses these terms as more or less synonyms for intrapreneurship (Delić et al. (2016), Göcke et al. (2022)).

Hence, some researchers use these different descriptions as interchangeable terminologies (Baruah and Ward (2015b), Huang et al. (2021)). Among these terms, and according to Åmo (2010) and Neessen et al. (2019), intrapreneurship and corporate entrepreneurship are the most researched and commonly used terms in the literature.

Vargas-Halabí et al. (2017) have identified three common elements that characterize these different terminologies:

- The phenomenon involves the entrepreneurial activities, efforts, and orientations performed within established organizations.
- Entrepreneurial activities are a result of the action of several participants, including an individual or group of individuals within the company and at different organizational levels, such as management, a unit, or operations.
- Entrepreneurial actions are aimed at improving the organizations' ability to innovate.

2.5 Intrapreneurship as a concept

To understand the concept of intrapreneurship, it is helpful to discuss the original phenomena derived from and the development of the different terms associated with this terminology. The following section highlights the concept of entrepreneurship and intrapreneurship.

2.5.1 Intrapreneurship as a subdomain of entrepreneurship

Entrepreneurship has a long history. It was the French economist 'Richard Cantillon' who coined the term 'entrepreneurship' in the middle of the 16th century as an economic term (Aygün et al., 2010) and was the first to use the term 'Entrepreneur' (Serinkan et al., 2013). He considered entrepreneurship from an economic perspective focusing on the economic development role of the entrepreneur. In 1911, Joseph Alois Schumpeter, an Austrian-trained economist, is credited with being the chief proponent and popularizer of the term 'Entrepreneur' (Rogers, 2014). According to Stevenson and Jarillo (1990), Schumpeter considered entrepreneurship in a more specific view as the process by which the whole economy moves forward and disrupts the market equilibrium. Schumpeter explains that an 'entrepreneur' is the individual whose function is to carry out new combinations called the 'enterprise'. New combinations arise in the form of innovations, and therefore, the development of an economy is a disruption of the market equilibrium (Tone, 2017).

Many authors explained that the concept was also developed from classical views of entrepreneurs as 'wealth creators' (Katsikis and Kyrgidou, 2009) and new classical view of entrepreneurs as 'innovators' that drive new products, exploit new markets, and change the rules of competition for their industry to a more evolutionary approach. The main shift of the entrepreneurship concept came from the Schumpeterian theory, which considered entrepreneurs as innovators who develop new activities and

markets in order to disturb the 'status quo' for new opportunities to occur. In this developed view of entrepreneurship, Lumpkin and Dess (1996) defined entrepreneurship as a 'New Entry'. In this context, the new entry is an essential act of entrepreneurship that entails entering new or established markets with new or existing goods or services that may be initiated at different levels; by an individual, a small company, or a large corporation.

Entrepreneurship is a multidimensional domain with various manifestations (Katsikis and Kyrgidou, 2009) and is characterized as a diverse, fragmented, complex, and constantly changing phenomenon that is difficult to study (Landström (2008), Shane and Venkataraman (2000)). Recently, the concept of entrepreneurship itself has changed in its definition. In this context, Kuratko and Audretsch (2009) argued that the word entrepreneurship had become synonymous with free enterprise or capitalism. Similarly, Low and MacMillan (1988) describe entrepreneurship as the 'creation of new enterprise'. Gartner (1985) explains that the term 'entrepreneur' usually has been given to the founder or someone who started a new business, and entrepreneurship is the creation of a new organization.

Intrapreneurship, as a modern and relatively new emerging research domain, is rooted in and considered a special type of entrepreneurship (Pinchot and Pellman (1999), Åmo and Kolvereid (2005), Menzel (2008), Bosma et al. (2010)), where many dimensions and sources of intrapreneurship are located within the studies of entrepreneurship (Cunningham and Lischeron, 1991). The broadest definition of intrapreneurship takes different forms as a field of entrepreneurship, but with a common agreement among scholars that it happens 'inside the organization'. In this regard, intrapreneurship takes different expressions among scholars, such as intrapreneurship is 'entrepreneurship within an organization' (Lumpkin and Dess, 1996), 'a spirit of entrepreneurship within the existing organization' (Serinkan et al., 2013), 'entrepreneurial action within an existing organization' (Azami, 2013), and 'in-house entrepreneurship' (Frederick et al., 2016). These expressions reflect the accepted general definition of intrapreneurship as 'entrepreneurship inside the organization'. According to Christensen (2004), intrapreneurship appears to be the most appropriate label for entrepreneurship phenomena occurring within an established organization, as long as the organization deals only with internal resources under its own control.

Several studies look into the similarities between the two concepts. In this context, entrepreneurship and intrapreneurship share many common characteristics, such as both focusing on innovation, emphasizing value creation, and involving undertaking risky activities (Azami (2013), Cadar and Badulescu (2015)). Bosma et al. (2010) add that both concepts also share many key behavioral characteristics, including taking the initiative, pursuing an opportunity, and some element of 'newness'. Intrapreneurship is related to implementing entrepreneurial skills and mindset within existing organizations (Chahine, 2021). Both entrepreneurs and intrapreneurs contribute significantly to the

economy as they help an existing or newly established organization engage in new business and expand to new markets (Maier and Zenovia, 2011).

Considering such similarities, Menzel (2008) suggested that intrapreneurship should be defined in relation to the concept of entrepreneurship. The various concepts that have emerged on the definition of the terminology of intrapreneurship correspond to a similar sense to that of entrepreneurship literature. The main distinguishing factor is that intrapreneurship focuses on internal entrepreneurial processes within existing organizations, while entrepreneurship entails developing a new enterprise outside of an existing organization (Parker, 2011). This study considers this general definition and focuses on exploring the phenomena within an organization.

Over the years, intrapreneurship has gained widespread acceptance and quickly attracted the attention of many researchers and scholars. Several studies suggest that intrapreneurship is more valuable and advantageous to organizations than entrepreneurship. For instance, Bhatia and Khan (2013) have argued that while entrepreneurship leads to the creation of new organizations, intrapreneurship sustains their continuity and drives them to success. In this sense, intrapreneurship is considered to be more important than entrepreneurship. Bhatia and Khan (2013) emphasize the role of intrapreneurs who reinvent the organization and save it from collapse. In another study, intrapreneurship has a higher success rate and provides more successful outcomes compared to start-up entrepreneurship (Shah et al., 2015). Specifically, the success rate of intrapreneurship can reach up to 80%, while an entrepreneurial startup can reach 20%.

Despite the fact that intrapreneurship and entrepreneurship share many similar aspects, several studies probe into the contrasts between the two notions and how they represent some distinct entrepreneurial behaviors. According to Camelo-ordaz et al. (2012, p.515), *"The key difference is in the context in which entrepreneurs and intrapreneurs carry out their activities; the intrapreneur recognizes opportunities and develops innovations from within an existing hierarchy"*. Intrapreneurship risks the capital of the parent companies and the firm's resources, aiming to add value to the products and services. In contrast, entrepreneur risks their own financial, social, time, and human capital (Antoncic and Hisrich (2003), Huang et al. (2021)). Thus, entrepreneurs are at a higher risk of losing their own funding and assets (Cadar and Badulescu, 2015). On the other side, when intrapreneurs fail, they lose their reputations and their ability to convince other employees to get their support in future projects (Filion, 1999). Another significant difference is explained by Shah et al. (2015) that is related to potential rewards. Rewards are unlimited in the case of entrepreneurs as they own the business, whereas intrapreneurs can receive little financial rewards.

Entrepreneurs and intrapreneurs face different challenges. The main obstacles for intrapreneurs are internally related to the corporate culture and processes, while for entrepreneurs, the market is the main

challenge to becoming a competitive force (Azami, 2013). Despite that both intrapreneurs and entrepreneurs have a focused vision around their activities, Filion (1999) described entrepreneurs as 'visionaries' focusing on the creation and realization of a central vision, while intrapreneurs are 'visioners' focus on developing and realizing emerging and contemporary visions that directly reinforce the business's central vision. Another significant point that emphasizes the initial scope and scale was raised by Shah et al. (2015). While entrepreneurs have limited initial scope and slow increase in scale as they have little security and resources, no safety net, and few supportive people around them, intrapreneurs have a more secure job and extensive supportive network of employees, and access to many resources such as finance, market research resources, a platform to conduct experiments and trials, and using lab and Research and Development (R&D) facilities within the organization, thus, their ventures have the potential for a rapid increase in scope and scale.

2.5.2 Intrapreneurship definition

Many researchers note that there is no universally or commonly accepted definition of intrapreneurship (Sharma and Chrisman (1999), Blanka (2019), Galván-Vela et al. (2021)). It is characterized as a multidiscipline and multidimensional concept with no unified definition identified (Antoncic and Hisrich (2003), Felício et al. (2012)). Thus, intrapreneurship lacks a cohesive definition. This is linked to the rapid interest in the phenomenon by scholars and theoreticians, who have provided their own definitions and interpretations in numerous studies since the 1980s (Delić et al., 2016). Therefore, a large number of definitions were found in the literature. Table 2.1 illustrates a chronological list of some of the most prominent definitions of intrapreneurship suggested by various researchers:

Author/ Year	Intrapreneurship concept
Pinchot (1985)	Intrapreneurship is the practice of developing a new venture within an existing organization to exploit a new opportunity and create an economic value
Nielsen et al. (1985)	Intrapreneurship is the development within a large organization of internal markets and relatively small and independent units designed to create, internally test-market, and expand improved and/or innovative staff services, technologies, or methods within the organization
Luchsinger and Bagby (1987)	Intrapreneurship is a venture that is generated within an ongoing organization
Perlman et al. (1988, cited in Weber et al., 2014)	The process by which a person meets their needs for autonomy, invention, management, and completion of projects in a complex bureaucracy. It is a process by which new ventures, products, and projects are developed and implemented
Rule and Irwin (1988)	Intrapreneurship is the entrepreneurial capability of an established corporation, including entrepreneurial qualities such as creativity and innovation
Kuratko et al. (1990)	Intrapreneurship is the autonomous strategic behavior of the employee to exploit a given business opportunity

Author/ Year	Intrapreneurship concept
Stevenson and Jarillo (1990)	Intrapreneurship refers to the process in which individuals within the company follow opportunities regardless of the resources they currently control
Zahra (1991)	Intrapreneurship refers to the formal and informal activities aimed at creating new business in established companies through product and process innovations and market development
In 1992 the 'intrapreneur' term was added to the dictionary (American Heritage Dictionary, 2022)	The 'intrapreneur' term was added to the dictionary in 1992. Intrapreneurship is related to individual actions and when a person within a large corporation takes direct responsibility for turning an idea into a profitable finished product through assertive risk-taking and innovation
Block and MacMillan (1993)	Intrapreneurship is about the implementation of innovations in organizations, where the adaption is initiated and wanted by an employee in a bottom-up way
Fry (1993)	Intrapreneurship refers to the process in which innovative products or processes are developed by creating an entrepreneurial culture within an already existing organization
Kuratko and Hodgetts (1995)	Intrapreneurship is the process of starting a new organization or a reform by an individual or a group working in an already existing organization
Carrier (1996)	The introduction and implementation of significant innovation for the firm by one or more employees working within an established organization
Sharma and Chrisman (1999)	Intrapreneurship is the process whereby an individual or a group of individuals, in association with an existing organization, create a new organization or instigate renewal or innovation within that organization
Chang (2000)	Intrapreneurship describes an entrepreneurial culture within an already existing organization to encourage innovations internally
Antoncic and Hisrich (2001)	Intrapreneurship refers to a process that goes on inside an existing firm, regardless of its size, and leads not only to new business ventures but also to other innovative activities and orientations such as the development of new products, services, technologies, administrative techniques, strategies, and competitive postures
Hornsby et al. (2002)	It is regarded as a strategy for the development and implementation of new ideas
Heinonen (2003)	Intrapreneurship refers to the entrepreneurial way of action in an existing organization with the main focus on recognizing an opportunity, exploiting it, and trusting that exploiting an opportunity in a new way that deviates from previous practice will succeed and support the realization of the organization's aims
Antoncic and Hirsich (2003)	Intrapreneurship is entrepreneurship within an existing organization, referring to emergent behavioral intentions and behaviors of an organization that are related to departures from the customary

Author/ Year	Intrapreneurship concept
Elfring (2005)	Intrapreneurship is the process whereby an individual or group of individuals, in the context of an existing firm, take the initiative to create innovative resource combinations
Mohanty (2006)	It is the practice of creating new business products and opportunities in an organization through proactive empowerment
De Jong and Wennekers (2008)	Intrapreneurship refers to the employees' initiative to undertake something new without them being requested to do so
Menzel (2008)	Intrapreneurship is the process during the course of which an intrapreneur discovers and exploits an entrepreneurial opportunity to develop new means-ends relationships within an existing organization
Balasundaram and Uddin (2009)	Intrapreneurship refers to entrepreneurial activities that receive organizational sanction and resources and commitments for the purpose of innovative results. The major thrust of intrapreneuring is to develop the entrepreneurial spirit within organizational boundaries, thus allowing an atmosphere of innovation to prosper
Åmo (2010)	Intrapreneurship is recognized as a tool for employees who want to realize their entrepreneurial vision
Bosma et al. (2011)	Intrapreneurship is defined as employees developing new business activities for their employer, including establishing a new outlet or subsidiary and launching new products or product-market combinations
Parker (2011)	Intrapreneurship, known as corporate entrepreneurship and corporate venturing, is the practice of developing a new venture within an existing organization to exploit a new opportunity and create economic value
de Villiers-Scheeper (2012)	Intrapreneurship is a multidimensional phenomenon that describes the process by which established firms can act innovatively, risk-taking, and proactively
Baruah and Ward (2013)	Intrapreneurship is a term that describes the innovation practice within an organization through which employees undertake new business activities and pursue different opportunities. It provides an effective way of managing an innovation culture and attaining organizational development
Moriano et al. (2014)	It is a bottom-up proactive work-related initiative of individual employees that are the driving force behind product development or improvement and/or market penetration
Brigić and Muzafer (2015)	Intrapreneurship refers to the development of the entrepreneurial spirit and culture in the companies as well as to helping innovative entrepreneurs in order to develop their business ideas, so they can use the infrastructure of the company, which gives a certain advantage compared to independent entrepreneurs
Shah et al. (2015)	Intrapreneurship refers to encouraging corporate employees to create new businesses by using a company's funds and other resources

Author/ Year	Intrapreneurship concept
Baruah and Ward (2015b)	Intrapreneurship representing employees' contribution toward the innovation framework of the organization, regardless of management wishes, illustrates a bottom-up entrepreneurial route
Berzin et al. (2016)	Intrapreneurship involves the process of entrepreneurship within an existing organizational structure for the development of a new venture, development in products, services, strategies, or administrative activities
Babic and Zaric (2017)	Intrapreneurship is the process of formation of small autonomous units within the company which are given the necessary resources in order to achieve greater flexibility and adaptability to changes in the environment
Vargas-Halabí et al. (2017)	Intrapreneurship is a process in which an individual or group of individuals, within the framework of an existing organization, identify, pursue, and encourage innovative opportunities and create a new organization, renewing the organization or introducing product and process innovations
Falola et al. (2018)	Intrapreneurship refers to employees' creativities in organizations to embark on new business activities or initiatives
Neessen et al. (2019)	Intrapreneurship is a process whereby employee(s) recognize and exploit opportunities by being innovative, proactive and by taking risks, in order for the organization to create new products, processes and services, initiate self-renewal, or venture into new businesses to enhance the competitiveness and performance of the organization
Guven (2020)	Intrapreneurship is defined as the presence of individuals in the workplace who work within the organization in activities that result in production, service, and process innovation
Alam et al. (2020)	Intrapreneurship is authorizing employees to use the resources of the organization to innovate changes within the organization and create a new business
Huang et al. (2021)	Intrapreneurship, from an organizational view, can be perceived as a sustainable strategic resource and dynamic capability that firms can adopt to exploit or explore business opportunities

Table 2.1 Definitions of intrapreneurship from the literature in chronological order

Definitions of intrapreneurship have varied significantly, which is evident from the long list of existing definitions presented in the above table. Some of the reasons why there seem to be so many different definitions are summarized by the researcher:

1) Scholars and researchers have studied the concept at different organizational levels, at the individual, the team, and the firm, leading to various definitions of focus and expansion of the concept beyond its boundaries as a result of the different levels of analysis.
2) The concept of intrapreneurship is related and routed to the phenomenon of entrepreneurship, which has been characterized as a fragmented and diverse field and featured as a dynamic, complex, and multidimensional phenomenon. These have been inherited in the concept of

intrapreneurship as one of its subfields, resulting in many broader as well as narrower definitions proposed by different authors in the context of entrepreneurship.

3) The terms have been defined in response to the broad focus by researchers from different perspectives on the concept of intrapreneurship. Some researchers narrow their focus to the associated characteristics or specific factors and dimensions of the concept. Others define the term according to the result and outcome of applying intrapreneurship inside the company. Some authors focus on the factors that facilitate intrapreneurship, while others deal with the concept as a process. These have led to multiple definitions of the concept that are varied in their contents.
4) The term has evolved over four decades reflecting the major changes in the management and strategy fields and corresponding to the challenges of today's rapidly changing markets, high competitiveness, and the development of technologies and globalization impacts. In this context, intrapreneurship is adopted inside organizations as a major solution for tackling these challenges from different aspects, including organizational survival, growth, profitability, and renewal.
5) The term has been merged and correlated with existing management and organization fields, such as creativity, innovation, organization culture, strategic management, and individual entrepreneurial behavior. Authors from various disciplines and domains analyze intrapreneurship in different manners and propose various definitions through various theoretical lenses. Besides, many researchers have studied the interfaces, dependencies, and correlations between these areas. Hence, the definition is expanded to different conceptual diversities and scopes.

Some authors have analyzed these varied definitions. For instance, Neessen et al. (2019) highlighted how the multi-definitions of intrapreneurship are based on one or more of the six themes listed below:

- Innovativeness and creation of new products/processes/services
- New business venturing
- Self-renewal, which is related to the transformation of the organization and redefining the concept of work
- Opportunity recognition and exploitation
- Proactiveness
- Risk-taking

Antoncic and Hisrich (2003) have classified the several focal areas of intrapreneurship research into three main elements:

- Individual intrapreneurs and their characteristics

- The creation of new ventures, types of new ventures, and how they fit into the organizational setting
- Entrepreneurial organizations and their characteristics focus on improving knowledge of intrapreneurial organizations, gaining a better understanding of successful intrapreneurs and new corporate ventures in their context, and encouraging entrepreneurship in order to enhance the performance and revitalize these organizations

Among the various definitions of intrapreneurship, Blanka (2019) highlighted that common terms like 'innovation', 'strategic renewal', and 'out-of-the-box thinking' are the most frequently used to label intrapreneurship as behavior in attaining competitive advantage and pursuing new opportunities. Authors such as Bosma et al. (2011) consider the scope of intrapreneurship among different definitions where there are at least three alternative conceptual approaches:

- The first is the 'pursuit of entrepreneurial opportunity'.
- 'New entry', includes entering new or established markets with new products or entering new markets with established goods or services.
- 'New organization creation', intrapreneurship with emphasis on innovation should always be associated with some sort of 'internal start-up' such as establishing a new subsidiary, a joint venture, or a new business unit.

Due to this wide range of definitions attached to the term, it is essential for this research to have a clear definition of intrapreneurship and narrow it down to one specific meaning to facilitate its understanding. This research defines intrapreneurship as:

An organization-level process related to the organizational practices, strategies, and behaviors by which a firm seeks to innovate, develop new products, technology, and services, and foster more initiatives and improvement efforts from their employees.

This definition values cultivating intrapreneurship amongst employees and considers the concept from an organization lens and referring to the following aspects:

a) The overall intrapreneurial activities and practices of the organization
b) The processes, methods, and structures organizations use for managing and supporting individual intrapreneurial initiatives and activities

Having defined intrapreneurship as a process is consistent with the view of de Villiers-Scheepers (2012), who explains that a process is manageable and controllable and should not be viewed as a discrete event, but as an integral part of the organization's culture.

2.5.2.1 Intrapreneurship and corporate entrepreneurship

Corporate entrepreneurship, in the literature, is usually conceptualized at the level of organizations and represents a top-down process. Guth and Ginsberg (1990) were among the first researchers trying to clarify the domain of corporate entrepreneurship through introducing two distinct types of corporate entrepreneurial internal activities; business venturing, which is described as creating and starting a new business within existing organizations, and strategic renewal, which is related to the organizations' transformation through the renewal of the key ideas upon which they are founded (Guth and Ginsberg, 1990). Zahra (1996) added innovation as a third type of corporate entrepreneurship and explained that innovation and venturing activities emphasize the creation of new business through market developments or by the innovation of the organizations' products, processes, technology, and administration. According to Zahra (1996), renewal encompasses various activities such as redefining the business concept, reorganizing, adopting new organizational structures, creating internal systems, and introducing system-wide changes so as to foster innovation and energize the firm. Another stream of research focuses on corporate entrepreneurship as a strategic component of the firm. In this regard, Dess et al. (1999) explain corporate entrepreneurship as transforming an organization through strategic renewal. Åmo (2010) agrees with Dess et al. (1999) and states that corporate entrepreneurship is recognized as a strategy that organizations can deploy in order to nurture innovation and achieve growth. Furthermore, academics and scholars have expanded the phenomenon to include different organizational behaviors. Corporate entrepreneurship, according to Rigtering and Weitzel (2013), is conceived as a process for fostering corporate change, renewal, and flexibility through management's innovative, proactive, and risk-taking activities.

Corporate entrepreneurship in recent years has gained more interest as a way for organizations to enhance the innovative capabilities of their employees (Urbano and Turró, 2013). Therefore, many studies in the corporate entrepreneurship field are also concerned with how organizations stimulate initiatives and innovation from employees and how top management can create a business strategy that influences employees to explore new business opportunities (Åmo and Kolvereid, 2005). In this context, corporate entrepreneurship refers to *"The process of enhancing the ability of the firm to acquire and utilize the innovative skills and abilities of the firm's members"* (Rutherford and Holt, 2007, p.430). In line with these views, Morris et al. (2008) emphasize using corporate entrepreneurship as a strategy that management can use to harness more innovative initiatives from their employees.

Scholars such as Åmo and Kolvereid (2005) suggest that intrapreneurship and corporate entrepreneurship terms represent processes of organizational renewal through employees' innovative initiatives. Similarly, Baruah and Ward (2015b) conclude that both terms demonstrate the creation, development, and subsequent implementation of innovative ideas within an organization. Underlying corporate entrepreneurship includes strategic elements and intrapreneurial managerial behavior

focusing on stimulating employees' intrapreneurial abilities within the boundary of an organization, and following the above discussion, this research considers corporate entrepreneurship synonymous with intrapreneurship. Such perspective is also followed by many scholars, such as Sharma and Chrisman (1999), Antoncic and Hisrich (2004), Fitzsimmons et al. (2005), and Huang et al. (2021). They used both terms interchangeably, presenting entrepreneurial activities within organizations.

2.5.2.2 Innovation: the core of intrapreneurship

Many authors suggest innovation and intrapreneurship as a concept to promote growth and development for organizations. Intrapreneurship and innovation are dynamic and comprehensive processes that are mutually reinforced in which the employees' behavior is integrated with favorable organizational factors that affect developing competitive advantage (Lechner and Gudmundsson, 2014). Innovation becomes critical for an organization seeking market continuity and attainment of a competitive differential (Marinho et al., 2016). Acar and Acar (2012) highlighted the significance of innovation as a critical capability to differentiate services, products, procedures, and overall business.

While innovation and intrapreneurship are attributed as major approaches leading to organizational success and achieving superior business performance, scholars have defined innovation in the context of intrapreneurship. Innovation is a crucial ingredient of intrapreneurship (Finkle, 2012) and is one of the significant factors of intrapreneurship, among others (Lumpkin and Dess, 1996). Intrapreneurship works as an incubator for innovation (Reuther et al., 2017) and is intrinsically tied to innovation on several aspects and levels, including the definition, processes, and outcomes (Huang et al., 2021). Intrapreneurship is a decisive factor that significantly influences innovation and is key to the innovation process, leading to its success and achieving meaningful results. Intrapreneurship aims to obtain innovation in all aspects of an organization, leading to business value (Ping et al., 2010). Innovation performance must be embedded in the organizational culture so as to inspire employees to engage in entrepreneurial and innovative behavior (Olokundun et al., 2017).

The notions of intrapreneurship and creative work behavior are inextricably linked in which innovation is a major activity that is stimulated through intrapreneurship among employees. The employee who pursues innovation is the primary contributor to innovation by intrapreneurship (Åmo, 2010). According to authors like Zhao (2005), the core of intrapreneurial efforts in an organization centers on the innovative activities of individual employees. Organizations need innovative employees so that companies be able to consistently innovate and perform the duties of discovery, development, acceleration, and scaling of the business (Corbett, 2018).

Intrapreneurship is crucial for facilitating and supporting the innovation process and identifying business opportunities. The different stages of the innovation process, which include idea conception, development, execution, and integration into the organization's business portfolio, require instilling an

intrapreneurial mindset among employees, which necessitates the development of an enabling culture and appropriate systems to motivate employees to pursue intrapreneurial activities (Manimala et al., 2006). The main source of innovation is to pursue an opportunity, and the basis of intrapreneurship is identifying and exploiting that opportunity and believing that it will be successfully implemented, thereby supporting the organization to accomplish their objectives (Heinonen, 2003). Allocation of appropriate resources, the formulation of a long-term plan, the commitment of top management support, and the elimination of restrictive rules and processes are all mandatory for successful innovation leading to greater effectiveness and productivity (Azami, 2013). These are areas that are facilitated and influenced by the organization's intrapreneurship functions.

Product innovation in manufacturing industries has been the primary focus of many empirical innovation studies (Acar and Acar, 2012). However, many authors have argued that there are different types of innovation. Innovation can be incremental or radical (Zhao (2005), Seshadri and Tripathy (2006), Oshri and Kotlarsky (2011)). Incremental innovation involves linear improvements (continuous and limited improvement) and gradual and systematic evolution of existing products, services, processes, and methods. In contrast, radical innovation involves substantial improvement (representing non-linear change) that requires experimentation and a determined vision to happen (Kuratko and Hornsby (1990), Latzer (2009)).

2.5.3 Intrapreneurs within an organization

The level of intrapreneurship of an organization is a reflection of the intrapreneurial behavior, action, and activity of employees (Åmo (2006), Gapp and Fisher (2007), Gawke et al. (2017)). Pinchot (1985) asserts that innovation almost never occurs in the absence of passionate individuals. Those are intrapreneurs who are 'dreamers who do', take their own initiative to do things, set their own goals, and tend to be action-oriented to transfer an idea into something that is profitable (Pinchot, 1985). Aygün et al. (2010) took a similar view and argued that intrapreneurs are good thinkers and planners, action-focused and always work toward achieving their goals. According to Lages et al. (2017), intrapreneurs are 'domestic entrepreneurs' with a distinctive focus on innovation and creativity that add value to their organization.

Menzel (2008) highlighted the vital role of intrapreneurs within the intrapreneurial process to explore and drive opportunities. He added that if no intrapreneur exists, there will not be any intrapreneurship. Similarly, without the action, effort, and achievement of individuals, intrapreneurship cannot be attained (Menzel et al., 2007). Pinchot and Pellman (1999, p.16) summarized this and stated that *"Innovations just do not happen unless someone takes on the intrapreneurial role"*.

Several studies have explored the intrapreneurial behavior of intrapreneurs and emphasized their role in enhancing the success of their employer's business. Organizations willing to act intrapreneurially,

their employees should exhibit intrapreneurial behaviors and demonstrate them in their actions (Neessen et al., 2019). The concept of intrapreneurship describes the intrapreneurial employee as proactive and always seeking to develop innovative ideas within the organization's boundaries (Åmo, 2010). They are more likely to avoid doing business in ordinary ways by engaging in experimentation with new organizational practices, procedures, structures, and approaches (Hecker, 2017). Bhatia and Khan (2013) considered intrapreneurs as intra-organizational revolutionaries driven by their willingness to reinvent companies, transform them, and push them forward. Jain et al. (2015) highlighted the result and outcomes of intrapreneurs. In their views, intrapreneurs or corporate entrepreneurs assist their organizations in establishing new businesses, creating new markets, and supporting new directions to enhance the competitive edge of the business.

The innovation role of intrapreneurs is a key to their intrapreneurial contributions. Jones (2013) characterizes them as innovation and new product development leaders who manage the development process. They drive the search and exploration for new opportunities that have the potential and may result in the development of new products, technologies, or markets (Camelo-Ordaz et al., 2012). Intrapreneurs demonstrate a high level of responsibility throughout the innovation process, ensuring that the idea is effectively transformed into a profitable business reality. In this perspective, intrapreneurs can make quick prototypes, experiment with and test new ideas, and learn quickly from results by identifying failures and what went wrong, redesigning and testing the products again, and overcoming difficulties that may arise (Pinchot and Soltanifar, 2021).

Being an intrapreneur or acting intrapreneurially is not restricted to specific functions or positions within an organization. Intrapreneurship is concerned with having intrapreneurs at all levels in the organization, involving all managers, employees, and staff in any role and function within an organization (Burgess, 2013). Intrapreneurs can be found in technical or non-technical functions, at any management level of both line or staff functions, including senior, middle, or junior levels, and in manufacturing or service-related roles (Seshadri and Tripathy, 2006).

An intrapreneurial organization provides the optimal environment for intrapreneurs to thrive and stay actively engaged in innovation and creativity (Toftoy and Chatterjee, 2004). Understanding how an organization can find, retain, and empower intrapreneurs, and create a corporate environment in which they can prosper, are essential steps toward success and facilitating intrapreneurship.

2.5.4 Intrapreneurship for every organization size

Traditionally, the concept of intrapreneurship was developed and applied to large businesses due to its beneficial effects on improving the performance of large organizations (Pinchot (1985), Zahra (1991)). Large firms dominated the research of intrapreneurship in the last 25 years (Van Der Sijde et al., 2013). Large firms are more likely to exhibit intrapreneurship to achieve long-term sustainable development

while increasing profitability and productivity in their structures and processes (Thornberry, 2001). However, Antoncic and Hisrich (2003) argued that intrapreneurship could be developed in organizations regardless of their size. In the UK, SMEs dominate the market. According to the statistics released by Department for Business, Energy & Industrial Strategy in 2021 (BEIS, 2021), the UK is home to 5.58 million SMEs (defined by fewer than 250 employees), accounting for 99.9% of the UK business population, with a turnover of £2.3 trillion represents half of the turnover in the UK private sector (52%). The total employment in SMEs was 16.3 million, accounting for three-fifths of the employment (61% of the total).

Recently, there has been a shift in the company size related to the study of intrapreneurship. In one of the initial studies of intrapreneurship in SMEs, Carrier (1994) compared the characteristics between SMEs and large organizations in terms of structural context, reward systems, strategic processes, and the consequences of dissatisfaction on intrapreneurs. She explained that intrapreneurship is equally vital in both large and SMEs despite their divergent properties. Aygün et al. (2010) explain the friendly environment of SMEs that is characterized as simple, flexible, and adaptable in their structure and process, whereas in large organizations, the structures and processes may constitute important impediments to intrapreneurship. SMEs have different complexities and intrapreneurship dynamics compared to large firms (Baruah and Ward, 2014c). This makes the identification and empowering of potential intrapreneurs in SMEs potentially follow different processes and mechanisms that may not be similar to those of large organizations.

2.5.5 The multiple levels of intrapreneurship studies within organizations

Intrapreneurship has been defined and studied at different organizational levels, the individual, the team, and the organization level (Seshadri and Tripathy (2006), Blanka (2019)). Among these, there are mainly two distinct trends that dominate the literature (Antoncic and Hisrich (2003), Menzel (2008), Antoncic and Antoncic (2011)); the first focuses on the ‘individual’ level concerning employees who act as intrapreneurs and implement intrapreneurship with particular emphasis on their intrapreneurial actions, attitudes, behaviors, and characteristics (Pinchot, 1985). The second one is the ‘organization’ level concerning the employer that employs individual intrapreneurs emphasizing the characteristics of such organizations.

Following this two-level construct of the phenomenon where it can take place, intrapreneurship is classified according to the level of the initiative and the direction as a ‘top-down’ process or ‘bottom-up’ process. The ‘top-down’ process represents the organization, management, strategic planning, and the firm level. Additionally, it represents the strategy that management might use to foster more initiatives and efforts from their employees (Bosma et al., 2010).

In the ‘bottom-up’ process, initiatives are generated by the individual or the employee level. This construct is commonly adopted by many authors such as Åmo and Kolvereid (2005), Rigtering and Weitzel (2013), and Baruah and Ward (2015b). In this regard, factors on the individual level are explored based on theories of intrinsic motivation, personality, attitude, and role and function of intrapreneurs. This research studies intrapreneurship as an organizational-level phenomenon. However, initiatives in a ‘bottom-up’ direction require ‘organization’ level support and are related to the ‘top-down’ process. This will be discussed in more detail in the following paragraphs by first understanding the ‘bottom-up’ process and then exploring how it works within the framework of the ‘organization’ level.

Academic literature on intrapreneurial initiatives from employees in a bottom-up direction seems to be mainly related to the following two main aspects (Åmo (2010), Pinchot and Soltanifar (2021)):

1) Innovative initiatives come from employees in response to the leadership requests and challenges that are aligned with its strategy.
2) Initiatives by employees that emerged independently and eventually recognized, approved by management, and integrated into the business concept. These initiatives can be viewed as being intrinsic to the individual themselves when setting their own goals and doing things without being asked to do (Åmo and Kolvereid, 2005). Such activities can also result from individual creativity (Zahra, 1991). These activities can take many forms and are referred to as ‘independent and autonomous actions’ (Lumpkin and Dess, 1996), ‘self-directed pursuit of opportunities’ (Kacperczyk, 2012), ‘autonomous strategic initiatives’ (Burgelman, 1991), ‘autonomous strategic actions’ (Linder, 2016), or ‘autonomous intrapreneurial initiatives’ (Åmo, 2010). This kind of initiative may be unknown to the management and may not be acknowledged or appreciated by them (Åmo and Kolvereid, 2005). This implies that if management does not buy in or support such autonomous intrapreneurial initiatives, they will not be implemented or succeed, and therefore, intrapreneurship will not happen. This unsuccessful approach is also mentioned by Hornsby et al. (1999) when individuals do not believe in their organization’s climate to support their efforts.

For ‘bottom-up’ intrapreneurial initiatives that are generated as a response to management, despite being initiated by individuals, they represent corporate entrepreneurship or intrapreneurship that should be studied at the organization level (Åmo and Kolvereid, 2005). This view is considered in this organizational-level research. Åmo and Kolvereid (2005) propose the model illustrated in Figure 2.1, combining both processes’ direction of intrapreneurial initiatives and how they can be integrated to represent the innovative behavior among employees.

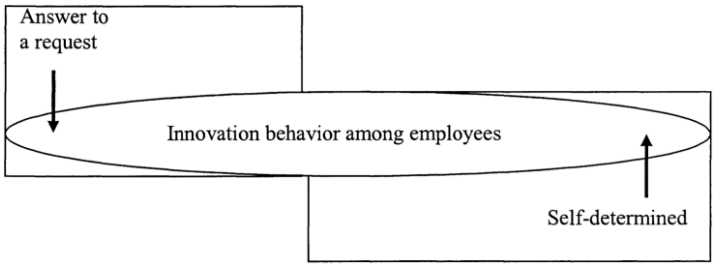


Figure 2.1 Illustration of employees' innovation behavior in the context of the bottom-up intrapreneurship process

The interaction and correlation between the two processes of organization and individual in the two directions are related to the success of intrapreneurship within organizations. Intrapreneurial behaviors of both individuals and organizations depend on the supportive cultural frameworks of the firm oriented toward stimulating innovation (Menzel et al., 2006). Zahra (1991) considers intrapreneurship to be a combination of both formal (management level) and informal (employee level) activities aimed at enhancing innovation and creating new business in established organizations. Management within an organization has a vital role in the two-way processes of intrapreneurship through orienting organizational and employees' initiatives toward successful innovation. In this context, management must then formulate a vision of the required form of the organizational culture whereby individuals are encouraged to buy into this desired culture (Åmo, 2010). Menzel (2008) affirms that the best results of opportunity discovery and exploitation are achieved when the two-level processes of the individual (intrapreneur) and the organizational (management) interact and cooperate closely, where both of them can build a shared understanding of the opportunity and how to exploit it.

Several researchers have highlighted how employees can behave intrapreneurially only when the organizational frameworks have provisions and facilities to support them so that they can act on their innovative initiatives. Organizations cannot simply anticipate their employees to be innovative and creative without any encouragement or motivation. Intrapreneurial behavior of employees is a reflection of the level of support they receive from their organization. Therefore, behaving like intrapreneurs is not a continuous or a stable characteristic of them as it is affected by and comprises situational components dictated by supportive organizational factors and entrepreneurial orientation (Badoiu et al., 2020). Organizations need to develop and nurture innovation rather than expect it to stem naturally from their employees. Although many scholars focus on employee intrapreneurial initiatives and activities as independent behavior, the organization will accommodate these behaviors and support employees' initiatives to generate a beneficial outcome. In this perspective, the existence of intrapreneurs alone in an organization is not sufficient for intrapreneurial success. To allow intrapreneurs to thrive, a conductive organizational environment is required, one that values the entrepreneurial spirit (Lages et al., 2017). Employees can behave intrapreneurially only if the organizational design is created in a way that supports them in doing so (Delić et al., 2016). Organizations targeting their employees to innovate

and act as intrapreneurs may need to alter their working conditions, where the tendency of employees toward intrapreneurial behavior depends on the supportive working environment (Reuther et al., 2017).

Authors such as Neessen et al. (2019) consider intrapreneurship to be more than an individual or organizational behavior but is a collection of activities undertaken by an individual or an organization to get from point A to point B in a timely manner, with the end goal of increasing the organization's competitiveness and performance.

Building on the above discussion, this research examines intrapreneurship as an organizational-level process, where management has a key role in providing a platform for intrapreneurship to flourish and develop.

CHAPTER 3: THE INTRAPRENEURIAL ORGANIZATION

3.1 Intrapreneurial organization

3.1.1 Classification of intrapreneurial organizations

The literature is dominated by using the term 'entrepreneurial' compared to 'intrapreneurial' when describing the concept of intrapreneurship for organizations or firms. However, both terms are used interchangeably in this research as intrapreneurship is related to entrepreneurial activities, behavior, and practices within an 'established' organization (Pinchot (1985), Christensen (2004), Fayolle and Basso (2010)).

Scholars have different views on the classification of an intrapreneurial organization. Authors such as Covin and Slevin (1991) contend that what identifies and signifies an organization as entrepreneurial and gives meaning to the entrepreneurial process is its behaviors and actions rather than its attributes or characteristics, such as the organization's culture and structure. It is the behaviors and activities that determine the organization that is more or less entrepreneurial. This firm-level entrepreneurial behavior is related to organizational attributes where it is affected and can be managed through creating the proper organizational strategy, structure, and culture. In a similar view, intrapreneurship should be viewed as an activity-based concept (Antoncic and Hisrich, 2001). According to Covin and Lumpkin (2011), organizations can exhibit entrepreneurial behaviors but not be regarded as such if the entrepreneurial practices do not sustain to some degree over time. An organization must demonstrate entrepreneurial behaviors on a sustained basis to become widely recognized as a distinguishing characteristic of the organization (Covin and Lumpkin, 2011). This implies that continuous and consistent intrapreneurial behavior, activities, and actions are what signify an intrapreneurial organization.

Intrapreneurial behavior can be demonstrated through various specific activities. Some of the major activities related to intrapreneurship are provided by authors such as Rigtering and Weitzel (2013). They declared that entrepreneurial activities within established organizations include, but are not limited to, new product/service development, strategic renewal, strategic repositioning, and new entry. Entrepreneurial behaviors are also represented by activities related to exploring, evaluating, and executing entrepreneurial opportunities (Shane and Venkataraman, 2000). Intrapreneurial behaviors also involve a combination of proactive, innovative, and risk-taking behaviors (De Jong et al., 2011). Intrapreneurial organizations are always engaging in activities related to venturing into a new business, innovation, and continuously renewing themselves (Mokaya, 2012).

The literature does not suggest or describe if an entrepreneurial organization is entrepreneurial in all of its activities and functions or whether it is reflected in some part or particular areas of the business (Andersén et al., 2015). They explain this by an example where some organizations can be innovative and risk-taking in product development while being quite cautious about hiring new employees, indicating an organization is not necessarily entrepreneurial in all of its business areas. Furthermore, if an organization is entrepreneurial in certain areas, other organizations may probably be entrepreneurial in other areas (Andersén et al., 2015).

Moreover, organizations vary in terms of the levels of intrapreneurship. *"Organizations differ with regard to levels of entrepreneurship. Organizations can be viewed on the intrapreneurship continuum that ranges from less to more entrepreneurial. Pure forms, in absolute terms, such as totally entrepreneurial or totally non-entrepreneurial organizations are abstractions that help us understand reality, but do not actually exist in the real world"* (Antoncic and Hisrich, 2003, p.9). Intrapreneurship as a continuum concept is clear in the perspective of Covin and Slevin (1989), as evident in their differentiation between conservative organizations that are characterized as risk-averse, non-innovative, and reactive and entrepreneurial organizations that are risk-taker, innovative, and proactive. Similarly, Miller and Friesen (1982) argued that entrepreneurship is often seen as a highly aggregated concept where organizations are classified as being entrepreneurial with a strong emphasis on product innovation or as bureaucratic that are characterized as reluctant to innovate (Miller and Friesen, 1982).

3.1.2 Definition of intrapreneurial firms

The essence of intrapreneurship is innovation, and according to Covin and Miles (1999), innovation is the single and common factor found across all intrapreneurial organizations. Miller and Friesen (1982, p.5), in their early work, described entrepreneurial organizations as *"Innovate boldly and regularly while taking considerable risks in their product-market strategies"*. Entrepreneurial organizations innovate not only in their markets but also through the development of new products and management processes aiming at enhancing their competitive advantage (Fitzsimmons et al., 2005). Covin and Slevin (1989) theorized the three dimensions that characterize an entrepreneurial firm; innovation, proactiveness, and risk-taking, which need to act together to form a strategic orientation toward entrepreneurship. Miller (1983) added that entrepreneurial organizations are those that heavily engage with product-market innovation, take on risky ventures, and beat competitors by being the first to introduce and develop proactive innovation. In contrast, a non-entrepreneurial firm *"Is one that innovates very little, is highly risk-averse, and imitates the moves of competitors instead of leading the way"* (Miller, 1983, p.771).

Scheepers (2008) suggested three main indicators that can be utilized to assess the entrepreneurial mindset of an organization; the entrepreneurial orientation of the firm, which encapsulates the strategic

mindset of the organization that incorporates the procedures and processes, practices, and decision-making activities in order to facilitate the recognition and exploitation of opportunities; the number of initiatives implemented in the organization; and the internal organizational culture conducive to support employees' entrepreneurial behavior. Ağca et al. (2012) pointed out that intrapreneurship incorporates aspects of both entrepreneurial orientation and corporate entrepreneurship and is classified into five dimensions: (1) innovativeness, (2) new business venturing, (3) self-renewal or strategic renewal, (4) risk-taking and (5) proactiveness which includes competitive aggressiveness. Ağca et al. (2012) mentioned that an organization that exhibits and performs one or more of these dimensions could be classified as an entrepreneurial organization. Covin and Slevin (1989) relate entrepreneurial firms to the actions of their higher management in which the top managers possess entrepreneurial styles represented in their strategic decisions and operating management philosophy. On the other hand, in conservative organizations, the senior management style is associated with being risk-averse, non-innovative, and reactive (Covin and Slevin, 1989). In a later study by Covin and Slevin (1991), entrepreneurial organizations engage in product-market or technological innovation, risk-taking behavior, and proactiveness in sustained behavioral patterns and at all organizational levels, reflecting the effective management practices and overall strategic philosophy of top management.

Lumpkin and Dess (1996) conceptualize the term entrepreneurial organization by distinguishing the main dimensions of firm-level entrepreneurship, including autonomy, innovation, risk-taking, proactiveness, and competitive aggressiveness. Intrapreneurial organizations are distinguished by practicing enlightened management principles and adopting an intrapreneurial style that eliminates bureaucratic barriers, develops an innovative culture, and stimulates intrapreneurship and innovation among the employees (Luchsinger and Bagby, 1987).

The characteristics of entrepreneurial organizations are not consistent and varied somewhat between authors and throughout time, but they were mostly made up of a combination of a certain number of strategic orientations such as innovation, risk-taking, and proactiveness. However, the different classifications have a specific focus on managerial, strategic, and cultural aspects of the firm that will be discussed in detail in the following sections.

3.2 How an organization can develop intrapreneurship - a review of the main research themes

The identification of the appropriate environment that is conducive to encouraging and stimulating intrapreneurial activities among employees has been a topic of interest for many researchers in the organization and management fields. Internal organizational supportive factors of intrapreneurship are varied and oriented to various focuses, resulting in wide approaches and multiple streams of strategies to promote intrapreneurship within an organization.

Intrapreneurship within an organization is influenced by the internal environment conditions that function together and are shaped by the behavior, style, and orientation of the management, the long-term strategy, and organizational systems and practices that foster creativity and innovation (Goosen et al., 2002). The first step in establishing an intrapreneurial organization, according to authors such as Frederick et al. (2016), is to identify the key barrier to intrapreneurship, which is mostly associated with the ineffectiveness of traditional management techniques that avoids intrapreneurial initiatives. In their view, managers have to adopt new practices and adhere to the principles of successful innovative organizations that include culture and vision-oriented to the market. The main managerial challenges stem from the organization's capacity to foster an intrapreneurial culture, design cooperative work relationships and offer adequate incentives (Huang et al., 2021). Achieving a consistent record of intrapreneurship requires that management provides strong leadership, focuses on generating new ideas, establishes a structured screening system, rewards innovators, and gives them freedom in their roles (Rule and Irwin, 1988).

To foster an intrapreneurial environment, it is necessary for organizations to establish a framework and formal structures (including strategy, vision, rewards system, and processes) that incorporate their informal structures (such as culture, communications, and minimum emphasis on mistakes) in which ideas are generated, implemented and supported (Filion, 1999). In the view of Frederick et al. (2016), organizations need to focus on individual responsibility, creating an environment of feedback and positive reinforcement, assigning explicit goals, and creating rewarding systems based on results. An important point made by Mohanty (2006) is that intrapreneurship can be realized systematically by implementing intrapreneurial strategies. In his view, for intrapreneurship to thrive, an organization needs to develop an environment inspiring employees to behave entrepreneurially with adequate support systems, structures, and resources.

The literature is deemed with different, scattered, and wide range of factors that promote intrapreneurship (as will be explained in section 3.3 and summarized in Table 3.1). This is based on the fact that intrapreneurship is described as *"a complex, mutually interrelated process between many actors and many units within and outside of the company"* (Menzel et al., 2007, p.733) and *"is a complex, multilevel construct where the intrapreneur is not a single actor within the environment, but acts as part of an organization and will thus be influenced by it"* (Neessen et al., 2019, p.565). Therefore, reviewing the literature and simplifying the introduction of these various and different factors for this study, they are organized into three main groups:

- Developing an intrapreneurial supportive culture that is integrated and complemented with
- Strong leadership and management support for intrapreneurial activities and
- A set of strategies oriented toward promoting intrapreneurship within organizations

These main factors are inseparable, function in tandem, and work collectively to nurture intrapreneurship. This approach of grouping the multiple factors stems from other works found in the relevant literature and is in line with many authors. In this context, O'Regan et al. (2006) affirm the close association between strategy, organizational culture, and leadership as the main drivers for innovation. While cultural and strategic supports complement and reinforce each other, an intrapreneurial organization does not seek to balance between them but adheres to continually developing them to their highest level (Oden, 1997). According to Chandler et al. (2000), culture as a supportive environment of innovation varies as a function of management practices. Organizational leaders can directly engage with intrapreneurs, support their intrapreneurial activities, and design and structure an organizational culture favorable for intrapreneurship. Strategic planning entails creating of intrapreneurial cultures where the culture needs to be incorporated into the overall direction of the business. Therefore, organizations aiming to have creative and innovative employees have to focus on developing their intrapreneurial culture through a strategy and plan and ensuring management support.

3.2.1 Intrapreneurial culture

Organizational culture ranks among the most essential factors for fostering intrapreneurship and is the most important mechanism for creating the necessary environment for innovation (Gursoy and Guven (2016), Arz (2017)), as well as one of the key factors to influence the rate of innovation in an organization (Acar and Acar, 2012). Organizations are not only required to possess intrapreneurs amongst their staff but also need to cultivate a culture in which they can grow and contribute to improving the company's market situation (Bhatia and Khan, 2013). Organizations that strive to achieve an intrapreneurial culture that supports creativity, experimentation, empowerment, and innovation will facilitate employees' idea generation and product development (Benitez-Amado et al., 2010).

Every organization has its unique culture within which it evolves, which determines the form, degree, and speed of innovation (Nacinovic et al., 2009). An organization's culture is built around all principles and rules that determine how the organization operates and allow for the creation of new and profitable ways to do the business (Menzel, 2008). Intrapreneurial behaviors of both individuals and organizations and their effects are attributed to the existence of supportive cultural factors (Carrier, 1994). Organizational culture, according to Nacinovic et al. (2009, p.377), can be understood as a *"System of shared values (that define what is important) and norms that define appropriate attitudes and behaviors for organizational members (how to feel and behave) that shape employee behavior and influences an individual's actions"*. Tesluk et al. (1997) pointed out that intrapreneurship flourished when these fundamental values, beliefs, and assumptions as essential elements of culture are reflected in the entire organization systems, processes and procedures, design of work, organizational structure, and the physical design of the workplace through observable patterns of behavior. An organizational culture conducive to intrapreneurship provides a stable context in which employees are empowered to generate

ideas and develop initiatives that will be supported, encouraged, and rewarded in the most effective way (Mohanty, 2006). The culture, therefore, is the single element that holds social, structural, and work-related behavior together. Neither innovation nor intrapreneurship will succeed unless the organization has the proper culture represented by values, beliefs, and supportive management style.

There are different approaches proposed in which organizational culture can be managed with the focus on supporting intrapreneurship. In this perspective, an intrapreneurial culture would be based on rules and practices that support employees in communicating openly, exchanging ideas and knowledge, learning from each other, and promoting a culture of support and mutual trust (Bhatia and Khan, 2013). Hisrich (1990) defines the main features of intrapreneurial culture as follows *"Develop visions, goals, and action plans; take action and be rewarded; suggest, try, and experiment; create and develop regardless of the area; and take responsibility and ownership. This environment, of course, supports individuals in their effort to create something"* (Hisrich, 1990, p.217). A culture that attracts and inspires intrapreneurial talent will cherish values of intrapreneurship, innovation, openness to new ideas, and autonomy (Hecker, 2017).

A culture of intrapreneurship, according to Mohanty (2006), needs to be formulated and oriented toward achieving clearly communicated goals and built around risk-taking, innovation, emotional commitment, autonomy, and empowerment. This provides the right infrastructure for new ideas and creativity to come up and for innovation to be implemented successfully. According to Gupta and Srivastava (2013), organizations striving to achieve intrapreneurship should, in the first place, develop an organizational culture that emphasizes lifelong learning, supports innovative thinking, and provides employees with the freedom to share their ideas (Gupta and Srivastava, 2013). An innovative culture that is associated with intensive features of creativity, orientation, flexibility, and dynamism is the kind of culture required to be created to trigger and promote intrapreneurship (Gursoy and Guven, 2016).

According to Tesluk et al. (1997), there are five main dimensions of organizational culture that drive creativity and innovation:

- Goal emphasis, where the goals for creativity and innovation and the standards for achieving those goals are made clear and available to all employees
- Means emphasis, in which the methods and procedures for creativity and innovation are communicated and transferred clearly to employees
- Reward orientation through allocating rewards and evaluations based on creativity and innovative results
- Task support by allocating resources, time, financial support, equipment and tools, materials, and services required to function innovative and to implement new initiatives, projects, and solutions

- Socioemotional support, where employees believe that they feel free to function creatively and are encouraged to take a risk and not punished in the event of a failure

McLean (2005) has studied the supportive organizational culture that encourages innovation and creativity. Among many enabling factors, they determine specific factors that influence the organizational culture:

- Organizational encouragement, including encouragement of risk-taking, idea generation, supportive evaluation of ideas, collaborative idea flow, and participative management and decision making
- Supervisory encouragement includes supervisory support of the team's work and new ideas, clarity of team goals and clearly communicating them, setting expectations for how those goals will be achieved, rewarding and recognizing accomplishments, and providing task support
- Granting and allowing freedom and autonomy to employees to support them in choosing the best means to achieve a goal
- and finally securing resources in terms of time and money

The following sections highlight the significance of some of these factors and shed more light on such elements representing an intrapreneurial culture.

3.2.1.1 Organizational structure

The literature stresses that an organization structure needs to be defined in a way that enables and improves employees' entrepreneurial activities. According to Christensen (2005), the corporate structure is an effective starting step in developing intrapreneurship, where organizations need to try new ways of organizing their structures proven to encourage innovation. The organizational structure determines and influences the organization's flexibility, the flow of information inside an organization, and the centralization of the decision-making (Neessen et al., 2019). Formality and task design, and authority relationships affect how employees manage their actions and use resources to achieve organizational goals (Jones, 2013).

Organizational structure has been studied in different ways, which is the base for facilitating an intrapreneurial culture and has a direct influence as a mechanism for a wide range of structural contexts within the firm. According to Drucker (1985), the simplest structure of an organization that accomplishes the job is the best one. The 'organic structure' is evident to be the most appropriate structure for innovation and to promote entrepreneurial activities and the single aspect of structure that best defines intrapreneurial organizations (Russell and Russell (1992), Aloulou and Fayolle (2005), Ireland et al. (2009), Martínez-Román et al. (2011)). An 'organic structure' is one that is characterized by a lower level of formalization and centralization, a few numbers of organizational levels, a flat

structure with a higher level of horizontal rather than vertical complexity, wider specialization, and teamwork, which is convenient for the development of intrapreneurship (Delić et al., 2016).

Ireland et al. (2009, p.31) note that *"Greater organicity implies a proclivity toward such qualities as decentralized decision making, low formality, wide spans of control, expertise- (vs. position)-based power, process flexibility, free-flowing information networks, and loose adherence to rules and policies".* An organization structure with such characteristics of decentralized decision making, semi-standardized procedures, and semi-formalized processes will make it easier to experiment with new ideas and innovate more effectively (Ireland and Webb, 2007), as well as increase the horizontal interaction and cooperation among employees, which facilitate the sharing and development of creative ideas (Ireland et al., 2006).

An organic structure is seen as a proper structure to stimulate different intrapreneurial dimensions within an organization. For instance, decentralization has a significant impact on influencing autonomy and entrepreneurship, informality increases employees' freedom and expands their choices to choose the best way to do their duties, and greater integration encourages teamwork by integrating activities across different teams and departments that facilitate the flow of information and communication (Gaspary et al., 2020). Gaspary et al. (2020) add that an organization associated with such a structure will encourage innovation through stimulating learning, knowledge-sharing, problem-solving groups, and job rotation. Hisrich (1990) sees that a flat organizational structure will encourage employees' networking and teamwork and, therefore, increase the number of sponsors and mentors. In this context, companies should look for reducing organizational hierarchy and move toward more flatter and flexible structures in which communication structures are decentralized through cross-functional innovation teams and the generation of ideas across disciplinary boundaries (Menzel et al., 2007). Similarly, Pinchot (1985) indicates that a flatter organizational structure and authority delegation to operating units is associated with better results of intrapreneurship.

In contrast to an organic structure, the 'mechanistic structure' of an organization is characterized by qualities of high centralization and formality, a high degree of vertical rather than horizontal interaction, and more specialized units and departments (Lumpkin and Dess, 1996). In such a structure, an increased amount of formalization indicating more written documents of organizational activities will hinder the organization more than it does help (Covin and Slevin, 1991). In a centralized organization, new ideas and suggestions need to go through an extended chain of command before receiving approval or resource support (Russell and Russell, 1992). A rigid organizational structure associated with high control is seldom for fresh ideas and initiatives to fit into, which forces innovators to cross boundaries seeking help and support from other teams (Pinchot and Pellman, 1999). A culture that supports control, either in decision making or in information flow, will impede creative performance and diminish innovation (McLean, 2005).

3.2.1.2 Learning culture

Organizational learning as a management field has emerged in the intrapreneurship literature domain to promote innovation and employee creativity. Organizational learning involves the acquisition and retention of knowledge and promoting employees' learning, thus closely related to enriching intrapreneurship and encouraging employees to act as intrapreneurs. In this context, Molina and Callahan (2009) highlight that developing an organizational learning culture will facilitate collective learning and the development of valued knowledge in which individuals can find new ways of doing things, continuously learn, discover, evaluate, and explore opportunities, which might be achieved through stimulating training and development, and learning processes. Organizational learning fosters intrapreneurial activities by enabling organizations to innovate, develop new businesses, and strategically renew their operations (Nason et al., 2015).

According to Haase et al. (2015), organizational learning represents a process directed toward the development and modification of the system of values and knowledge and enhancement of capabilities for action and problem solving, resulting in an environment in which employees feel pride in their job and are able to improve and develop. Intrapreneurship also can lead to organizational learning, which enables the changes in organizational routines to become a new routine improvement and may lead to some disruptions that are part of the learning process (Antoncic and Hisrich, 2003). The top management is responsible for stimulating a learning culture essential for developing distinctive technological competencies that support organizations to develop, integrate and manage their skills, expertise, and capacities (Bolívar-Ramos et al., 2012).

It is critical to facilitate an environment that continuously develops itself, values knowledge, and enables learning for every employee. Organizational learning can be achieved when employees start forming informal networks, exchange knowledge and create shared perspectives, driven by an organizational structure that promotes communication, cross-function integration, and knowledge sharing (Hayton, 2005). In a similar view, having effective and transparent communication, free flow of information, and knowledge sharing are necessary conditions to facilitate learning and develop intrapreneurship (Morais et al., 2021). An open culture needs to recognize the multi-level nature of learning, such as learning from experience, experimentation, trial and error, and enabling mentoring and personal one-to-one coaching schemes, thus, supporting intrapreneurs to develop innovative ways of doing things (Smith et al., 2016). For Haase et al. (2015), a culture of learning is a key feature of intrapreneurial culture through directing long-term learning processes, including continuous training and encouraging testing and experimentation in order to support employees in gaining and developing new knowledge, skills, habits, and behaviors. Individual employees with a high learning orientation seem to be more active in seeking challenges and exploring opportunities for developing knowledge and skills, building expertise in their functions, investing time and efforts to do complex duties, and

searching for new ideas that have the potential to be successfully commercialized (Yildiz et al., 2021). Organizations that support experimentation will facilitate employees' learning and motivation to know how to do new things and build the knowledge needed to take an idea forward (Floyd and Wooldridge, 1999).

A culture of organizational learning supports individual learning through intrapreneurs who may work as mentors to other employees and guide them to recognize business opportunities (Molina and Callahan, 2009). Furthermore, the existence of role model employees represents a significant source of learning as they act as a source of social persuasion, inspire and increase the confidence of other employees about their intrapreneurial initiatives, where others can learn from them how they manage challenges and stress (Newman et al., 2019). Information sharing is a productive way that leads to individual, collective and organizational learning and spreads a culture of learning across the entire organization (Haase et al., 2015).

3.2.1.3 Rewards system

The organization's reward system can influence an intrapreneurial culture that is supportive of innovation. Intrapreneurial organizations are known for providing a reward system based on performance which has a direct effect and implications on employees to embrace intrapreneurship (Hornsby et al. (1993), Kuratko et al. (2014), Falola et al. (2018)). The reward system is a reflection of the organizational culture and acts as a statement of its values, beliefs, and norms, and defines who gets rewarded and why (Nacinovic et al., 2009). On the other hand, the organization that is not capable or unwilling to offer adequate rewards will suffer from losing intrapreneurs, who may move to another organization that can satisfy their professional fulfillment (Mokaya, 2012).

Scholars have identified the positive influence and motivation of such rewards to spur intrapreneurial behavior. In this context, rewards improve the motivation of employees to act in a more innovative way (Hornsby et al., 1993) and increase their willingness to take part in innovative projects, commitment, and job satisfaction (Neessen et al., 2019).

Many scholars clearly express the intrinsic rewards associated and embedded with intrapreneurial work resulting from the work itself and benefits the employee. This includes an increase in the level of satisfaction of employees as a result of developing their own idea (Kuratko et al., 2005). Some of the intrinsic rewards lie in feelings of accomplishment, personal achievement, the satisfaction derived from completing interesting and challenging tasks, and increased job autonomy and professional growth (Huang et al., 2021).

The reward system of the organization is widely known as extrinsic rewards. These are motivations associated with an external force, including monetary gain and tangible rewards, explicit recognition,

or promotion (Orchard et al., 2018). Block and MacMillan (1993) also identify different incentives such as share options, bonuses and salary reviews, career advancement, and employee appreciation and acknowledgment. In this perspective, organizations have different options for the type of rewards and how they implement the reward system and their criteria. Therefore, the organization's choice of rewards is identified by its financial constraints and cultural attitudes (Hughes and Mustafa, 2017).

A culture of reward should be encouraged by communicating a clear message to employees that financial and non-financial rewards are linked and can be gained through implementing innovation effectively (Sun et al., 2012). Three main rewards were identified by de Villiers-Scheepers (2011) that should be inherent in the organizational culture and can be steered by management practices to inspire their employees and recognize their abilities and talents:

- Social incentives encompass different forms and methods of rewarding employees, such as establishing a culture of celebration by involving upper management in employees' achievement, supporting employees to overcome challenges, expanding job duties, connecting rewards to reflect employees' performance, and providing special recognition for intrapreneurial activities
- Formal acknowledgment and support incentives refer to providing formal support in the form of securing financial resources and time for new ideas and encouraging individuals to take calculated risks
- Organizational freedom and autonomy incentives involve enabling and granting employees the authority to make their own decisions and follow their own ways of working in order to achieve meaningful outcomes

Individuals' willingness and ability to involve in intrapreneurship and to what extent they engage in innovative, proactive, and risk-taking behavior are determined mainly by the type of rewards and reinforcement provided (de Villiers-Scheepers, 2011). While the reward system can have a considerable influence on innovative activities (Chandler et al. (2000), Kuratko et al. (2014)), rewards need to be designed in correspondence to the fact that different types of rewards can stimulate different aspects of innovation and lead to different outcomes. Therefore, reward systems can be easily changed and need to be managed and implemented with care to have an effective outcome of intrapreneurship and achieve desired results (Nacinovic et al., 2009). It also can be designed and tailored to accommodate individual achievement (de Villiers-Scheepers, 2011). Hence, organizations can direct a specific type of reward to target certain results. For instance, organizations that reward their employees by giving them bonuses or stock options proportional will give them a sense of feeling like being owners of the firm, discourage them from thinking about leaving the firm, and motivate them to perform more productively (de Villiers-Scheepers (2011), Jones (2013)).

There are many major points to consider in the overall designing of a successful, competitive, and fair rewards system that fosters employees' intrapreneurial engagement. An effective reward system needs to be aligned to achieve certain goals (Neessen et al., 2019). Management should also design appropriate financial and recognition reward systems based on significant achievements and contingent on performance (Hornsby et al. (1993), Ahmad et al. (2012)). Hayton (2005) stresses that such a powerful rewards system can go beyond rewarding some overall performance and extend to include the achievement of significant milestones and upon the value of initiatives or major achievements. Management needs to consider this by rewarding all forms of innovative activities and designing a suitable reward scheme for each type of intrapreneurial activity (Martiarena, 2013).

Some of the main features to consider when designing a competitive, successful and fair reward system were suggested by Nacinovic et al. (2009), including full and open transparency of awards, clear communication to all workers about reward availability, rules and criteria to be satisfied, and announcing award recipients. The extent of employees' trust in the reward system affects and influences their level of engagement and dedication to innovation (Falola et al., 2018). In this perspective, if an employee shows a high level of trust in the organization's reward system, then he/she will demonstrate a higher level of both commitment to innovation and taking the risk associated with the intrapreneurial activity (Alpkan et al., 2010).

3.2.1.4 Organization freedom

Organizational freedom refers to the autonomy and discretion provided for employees to enjoy performing their work. Freedom is key, in particular, for engineers to be original and active in creating new initiatives and continuously engage in any innovation and changes within organizations (Osman et al., 2017).

The freedom involves a decentralized decision-making process that enables employees to design their work in the most effective way, thus resulting in more intrapreneurial activities (Neessen et al., 2019). Work discretion and giving employees autonomy represent the organizational support for accepting failure, decision-making liberty, and delegation of power and responsibility (Kuratko et al., 2014). Therefore, freedom is attributed to trust and appreciation from leaders where employees involved in intrapreneurial roles prefer to take full ownership without referring back to their managers, enjoy doing their tasks in their own ways, and are permitted to fail and take risks (Deprez and Euwema, 2017). It is key that managers grant employees the autonomy to involve in intrapreneurial behavior. Managers who grant autonomy to their employees always focus on managing output rather than input and on outcomes rather than procedures and methods, supporting intrapreneurs not controlling their processes, and giving them some room to make changes (Gerards et al., 2021).

Badoiu et al. (2020) argue that entrepreneurial outcomes are obtained when employees are given autonomy, failure is accepted, and criticism of their mistakes is avoided. One of the main advantages obtained when giving freedom to employees is that they develop a sense of psychological ownership over their tasks, leading them to be more committed to working toward organizational goals and objectives and investing more time and effort in promoting new ideas (Falola et al., 2018).

3.2.1.5 Risk-taking and tolerance of failure

An organization willing to undertake innovative activities needs to create a healthy risk-taking culture where failure is part of the innovation process. No organization is immune to the possibility and risk of failure with the fact that embarking on opportunities has some chance of failure (Hashimoto and Nassif, 2014). Innovation fundamentally is a risky process where the probability of success is uncertain and low; therefore, organizations that avoid facing failure will refrain from such activities (Pérez-Luño et al., 2011).

The risk-taking behavior of an employee is very important for organizations to drive and develop their employees' intrapreneurial abilities (Ahmed et al., 2013). Employees' willingness to take a risk is more closely tied to the overall organizational culture and relates strongly to the level of support, structure, resources, and management behavior toward taking a risk and tolerating failure (Kuratko et al., 1990). Similarly, Aparicio (2017) explains that risk-seeking behavior within an organization is determined by individual attitudes toward risk, management support, and the internal culture. Employees' intrapreneurial activities are initiated when risk-taking and accepting failures are supported by management decisions (Kuratko et al., 2005). Employees will be more inclined to engage in risk-taking associated with innovative activities when they believe they are supported and backed by their managers (von Treuer and McMurray, 2012). SMEs are in a more challenging position to manage the risks associated with intrapreneurial activities compared to large firms where they have more capabilities and resources (Mustafa et al., 2018).

Fear of failure has a negative impact on intrapreneurship, especially when individuals have a risk-averse attitude (Urbano and Turró, 2013), and may impede employees from pursuing intrapreneurial activities associated with some risk. Intrapreneurship can be stifled or even eliminated when risk-taking is not supported. Therefore, organizations must show that failure will be tolerated and employees feel empowered to take risks (Burgess, 2013). Organizations not only need to foster a greater risk-taking culture but need to integrate failure into a continuous cycle of learning within the organization (Zhao, 2013), in which failure is considered as an opportunity and lesson to learn from and not as a reason to be punished, thus leading to a learning culture in which the emphasis is placed on what was learned when ideas are unsuccessful so as to let people not fear about losing their jobs (Menzel et al., 2006).

3.2.1.6 Physical work environment

A physical environment must be structured and designed in a way that supports and facilitates intrapreneurial activities, cooperation and networking. Menzel et al. (2007) explain that a work environment encouraging intrapreneurial actions focuses on having a physical office layout that ensures employees' privacy where they can concentrate without interruption. Such a supportive physical environment is also characterized by having an appropriate and controlled light and temperature and the existence of facility spaces that support employee interaction and informal meetings, such as staff restaurants and coffee areas that act as a hub for gathering and availability of meeting rooms (Menzel et al., 2007). Menzel et al. (2007) add that a physical setup should support mutual cooperation that goes beyond space and time where employees can communicate with each other as directly as possible and encourage networking that enables an intrapreneurship-friendly culture. In a similar view, Ashkanasy et al. (2014) explain that an open-plan office design could support this by improving cooperation, social interaction, and engaging closely with other teams, which ultimately affect the attitudes and behaviors of employees that enhance their performance and well-being at work. In a similar view, open-plan office design has a positive influence on intrapreneurs by encouraging communication and cooperation and facilitating social exchanges (Gerards et al., 2021).

3.2.1.7 Organizational resources

Resources availability is important for the success of intrapreneurial activities (Rigtering and Weitzel, 2013), and lack of it will constrain the organization's ability to pursue innovation (Amabile et al., 1996). Russel (1999) explains that organizational resources are defined in a broad sense to include money, time, people, equipment, and competencies. In the view of Amabile et al. (1996), resources include everything available to the organization and are offered to recognize opportunities and aid innovative work, such as sufficient time and the availability of training.

Aloulou and Fayolle (2005) highlighted that the existence of resources sufficient for intrapreneurship is an important contextual factor, especially in high-growth potential firms, which become more effective when supported and reinforced by a strategic orientation to deploy and coordinate different resources to achieve the desired results. Organizations with abundant resources have a greater ability to engage in intrapreneurial activities than those with limited resources (Covin and Slevin, 1991). Covin and Slevin (1991) add that the power of resources is closely tied to and influenced by organizational competencies such as plant and equipment, personal and functional level capabilities, marketing research system, and organization capability to get new products in the market in a timely manner, thus greater results will be achieved when both organization competencies and capability combined and integrated. Firms that create, acquire, and leverage resources will have the opportunity to achieve a sustainable advantage (Barney, 1991). Barney (1991) explains that some kinds of innovation require laboratories, scientists, and slack financial resources that are not needed for day-to-day operations.

However, for organizations operating in technologically intensive industries, the cost of developing technology-based resources tends to be more expensive (Newbert et al., 2008).

Time is one of the main resources given to an employee to foster innovative ideas and complete the work on the intrapreneurial activity. Some authors suggest that time needs to be managed effectively. Amabile et al. (1996) highlight that the lack of time may lead to distrust and burnout. On the other hand, providing an excessive amount of time might diminish the sense of challenge and impede innovative performance (McLean, 2005). Time needs to be granted in a balanced way that leads to productive work of normal duties, incubating ideas, and embarking on innovative activities. This could be supported by a moderate workload and avoid imposing time limitations on all responsibilities of an employee (Frederick et al., 2016).

3.2.1.8 Flexible organization boundaries

Organizational boundaries refer to actual and imagined boundaries that prohibit employees from looking at problems outside their own jobs, resulting in employees having relatively a very narrow perspective about their organization (Hornsby et al., 1993). An organization should be seen holistically as full of opportunities spanning across several functions (de Villiers-Scheepers, 2012). Therefore, it is necessary for an organization to structure flexible organizational boundaries to promote intrapreneurial activities. In this perspective, organizations need to avoid having rigid standards of performance, remove standard operating procedures of job roles and avoid having narrow job descriptions (Hornsby et al., 1993), and structure boundaries that guide and stimulate coordinated activities of innovation across the entire organization (Kuratko et al., 2014). Forming flexible organizational boundaries will have a positive impact on enhancing the flow of information across different departments and functions inside the organization (Hornsby et al., 2009) and developing processes and policies that reduce uncertainty in jobs in order for employees to believe that existing processes do not inhibit the development of new initiatives (Badoiu et al., 2020).

The flexibility in organization boundaries is a reflection of organization structure which encourages communications. Communication is clearly an organizational feature that is empowered by loose organizational boundaries and avoiding excessive formal communication. Developing an appropriate structure based on flexibility is a key strategic challenge for many organizations today (Delić et al., 2016). Flexibility requires an organizational process that is loosely formalized and thus continuously fine-tuned for each task (Medina et al., 2005). Flexible organizational boundaries can be achieved by encouraging work autonomy in executing tasks and decision-making and removing written regulations, standard operating procedures, and administrative policies and processes (Ahmad et al., 2012). Flexibility in organizations is extremely advantageous in enabling employees to search for new ideas and projects and helping them grow and develop their skills and talents, thereby encouraging intrapreneurship (Baruah and Ward, 2014b).

The communication system within the organization plays a key role in determining the effectiveness and the power of many cultural elements supporting intrapreneurship. In intrapreneurial organizations, communication systems need to be designed to reflect features such as openness and ease of interaction so as to facilitate idea generation and development (Filion, 1999). In this context, a transparent communication system will effectively support the flow and exchange of information and ease of sharing ideas (Haase et al., 2015). Good communication in terms of quality and quantity helps in introducing new ideas, familiarizing all staff with the latest industry trends, promoting interdisciplinary cooperation, and focusing the attention of employees and managers on the opportunities and threats in the external environment (Zahra, 1991). An effective communication system must transcend organizational structure and open the channel for employees to express their views and suggestion for improvement through a feedback system (Zhao, 2013). The CEO and top management are recommended to possess high communication skills to understand different employees and their capabilities and aspirations while maintaining a substantial level of interaction with all employees (Baruah and Ward, 2014b).

An important aspect of flexibility in an organization is offering time and location-independent job styles. Employees should be provided a level of autonomy to choose when and where to work, thus making a better work-life balance while being more productive (Gerards et al., 2021).

3.2.1.9 Teamwork

Innovation in many cases results from the effort of several parties and teams across the whole innovation process, from idea generation to commercialization. Teamwork enables the integration of individual skills into group work, hence increasing the collective capacity to innovate (Frederick et al., 2016). They say that when employees collaborate and work together, they have a better understanding of one another's skills and abilities, support utilizing the best experience of members, and provide the best support to each other (Frederick et al., 2016).

Innovation has more favorable results when teamwork involves different and cross-functional experiences of employees (Sun et al., 2012), resulting in more positive effects on cycle time and project performance when developing products, systems, software, and services (Marion et al., 2012), and spark valuable and incremental innovations (Ireland and Webb, 2007). Cross-functional work involves the development of skills and capabilities that are required to solve complex problems and the creation, planning, and realization of innovative projects (Weber et al., 2014). The cross-functional integration in an organization is associated with a high level of coworker cohesion and peer support, which will enhance communication and reduce conflict between team members and across the entire organization, ultimately accelerating the innovation process (von Treuer and McMurray, 2012).

A teamwork approach and supporting the overlap of different functions need to be instituted as a working style by the decision-makers so that learning takes place by joint action rather than by formal communication (Block and MacMillan, 1993). In this perspective, teamwork is facilitated by the overall social context, including effective networking and good individual relationship with other colleagues (Turro et al., 2016). Cross-functional work, when combined with a high level of communication within a flexible structure, will facilitate idea generation, knowledge sharing, and overall organizational learning (Hayton (2005), Menzel et al. (2007)).

3.2.2 Leadership and management support

All levels of management play a crucial role in driving intrapreneurial activities within established organizations. Management practices have a significant influence in driving the success of intrapreneurial organizations by integrating the intrapreneurial activity into the firm's systems and processes, which are very important to the employees willing to act intrapreneurially. Managers with the authority they possess can directly support their employees in exploring new opportunities, pushing their initiatives forward, and designing work procedures and processes to facilitate intrapreneurship (Moriano et al., 2014). Innovation level is impacted by management behavior and decisions that are manageable and can be discouraged or encouraged based on management actions (Nacinovic et al., 2009). According to Christensen (2005), managers might be the greatest impediment to intrapreneurs, as a single decision by them could potentially kill a project before it even has the opportunity to start. Intrapreneurship cannot take place without the support of the management team that initiates intrapreneurship by creating an atmosphere of intrapreneurship in an organization (Van Der Sijde et al. (2013), Toksöz,. (2021)). Therefore, organizations need to make a high investment in leadership and management to enable intrapreneurship within organizations (Menzel et al., 2007).

Management support is described as management's willingness to facilitate and influence intrapreneurship by encouraging employees to embark on innovative activities and believing that these activities involve some risk that needs to be taken (Neessen et al., 2019). According to Hornsby et al. (1993), management support reflects the extent to which management organized and structured itself to encourage employees to believe that innovation is a key role in any employee's job. Management support can be demonstrated through specific actions such as the quick recognition and acceptance of ideas, acknowledgment of employees who are the source of ideas, support for testing and small experimental projects, and securing financial support to get projects up and running (Hornsby et al., 1993). These findings indicate that the management level provides a structural power to '*make more of*' organizational factors that encourage and promote intrapreneurial actions (Hornsby et al., 2009).

The quality of the relationship between managers and their employees that is manifested in many forms is critical to promoting intrapreneurship. The closer the unit manager as a leader works with other

employees of the organization, the better possibilities they have toward stimulating intrapreneurship (Heinonen, 2003). An organization that promotes free debate and open discussion, as well as a strong relationship between managers and employees based on trust, is the kind of organization where employees might feel more comfortable taking risks and suggesting new creative and innovative ideas (McLean, 2005). Employees are more likely to participate in intrapreneurial activities and go beyond their job tasks when they trust both their team colleagues (horizontal trust) and managers (vertical trust) (Hughes et al., 2018). The actions and behaviors of employees are a reflection of the relationship and social exchange with their managers, where mutual trust is considered a crucial element in facilitating intrapreneurship in terms of stimulation of employees' innovative behaviors and personal initiative; thus, an employee can abandon formal procedures and organizational rules and get their manager's support when things go wrong or they make mistakes (Rigtering and Weitzel, 2013).

Moreover, if adequate communication is performed by managers to all workers, new initiatives and projects will be perceived more and adopted more positively (Badoiu et al., 2020). The concept that employees believe in their top management's willingness to recognize ideas with the potential for new opportunities must be regularly reinforced among employees so that they are not afraid or hesitant to voice their ideas and express their thoughts (Bhatia and Khan, 2013). Leaders as human beings must be open and honest about their weaknesses, such as their inability to provide interesting tasks or share exciting information at the right time. Such openness and transparency about this make intrapreneurs more confident to pursue new initiatives, take the risk associated with them, and increase the level of trust between them and their leaders (Deprez and Euwema, 2017).

Different layers of management have different roles to play in promoting intrapreneurship within an organization. Managers located at various hierarchal levels do not perform homogeneous functions and hence have a varied scope of management aspects and possess distinct roles to play in the strategic renewal of their business (Floyd and Lane (2000), Hornsby et al. (2009), Glaser et al. (2015), Mustafa et al. (2018)). Top management support, including the CEO and their direct subordinates, is essential for the successful integration and implementation of new technologies in organizations, the development of distinctive technological competencies and skills, and the incorporation of a learning culture based on a shared vision, group learning, and mental models (Bolívar-Ramos et al., 2012). Leaders' support can be demonstrated by their commitment to instilling an intrapreneurship philosophy through supporting employees' initiatives and encouraging collaboration and teamwork (Gupta and Srivastava, 2013). Leaders also should create or develop strategies and policies that will engage all employees and nurture innovation at all levels of the organization (Molina and Callahan, 2009).

Top management support may be demonstrated in different actions and practices. According to Menzel et al. (2007), they must encourage successful intrapreneurship among engineers by allocating human and financial resources and those as needed, such as rewarding engineers for intrapreneurial activities

regardless of the associated possibility of failure. The support of top management in terms of providing consistent efforts and patience, granting incentives, and developing an atmosphere conducive to intrapreneurship is critical to the success of complex projects that are long and full of risks (Toksöz, 2021). Management also needs to provide visible support and show commitment to their business. In this perspective, high-level managers can develop an intrapreneurial strategic vision and act on it, as well as stimulate the development of cultural norms that strengthen employees' commitment to the intrapreneurial strategic vision (Ireland et al., 2009). Management's strong commitment to intrapreneurship is a prerequisite for intrapreneurial activities within an organization, which is an additional step toward developing an intrapreneurship-friendly environment (Blanka, 2019). Seshadri and Tripathy (2006) were able to argue, after interviewing 30 managers from Indian companies, that top management is an important enabler of intrapreneurship. They noted that their support for the intrapreneurs, the freedom to fail, accepting mistakes, and spreading a learning environment all contribute to successful intrapreneurship (Seshadri and Tripathy, 2006). The top management should not only focus on attracting but also on retaining talented employees by giving them numerous opportunities to demonstrate their intrapreneurial potential (Bhatia and Khan, 2013). Block and MacMillan (1993) call senior management the organization's most significant advocate of innovation and new ventures. They are the most critical organizational factor that creates a corporate environment conducive to intrapreneurial ideas and action. Senior management within an organization is responsible for forming and implementing a strategy focused on achieving its goals (Kuratko et al., 2004).

According to Burgelman (1984), one of the principal duties of senior managers is setting the strategic and structural context of the organization in such a way that promotes intrapreneurship. Moreover, strategic leaders who are keen to sustain an intrapreneurial strategy need to create and reinforce an organizational culture with the right norms and values that support innovation characteristics and generate intrapreneurial behavior (Russell, 1999). In the view of Frederick et al. (2016), top-level managers must identify the elements of the organization's structure, control systems, and human resource management systems that inhibit or facilitate intrapreneurial behavior, then redesign these elements in a way to promote an 'innovation friendly' workplace that supports innovative-minded employees to reach their full potential.

It is not just senior managers who have the strategic responsibility for intrapreneurship orientation. Managers who are positioned in the middle of an organization's leadership structure need to be part of the organization's strategy through communication with senior managers. They have a major role in the successful implementation of the organization's strategies and goals as well as influence the operationalization of the intrapreneurial strategy (Kuratko and Morris, 2018). Misaligned strategic focus between levels of management will inhibit intrapreneurship (Aparicio, 2017). Middle-level managers act as promotors of innovation by linking and connecting ideas and strategies across different

levels and with the right people (Kuratko and Audretsch, 2013). Hence, an organization's ability to act more intrapreneurial is highly influenced by the commitment of its management to perform its intrapreneurial strategies.

Management style is a key variable in shaping the behavior of managers and their level of support for intrapreneurship. This, thereby, may affect how they engage and professionally manage the conditions that tune-up intrapreneurship. In this perspective, the management style determines the extent to which managers influence intrapreneurship by accepting and adopting employees' suggestions, advocating ideas, recognizing their subordinates' activities, allocating the necessary resources, and establishing supportive operating procedures (Antoncic and Hisrich, 2001). Transformational leadership is the style seen by many authors that could advance intrapreneurship. According to Moriano et al. (2014, p.106), Transformational leadership refers to *"The leader inspiring their followers to adopt the vision of the organization as if they were their own and focus their energy toward the achievement of collective goals".* Transformational leadership describes leaders who provide clear direction and a vision for achieving common goals, inspire and motivate employees to strive for successful results, and are keen to maintain a positive relationship with their subordinate employees (Gerards et al., 2021). Transformational leadership improves the overall level of intrapreneurship within the organization where leaders influence their followers, intending to achieve superior results in the short term or develop followers into leaders in the long term (Huang et al., 2021).

3.2.3 Intrapreneurial strategy

Intrapreneurship is seen by many scholars as a strategy to transform the organization into an intrapreneurial entity. In this perspective, the phenomenon describes a strategic vision that represents the organization's commitment to innovation and entrepreneurial activities and behavior that draws the future picture of the business (Ireland et al., 2009). For Kuratko and Hornsby (1990), intrapreneurship is a growth strategy to obtain a competitive advantage where the first step in planning a strategy is to share the organization's vision of innovation with all employees so that they can understand and act on it. A corporate entrepreneurship strategy is defined as a *"vision-directed, organization-wide reliance on entrepreneurial behavior that purposefully and continuously rejuvenates the organization and shapes the scope of its operations by recognizing and exploiting entrepreneurial opportunities that are oriented to innovation"* (Ireland et al., 2006, p.21).

Intrapreneurship is more powerful when it is aligned with the organization's strategic goals and when employees are empowered by being given a clear vision of the future that helps in decision making, increases commitment, and motivates employees to action (Oosthuizen and van der Merwe, 2009). Articulating successful intrapreneurial strategies requires sharing and communicating the business strategy and the future vision of the corporate while incorporating all employees at any level to be an

integral part of achieving the vision and goals (Mokaya, 2012). This, according to Frederick et al. (2016), is the initial stage in planning an intrapreneurial strategy to share the vision of innovation with employees seeking high achievement. Some of the activities attached to forming and enacting a strategic mission and goal include analysis, planning, decision making, strategic management, sharing value system and corporate vision, and many other aspects of the organization's culture (Dess et al., 1997). Pinchot and Pellman (1999) conclude that effective innovation organizations should be:

- Providing a focused, shared, and cross-boundaries vision that guides the intrapreneurial spirit of the organization
- liberating the intrapreneurs to achieve that vision and focus on a coherent strategy

Pinchot and Pellman (1999) affirm that to communicate the vision and strategy successfully, the organization needs to communicate confidence in the overall direction by being completely open-minded about how to achieve the ultimate goal and allowing all employees to contribute to the shaping and elaboration of the vision, thus increasing their level of commitment. According to Filion (1999), when employees are committed to their jobs, they feel that the business belongs to them and consider themselves owners of the business so as to continue to evolve and grow within the organization.

The concept of 'strategic intrapreneurship' recently emerged by combining two main fields; intrapreneurship and strategic management, and referring to strategic entrepreneurship in an established organization. Strategic entrepreneurship is the means by which organizations can maximize entrepreneurial capability through strategic management (Smith et al., 2016). The concept integrates entrepreneurial aspects such as opportunity searching and strategic perspectives such as advantage-seeking in order to form and execute wealth-creation intrapreneurial strategies (Ren and Guo, 2011). It also involves actions concentrated on exploiting current advantages and exploring new opportunities resulting in values for both individuals and organizations (Hitt et al., 2011). If strategic intrapreneurship is effectively utilized and implemented, the organization will be able to manage and use its resources and capabilities more efficiently, resulting in a business that will grow and sustain its success in a competitive environment (Guven, 2020). The intrapreneurial strategy has a certain focus on the process of innovation by acting as an ongoing management process for proactive exploration of new opportunities and for maintaining a persistent pattern of innovation-related activities and resource allocation (Russell and Russell, 1992). While such strategies among different organizations vary in their degree of entrepreneurial intensity, they should be considered from the view of continuous activities (Frederick et al., 2016).

Both strategic entrepreneurship and strategic management should not be merged and need to be allowed to exist independently of each other since they differ in terms of their focus and, to some extent, in relation to outcomes (Stokvik et al., 2016). More specifically, Stokvik et al. (2016) explain that

developing intrapreneurial culture is a significant focus of strategic entrepreneurship but not one that strategic management should develop. Barringer and Bluedorn (1999) studied strategic management practices and their influence on intrapreneurship. The results show that 'scanning intensity' to recognize opportunities and threats is an essential strategic practice and correlate positively to the firm intrapreneurial behavior. A strong relationship also exists between 'planning flexibility' (which represents the organization's ability to change its strategic plan to adapt to environmental change) and intrapreneurship. The positive relationship between 'locus of planning' (refers to the extent by which employees engage in the strategic planning activities) and intrapreneurship intensity reflects a high level of employee participation in the planning process, thus increasing opportunity recognition (Barringer and Bluedorn, 1999).

The literature has offered some of the theoretical models of firm-level intrapreneurial activities that incorporate the intrapreneurial strategy with the conceptual theories of management and entrepreneurship. Russell and Russell (1992) provided an experimental model using a sample of 77 strategic business units. The model (provided in Figure 3.1) considers entrepreneurial strategy as process-oriented by explaining its relationship with the internal and external factors of the firm. Entrepreneurial strategy is seen as a direct function of three main elements, organizational structure, environmental uncertainty, and organizational culture represented by innovation-related norms, but they have different influences. A strong and direct correlation was observed between organizational culture and successful entrepreneurial strategies. A high level of environmental uncertainty characterized by the change in customer demands, industry-related technology, or strategic relationship between competitors generates more innovations by providing a richer source of potential opportunities. Both environment uncertainty and organization structure have a direct effect on the entrepreneurial strategy and an indirect effect through their impact on innovation norms.

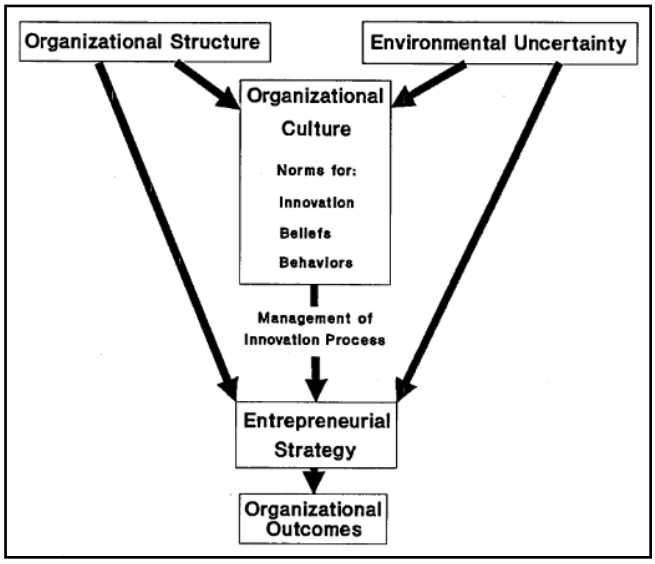


Figure 3.1 Initial model for corporate entrepreneurial strategy (*Russell and Russell, 1992)*

Frederick et al. (2016) conceptualize intrapreneurship strategy by providing the ABC model that is adapted from Ireland et al. (2009) model for entrepreneurial strategy (illustrated in Figure 3.2).

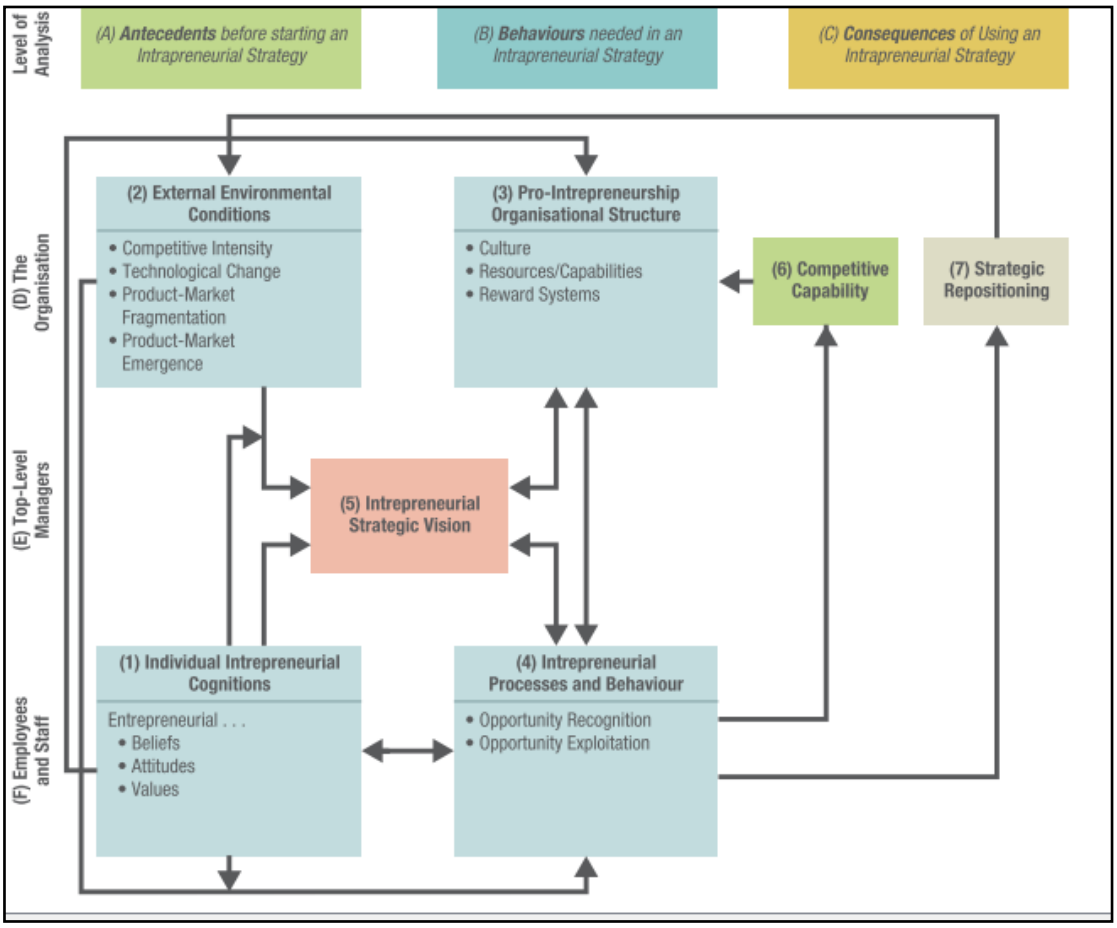


Figure 3.2 The ABC model, conceptualizing intrapreneurship strategy (Frederick et al., 2016), adapted from Ireland et al. (2009)

At the heart of the model is the intrapreneurial strategic vision by top management that acts as the engine for the different parts of the model made up of the three levels of analysis: Antecedents (A), Behaviours (B), and Consequences (C), and three different Operational Levels, the organization itself (D), Top-Level Managers (E) and the Employees and Staff (F).

The intrapreneurial strategy is reflected by the existence of three internal components: an intrapreneurial strategic vision, a pro-intrapreneurial organizational architecture, and intrapreneurial processes and behavior as seen across the organizational hierarchy. The intrapreneurial strategy contains a philosophical component, which is represented by an intrapreneurial strategic vision that accompanies and stimulates a pro-intrapreneurial organizational architecture as well as intrapreneurial processes and behavior (Ireland et al., 2009).

Frederick et al. (2016) assert that in the absence of an intrapreneurial strategic vision, the element of pro-intrapreneurship organizational structures (culture, resources, and reward system) are unlikely to

take shape, as there will be no overriding philosophical explanation or perspective approved by top management that encourages intrapreneurial thoughts and actions throughout the organization. Frederick et al. (2016) further explained that an intrapreneurial strategy differs from other kinds of strategies that interact with many other organizational aspects and must continuously encourage intrapreneurial behavior. Therefore, it may take a longer time to evolve where it requires more than just one decision, act, or event. It requires the creation of congruence between the intrapreneurial vision of the organization's leaders and the intrapreneurial actions of those throughout the organization, as facilitated through the existence of a pro-intrapreneurial organizational structure (Frederick et al., 2016).

The literature reviewed so far demonstrates a wide range of organizational factors for promoting intrapreneurship, which leads to many components that exist across various concepts and theories. To enrich the understanding of the concept of intrapreneurship and its influential factors, the following section will explore the developed models of intrapreneurship among theoretical studies and empirical research derived from the intrapreneurship literature.

3.3 Conceptual models of intrapreneurial organizations

There have been a number of researches conducted regarding the formation of environmental conditions in the context of developing intrapreneurship. While many scholars have investigated such factors extensively, few components are consistent among such developed models. These models have been emerging in different contexts and from different perspectives, which will be explained in this section.

The earliest studies started since the term intrapreneurship was introduced. Kanter (1985) introduced facilitating conditions for companies desiring to implement intrapreneurial management. The study was based on the literature review and the empirical study of twelve companies that varied in their innovative intensification (six high innovative companies and six low-level innovative companies). The facilitating conditions as per the results are related to 'Jobs' when defined broadly rather than narrow and when tasks focus on results and achievements rather than rules or procedures to be followed; an 'organization structure' based on small teams or units that have a strong connection and relationship with other organization functions to strengthen interdisciplinary integration; a 'culture' that place a high value on employee and invest in developing their capabilities through training and development. Kanter (1985) described it as a 'culture of pride' that rewards good efforts and high levels of achievement based on management's high respect for their employees and continuous recognition, praise, and acknowledgment of their employees' innovative activities. And finally, 'Tools' that support the process of transforming ideas into innovative actions are represented by information shared with everyone through open communication, collaboration among teams, and resource availability such as time, experimentation, and financial support for innovative activities.

Kuratko et al. (1990) reviewed the literature from the late-1980s until 1990. They have noticed the wide variety of intrapreneurial enabling factors and summarized the focus of the literature on five main common factors:

- A reward system that is effective and takes goals and feedback into account, and focuses on individual responsibilities and their achievements
- Management support for intrapreneurship which is related to the willingness of managers to facilitate and support intrapreneurial projects
- Resource availability for intrapreneurial activities, including time
- An organizational structure that manifests itself in various ways
- And risk-taking demonstrates the willingness of employees and managers to take risks and tolerate failures

In their approach to developing an instrument that diagnoses the degree of intrapreneurship culture within a corporate setting (called the Intrapreneurial Assessment Instrument [IAI]), Kuratko et al. (1990) hypothesized five factors that summarize the major factors of intrapreneurship in an organization as found consistent in the literature. These factors were:

- Management support for intrapreneurship
- Reward and resource availability
- Organizational structure and boundaries
- Risk-taking
- and Time availability

Accordingly, they conducted a study to test the five conceptual factors using a sample of 111 firms in the USA listed in the Fortune 500 firms in the Midwest of the USA. The selected firms have moved recently into a less regulated environment, which potentially can allow them to develop innovative products and services. The data were collected through surveys from low to mid-level managers sample. Kuratko et al. (1990) determined that among the five factors, just three factors were found significant to fostering intrapreneurship; management support, organizational structure, and resource availability. They considered these factors as initial steps that guide organizations toward intrapreneurship.

This preliminary empirical research demonstrates the foundation of a multidimensional framework for developing an intrapreneurial culture within organizations. While the study of Kuratko et al. (1990) did not validate all the hypothesized five-factor model, it emphasizes the importance of additional research in this field in exploring the internal organizational factors that foster entrepreneurship.

Zahra (1991) conducted an exploratory and extensive study using 119 industrial firms selected from the Fortune 500 list in the USA. These firms are on the cutting edge in developing intrapreneurship. Data

were collected through a questionnaire targeting CEOs and executive teams. Zahra (1991), in his study, has combined environmental, strategic, and organizational variables (As presented in the model illustrated in Figure 3.3). This study examined several internal organizational factors, both tangible and intangible factors, that can hinder or influence an organization's pursuit of intrapreneurship. Here the focus is on the internal intrapreneurship of Zahra's study, which he refers to as covering internal activities targeting to expand the product, process technology, and administrative innovation.

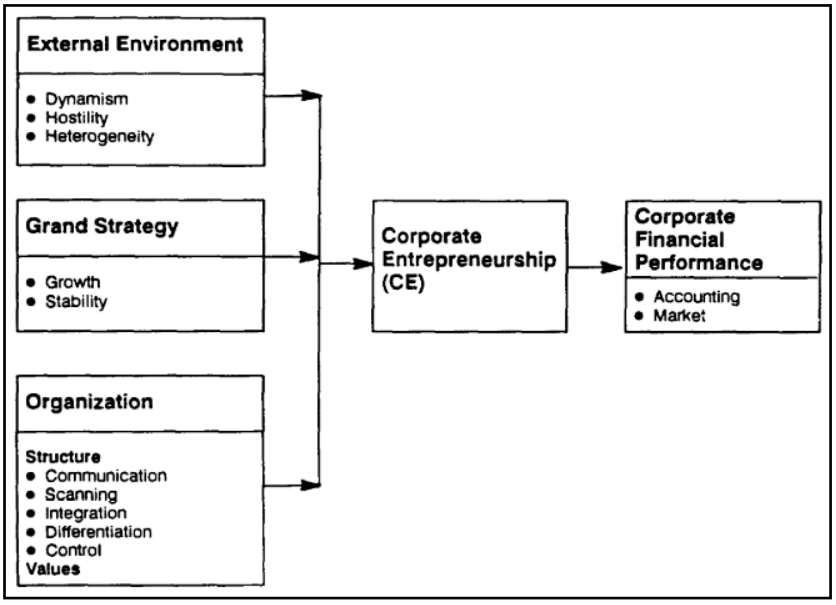


Figure 3.3 A model of predictors and financial outcomes of Intrapreneurship (Zahra, 1991)

Tangible factors are related to the formal organizational structure represented by communication, scanning, integration, differentiation, and control variables. In more detail, formal communication associated with high-quality help both managers and employees in the process of creating new ideas, focusing attention on exploring opportunities, keeping employees updated about the market trends, and promoting interdisciplinary cooperation.

Scanning represents the formal activities to collect and analyze information about the external environment, industries trend, and competitors, which supports the executive team to anticipate threats and opportunities to decide upon and act on.

Integration refers to the formal organization activities to connect different units or levels within the hierarchy that help in exchanging information and facilitate support among teams. Differentiation reflects the division of labor within the company in a way that builds commitment and specialization to areas of expertise and profession, which allow employees to be more familiar with the objectives and goals of their unit and organization. This facilitates communication and sharing of ideas and knowledge.

Formal control enables the organization to differentiate between selecting promising opportunities and projects from the less valuable ones. Also, control demonstrates the existence of formal channels to receive formal support for new ideas.

Intangible factors are related to organizational values that describe the managerial philosophy and formal norms that support employees' behavior consisting of 'individual centered' values. These focus on how firms treat and view their employees, involving aspects such as promoting individual creativity, creating a climate that integrates employees with company goals and strategy, and increasing their commitment. The other form of organizational value is 'competitive values', which reflects the approach that management and employee follow in achieving company goals and adapting to environmental changes, including observing industry trends, experimenting with new ideas, and taking advantage of emerging opportunities in the market.

The result of Zahra's (1991) study indicated different relations among these factors associated with intrapreneurship. For organizational structure, it was found that formal communication, scanning, and integration were significantly and positively associated with intrapreneurship, while differentiation and increased formal controls have a negative impact and may hinder intrapreneurship. Moreover, articulating clear organizational values, whether they pertain to employees or competitions, is positively associated with corporate entrepreneurship.

According to Zahra (1991), the intensity of corporate entrepreneurship is also influenced not only by internal organizational factors but also by corporate strategy and factors from the external environment such as dynamism, hostility, and heterogeneity. Zahra advocated for the conduct of further research to investigate managers' roles in establishing an organization that is conducive to intrapreneurship.

Hornsby et al. (1990) expanded and strengthened the initial research by Kuratko et al. (1990) by increasing the number of managers involved in the sample size and the number of items included in the IAI. The study identified five main factors; management support, autonomy/work discretion, rewards/ reinforcement, time availability, and organizational boundaries, which are more compatible with the existing literature. In a later study, Hornsby et al. (1992) developed a revised version of the IAI called the Corporate Entrepreneurship Assessment Instrument (CEAI) by increasing the sample of managers and supervisors who participated in the study, resulting in a more reliable CEAI tool with more elements involved for each factor. Hornsby et al. (1993) reviewed the literature and developed their work from 1990. They created a theoretically interactive model including individual and organizational aspects that lead to developing intrapreneurial behavior within an organization, as presented in Figure 3.4.

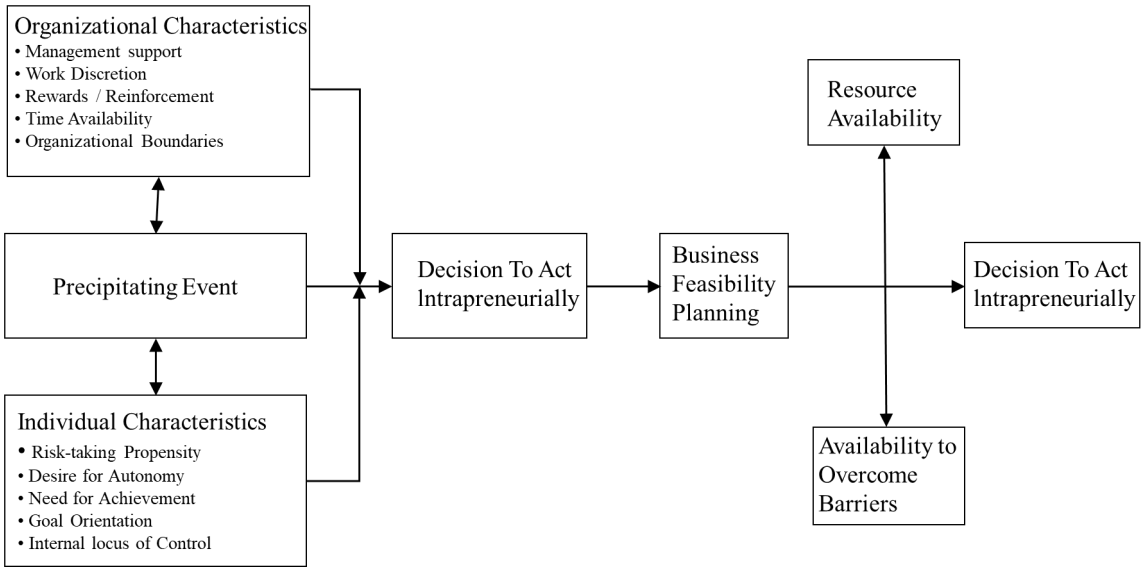


Figure 3.4 An interactive model of intrapreneurship by Hornsby et al. (1993)

The organization factors in this theoretical model are developed in their contents and meanings. These factors are related to management support, work discretion, reward/reinforcement, time availability, and organizational boundaries. Hornsby et al. (1993) also indicate that individual characteristics representing the personality and traits of employees, such as risk-taking propensity, desire for autonomy, need for achievement, goal orientation, and internal locus of control, have a significant influence on intrapreneurship.

The decision to act more intrapreneurially is a consequence of the interplay between organizational characteristics, individual characteristics, and precipitating events. The latter is related to environmental factors such as hostility, dynamism, heterogeneity, and organizational changes such as the development of new processes, management change, economic change, and cost reduction (Hornsby et al., 1993).

Covin and Slevin (1991) developed an integrative and conceptual model of intrapreneurship as an organizational level concept and firm behavior for large firms, presented in Figure 3.5. The factors influencing intrapreneurship include external, strategic, and internal variables. The internal enablers are related to top management values and philosophies, describing their beliefs, value structure, and philosophy that influence strategic decisions; organizational resources and competencies serve as the foundation for all organizational activities and actions related to monetary resources, plant and equipment, functional level capabilities, organizational capabilities to introduce new products in the market, and the effectiveness of the marketing research system; organizational culture demonstrates the shared set of values, beliefs, attitudes, and assumptions that influence employees to do and shape their behavior in an organization. A positive culture is one that is aligned with the organizational vision, mission, and strategies; and finally, an organizational structure defines the departments and work units

within the firm, which determines how workflow, communication, and authority are demonstrated in the organization.

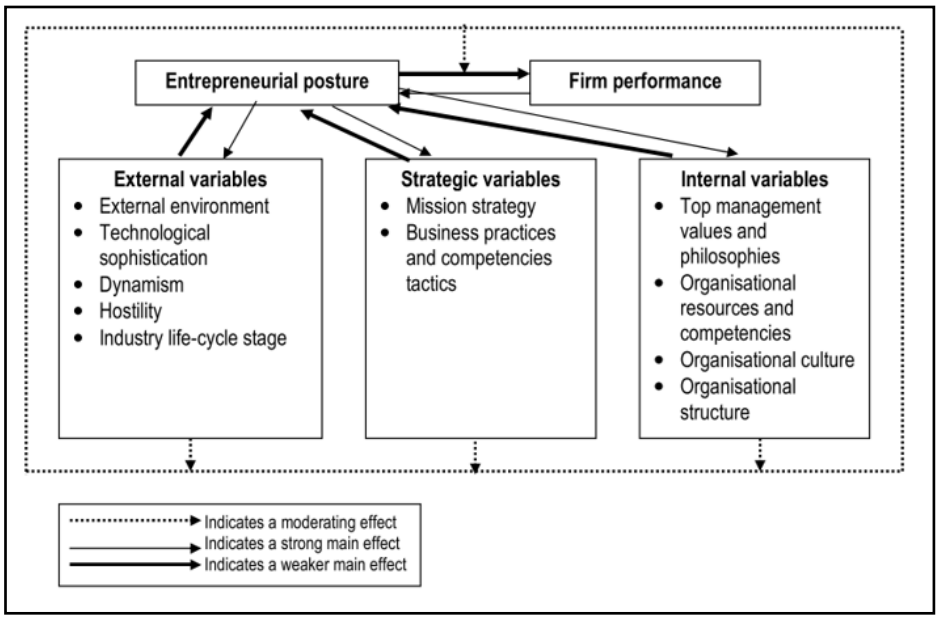


Figure 3.5 A conceptual model of entrepreneurship as a firm level by Covin and Slevin 1991

Covin and Slevin's (1991) model is unique in that it added strategic variables such as mission strategy that determine the overall strategic philosophy and orientation of the organization. Their analysis showed that a growth strategy influences intrapreneurship. The second strategic variable involves the business practices and competitive tactics that translate how the business-level strategy will be executed at the different functions in the firm.

This model also expresses how these factors relate to the entrepreneurial posture, which illustrates the firm's intrapreneurial behavior, including management's decision to take risks in strategic action and investment decisions, innovativeness and tendency toward technological leadership, and proactiveness of the firm to compete in the market. One of the main limitations of this model is its generalizability and applicability to all business organizations. This theoretical model is not applicable to all business organizations. It is more suitable for large organizations and is less suitable for small businesses, where the organization structure has less influence on entrepreneurial posture. At the same time, numerous variables defined explicitly in the theoretical model represent broad constructs operating with a great degree of generality (Covin and Slevin, 1991).

Zahra (1993) expanded on Covin and Slevin's (1991) integrative model by focusing on examining the association between the firm intrapreneurship and the external environment. The model is presented in Figure 3.6. Zahra (1993) argues for the narrower classification of external factors. He removed the technological sophistication from Covin and Selvin's (1991) model and added 'environmental munificence', by which he means the richness of innovative potential in a certain industry as a multi-

dimensional concept representing the external environment. The revised internal set highlights four main variables:

- Managerial values and backgrounds such as age, previous experience, and functional expertise
- Organizational structure is represented by features of centralization, formalization, complexity, and organicity
- Managerial process, including participation and fairness
- Organizational culture, including openness and empowerment

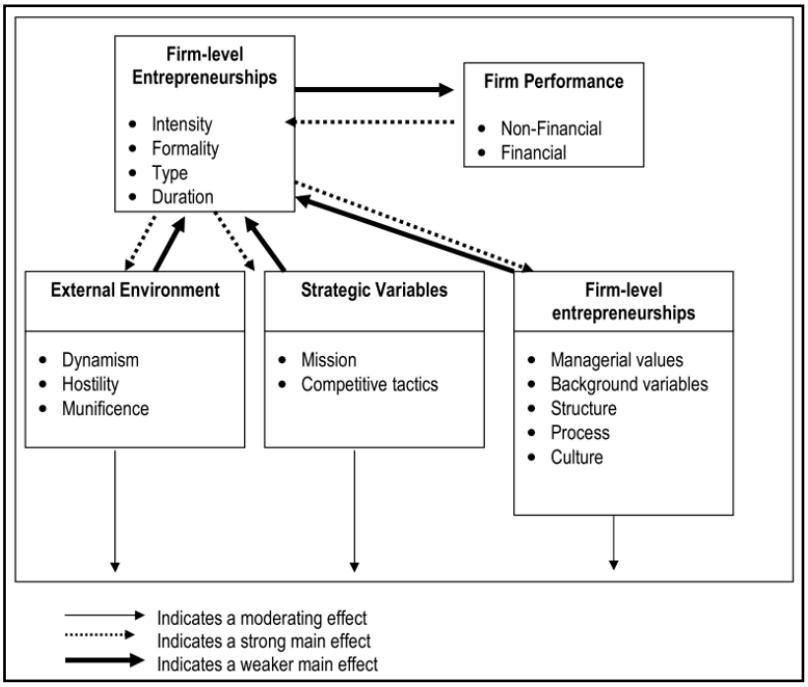


Figure 3.6 Firm-level entrepreneurship by Zahra (1993)*, revised from Covin and Slevin (1991)*

Antoncic and Hisrich (2001) reinforce the results from Zahra (1991) by conducting a cross-national study between the USA and Slovenia. The factors influencing intrapreneurship are related to internal and environmental dimensions, as illustrated in Figure 3.7.

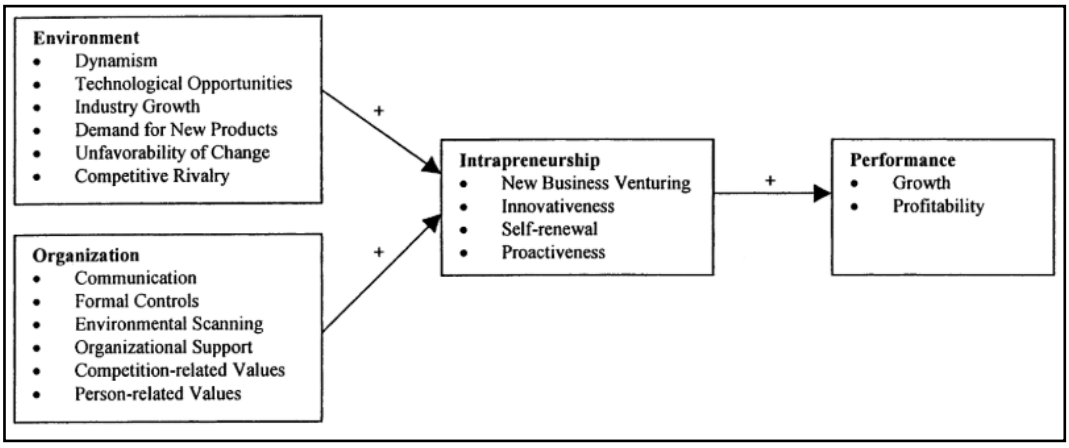


Figure 3.7 The theoretical model of Intrapreneurship (Antoncic and Hisrich, 2001)

The aim of Antoncic and Hisrich's (2001) study is to generalize the intrapreneurship factors across countries. Data were collected through a survey using a sample of 192 firms consisting of a mixture of medium and large sizes from various industries.

The organization represents the internal environment and acts as the intermediate context in which intrapreneurship can flourish. The authors identified different dimensions as internal influencing factors for intrapreneurship:

- Open communication with high-quality information sharing
- The use of formal controls to evaluate intrapreneurial activities and project selection
- Environmental scanning focuses on forecasting the industry environment and economic changes
- Organizational support of management in terms of providing training, trust, rewards, and time
- Organization values in terms of values/beliefs and visions of strategic leaders focus on competition and person-related values related to the attitude of the individuals

These factors were tested in relation to intrapreneurship in terms of business venturing, innovativeness, self-renewal, and proactiveness that lead to more profit and business growth. The results indicate that all six factors are positively and significantly related to the influence of intrapreneurship within organizations. Antoncic and Hisrich (2001), in their study, affirmed that intrapreneurial activities and orientations are essential for the performance of existing firms. These factors can be more effective as they are, to a large extent, managed directly or indirectly by management, which should be considered when creating the appropriate intrapreneurial strategy for the organization. Despite the effect of organizational factors following similar patterns on intrapreneurship in both countries, they have different importance among them. The model provided by Antoncic and Hisrich (2001) considered organizational factors as a proposition and does not include to which degree how they are useful and productive.

Hornsby et al. (2002) empirically investigated the organization's internal factors that influence middle managers to engage with intrapreneurial activities. Data were collected through a survey from 761 middle managers working in 17 organizations from different industries such as manufacturing, service, and finance throughout the USA and Canada. Their study was driven by the lack of consensus in the literature about the key internal organizational factors that stimulate intrapreneurship. The study started by reviewing the recent convergence factors in the literature that influence intrapreneurship within organizations. Hornsby et al. (2002) conceptualized five main factors:

- The existence of an appropriate reward system that focuses on individual tasks and achievements. This will also encourage middle managers to take on the risks involved with entrepreneurial activities
- Management support reflects managers' tendency to facilitate and foster entrepreneurial activity by championing innovative ideas, securing necessary resources and expertise, and integrating the entrepreneurial activity within the firm's system and processes
- Resources availability includes the availability of time and encouraging experimentation
- A supportive organizational structure that enables the process of evaluating, selecting, and implementing ideas
- The final dimension is risk-taking, which indicates the middle managers' willingness to take risks and tolerate failures when they happened

Figure 3.8 illustrates the model developed by Hornsby et al. (2002). This empirical study indicates the

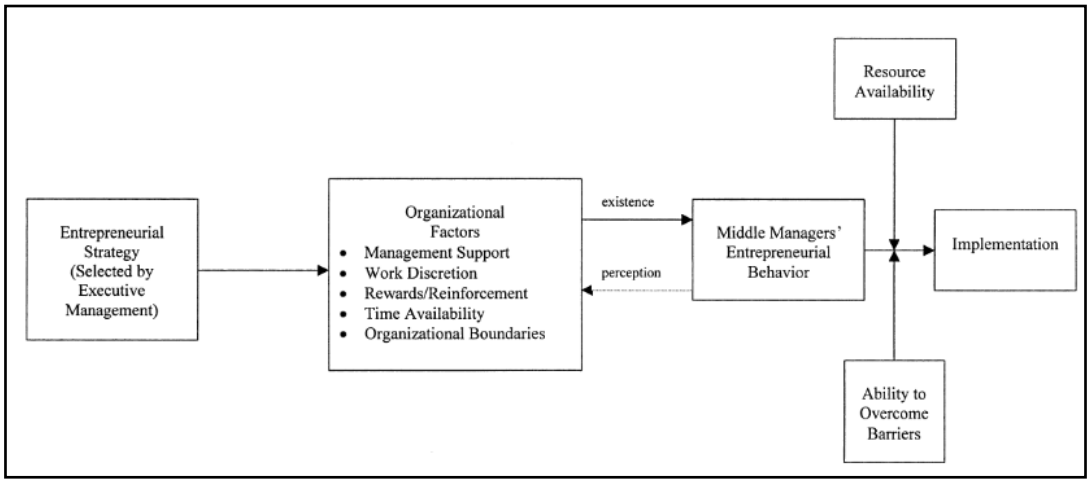


Figure 3.8 Middle manager's perception of the internal environment (Hornsby et al., 2002)

existence of five significant organizational factors that influence middle managers to foster entrepreneurial activity within established firms; management support, work discretion/ autonomy, rewards/reinforcement, time availability, and organizational boundaries. These emerging factors are titled and labeled differently from the five conceptualized factors based on the elements that comprise them. These represent a parsimonious description of the internal organizational factors that influence middle managers to foster entrepreneurial activity within established companies. The study highlights that these internal factors are affected by the entrepreneurial strategy developed by higher management.

Other researchers have explored different conditions and enablers by integrating external environment and internal organizational factors. A study demonstrated in Figure 3.9 was conducted by Antoncic and Hisrich (2004) using a large sample of 477 Slovenian firms.

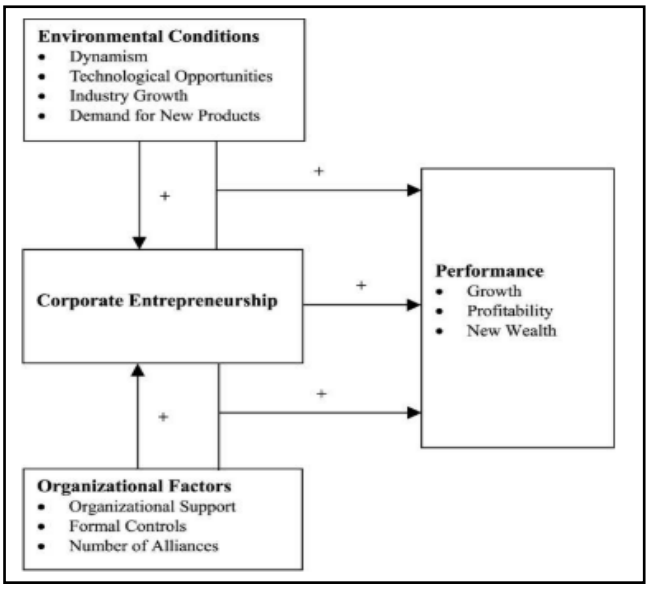


Figure 3.9 Model of intrapreneurship and wealth creation (Antoncic and Hisrich, 2004)

The results showed that strategic alliances, represented by the relationship of the firm to other firms in the form of customer-supplier relationships, licensing, technology sharing, joint development, and joint ventures, are essential organizational elements in fostering corporate entrepreneurship. This is combined with another two factors of formal controls and organizational support (represented by management support, work discretion, rewards, time availability, and flexible intra-organizational boundaries), which are all collectively found strongly conducive to intrapreneurship and consequentially have a direct effect to enhance the firm performance and wealth creation. Environmental conditions such as dynamism, technological opportunities, industry growth, and demand for new products are critical in relation to intrapreneurship. The study highlights that management support, among all examined organizational factors, is the most important and has the most substantial influence on intrapreneurship.

The study conducted by Antoncic and Hisrich (2004) was driven by the limitation of previous studies concerning a small sample size, which affects the generalization of findings and test of the phenomenon outside the USA. That data were collected from firms that had more than 30 employees as it was biased toward large firms that were 21 to 50 years old and operating in the manufacturing sector. Data were collected from one executive manager in each firm using an email survey.

Antoncic and Hisrich (2004) emphasize that the developed model in this study is not totally comprehensive because it has a limited number of components. It can be further extended by examining other organizational elements such as structure, communication, values, and individual characteristics of intrapreneurs and senior managers.

In a qualitative and single case study of Danfoss Drives, a Danish engineering and industrial company with 17000 employees, Christensen (2005) builds upon the factors from the studies of Kuratko et al.

(1990) and Hornsby et al. (2002) and studies intrapreneurship involving three levels of analysis: the firm (strategy and performance); employees (their interaction); and the use of factors (tracing different enablers) to provide deep analysis and multiple perspectives of intrapreneurial behavior. Data were collected using four interviews with employees from different positions and site observation. The study concluded that the five common enabling factors identified in the literature (rewards, management support, resources, organizational structure, and risk-taking) are insufficient to facilitate intrapreneurship in knowledge-intensive companies. Three other factors emerged from the case study:

- Communication is related to aspects such as having one main common language used by employees, using informal general communication where face-to-face interaction is the most preferred one to use, availability of information about products, developing a standard information structure for meetings and reports, and frequent physical meetings on the group and team level where employees can interact and collaborate.
- Culture is represented by exhibiting an innovative culture where innovation is not restricted to the R&D team. Therefore, ideas will be generated across the entire firm and get supported by all internal functions. This culture is associated with management practice to decentralize decision-making and delegation of authority that increase the level of commitment from employees and create more flexibility.
- The third factor is the process where the firm puts in place several rules and procedures to manage projects and ways of working to ensure high quality. These processes are frequently reviewed and developed to give better results.

The case of Danfoss shows that enabling intrapreneurship is related to the existence of eight factors that are not of equal importance or propose to influence intrapreneurship directly, but they interact to enable intrapreneurship. Adopting an entrepreneurial strategy will increase the effectiveness of utilizing these factors and integrating them together in a way to enhance the level of intrapreneurship within the firm. The case indicates that other firms may develop different factors as each one has its own context. The study clearly shows that firms that belong to different industries require different intrapreneurial setups and enabling factors.

Using a sample of 458 managers at different hierarchal levels within their companies, Hornsby et al. (2009) investigated the perception of the five intrapreneurial factors from the literature (management support, work discretion, rewards/reinforcement, time availability, and organizational boundaries) and how they encourage intrapreneurial activities of managers represented by the number of intrapreneurial ideas implemented. Managers from different levels in their organizations, including first, middle, and senior-level management, participated in this study. Hornsby et al. (2009) found that these organizational factors have different effects on the number of intrapreneurial ideas implemented across managers, and they influence managers at different structural levels to different degrees. In more detail,

senior and middle managers, in particular, were more inclined to execute entrepreneurial ideas than frontline managers. The findings also show that among the five factors, only three factors (management support, rewards/reinforcement, and work discretion) were found to correlate substantially with the number of intrapreneurial ideas implemented by middle and top-level managers.

In a study to assess the firm-level entrepreneurship in developed countries and emerging economies, de Villiers-Scheepers (2012) conducted a study in South Africa involving firms of all sizes from the ICT industry. Most firms are older than seven years and employ more than 100 employees. In this study, information was collected through a survey, and participants were recruited from different managerial positions, including the Chief Information Officer, Information Technology Manager, the CEO, and Sales Managers. He assessed the five factors mostly applied in developed countries (management support, autonomy, rewards, time availability, and organizational boundaries). The study results show that two factors, organizational boundaries and time availability, did not have a significant correlation with entrepreneurship. The study also concludes that entrepreneurial behavior within organizations depends on the economic context and conditions in which they are applied.

Hughes and Mustafa (2017) conducted a qualitative study using a multiple case study approach to examine the five common antecedents for creating an internal environment conducive to entrepreneurship (top management support, time availability, rewards/reinforcement, work discretion/autonomy, and organizational boundaries) in the context of SMEs in developing economy. The four case studies were selected purposefully from various industries (tourism, retail/sales, ICT, and health and safety and distribution) operating in the services sector in Kenya. Hughes and Mustafa (2017) show that internal settings for intrapreneurship in Kenyan SMEs are much more interactive and sophisticated than those currently described in the literature or firms from developed countries in the west, particularly cultural and contextual factors. The findings show that only two of the five traditional antecedents, namely top management support and organizational boundaries, are significant for promoting intrapreneurship within SMEs in the Kenya service sector. Furthermore, they were applied and carried out in ways that were distinct from those described in the literature.

A single case study of a new technology-based firm (NTBF) was also conducted by Badoiu et al. (2020) to gain a better understanding of organizational factors and personal motivations of intrapreneurs that may support intrapreneurial behaviors among employees. The selected firm is a five-year-old and is classified as a small firm with a total staff of 37 employees operating in the ICT sector in Spain. Data were collected through semi-structured interviews with the founders, high-level managers, and intrapreneurial employees. The study examines the five factors of the CEAI (top management support, work discretion, rewards and reinforcement, time availability, and organizational boundaries) that support engaging employees in intrapreneurial activities. Badoiu et al. (2020) build on the interactive model by Hornsby et al. (1993) that combines both organizational and individual factors of

intrapreneurship. The results illustrate that management and individual intrapreneurs have different perceptions of the supportive factors. Founders score higher positive perceptions than intrapreneurs on three factors, namely management support, rewards/reinforcements, and organizational boundaries, while they have a lower perception of time availability. All five factors were found relevant for managers and employees, but they have different degrees of importance. Work discretion is the most valued dimension for both founders and intrapreneurs. Top management support and rewards were also significant for both. Founders and intrapreneurs place less importance on time availability and organizational boundaries than other factors.

Toksöz (2021) conducted a comparative study using a mixed-method to investigate intrapreneurship culture in the context of engineering firms in the USA and Germany using a sample of 50 firms of different sizes in each country. The study utilized the CEAI tools to examine the five common factors that impact intrapreneurship; organizational boundaries, work discretion/autonomy, rewards/reinforcement, time availability, and management support. The study identified three main factors across both countries that might hinder intrapreneurship. These factors are lack of communication, insufficient support from upper management, and lack of an adequate reward system. Managers in both countries recognize the significance of intrapreneurship for their respective organizations. However, from the employees' perspective, they have less perception of intrapreneurship than management. The results indicate that engineering firms in the USA support intrapreneurial behaviors more than those in Germany. Such results are rooted in cultural differences between the two countries, where culture plays a critical role in determining or promoting intrapreneurial behavior within the organization. Thus, employees in Germany demonstrate less intrapreneurial behavior compared to those in the USA. More specifically, in contrast to their American counterparts, German employees and managers dislike an uncertain work environment that provides greater independence and flexibility. Similarly, American employees are more individualistic than German employees and managers. Therefore, they can do better when it comes to individual intrapreneurship behavior than the employees in Germany.

A study by Ahmad et al. (2012) was conducted using Malaysian manufacturing companies operating in sectors like manufacturing semiconductors, hard drives and personal computers, and two-way radio production. A total of 263 employees took part in this study, including engineers and managers. The findings highlighted four organizational factors that positively affect intrapreneurship and may encourage intrapreneurship behavior among employees. These factors are management support, work discretion, reward and reinforcement, and time availability, whereas organizational boundaries have lesser effects.

The study of Orchard et al. (2018) examines the relationship between managers and their employees and the extent to which it influences the organizational environment through the five main factors of

intrapreneurship; organizational boundaries, work discretion/autonomy, time availability, management support, and rewards/reinforcement. This study utilized nine SMEs selected randomly from the technology industry within the UK. Data were collected using a survey from 162 participants from these firms. The results show that the leader-employee relationship significantly and positively influences the entrepreneurial environment through the employee's perception of the degree and level of the presentation of the five factors within the firm. This study was unique in that focusing on a specific industry and company size.

Table 3.1 below summarizes the main models and empirical studies derived from the literature on intrapreneurship theories, showing the internal organizational factors and a brief on the study detail such as methodology and sampling wherever relevant.

Author	Organizational model/study (internal intrapreneurial factors)	Study detail and design/ Methodology/ Sample size
Kanter (1985)	• Jobs • Structure • Culture • Power tools	Studying the facilitating conditions for companies willing to implement intrapreneurial management. This empirical study includes twelve companies that varied in their innovative intensification (six high innovative companies and six low-level innovative companies)
Covin and Slevin (1989)	Performance among small firms in hostile environments was positively related to: • Organic structure • An entrepreneurial strategic posture • A competitive profile that is characterized by a long-term orientation, high product/service prices, and a concern for predicting industry trends	The study consists of 161 small manufacturing companies (representing 25 different industries) in the USA. The number of employees in these firms ranges from 5 to 500. Data were collected through a survey where the questionnaire was mailed to the senior-most managers
Kuratko et al. (1990)	The study tested the five conceptual factors (management support, reward and resource availability, organizational structure and boundaries, risk-taking, and time availability). Only three factors were found relevant for fostering intrapreneurship: • Management support • Resource availability (including time) • Organizational structure	The study aims to develop an instrument that diagnoses the degree of intrapreneurship culture within a corporate setting (IAI). The study utilized a sample of 111 firms in the USA listed in the Fortune 500 firms. Data were collected through surveys from low to mid-level managers
Zahra (1991)	Structural tangible factors: • Communication • Scanning • Integration • Differentiation • Control Intangible factors that refer to dominant organizational values: • Individual-centered values • Competitive values	The model posits that a combination of environmental, strategic, and organizational-related variables jointly influences intrapreneurship efforts. Organizational-related variables include tangible and intangible factors. The study used a sample of 119 industrial firms selected from the Fortune 500 list in the USA. Data were collected through a questionnaire targeting CEOs and executive teams

Author	Organizational model/study (internal intrapreneurial factors)	Study detail and design/ Methodology/ Sample size
Hornsby et al. (1990), Hornsby et al. (1992) and Hornsby et al. (1993)	A theoretical and interactive model of intrapreneurship. Organizational factors are: • Management support • Autonomy/work discretion • Rewards/reinforcement • Time availability • Organizational boundaries	Hornsby et al. (1990) expanded and strengthened the initial research by Kuratko et al. (1990) by extending the sample size of managers to develop the IAI. Hornsby et al. (1992) used a larger sample of supervisors and managers and developed a revised version of the IAI called the CEAI. Hornsby et al. (1993) developed a theoretical and interactive model of intrapreneurship based on their previous studies. The decision to act more intrapreneurially is a consequence of the interplay between organizational characteristics, individual characteristics, and precipitating events
Covin and Slevin (1991)	An integrative and conceptual model Strategic variables: • Mission strategy • Business practices • Competitive tactics Internal variable: • Top management values and philosophies • Organizational resources and competencies • Organizational culture • Organizational structure	Developing an integrative and conceptual model of intrapreneurship as an organizational level concept and firm behavior for large firms. The proposed model delineates the antecedents and consequences of an entrepreneurial posture as well as the variable that moderate the relationship between entrepreneurial posture and firm performance. These variables are related to internal, strategic, and external aspects. This model suits large organizations and is less suitable for small businesses
Zahra (1993)	Strategic variables: • Mission • Competitive tactics Firm-level entrepreneurship: • Managerial values • Background variables • Structure • Process • Culture	A conceptual and integrative model of firm-level behavior developed from Covin and Slevin's (1991) model. This model has a narrower classification of the external factors and modified internal variables
Lumpkin and Dess (1996)	Organizational factors: • Size • Structure strategy • Strategy-making processes • Firm resources • Culture • Top management team characteristics	A conceptual framework was developed for investigating the relationship between Entrepreneurial Orientation (EO) and firm performance. Organizational and environmental factors will moderate the relationship between EO and firm performance. EO is represented by dimensions of autonomy, innovativeness, risk-taking, proactiveness, and competitive aggressiveness
Ireland et al. (2009)	Organizational architecture: • Structure • Culture • Resources/capabilities • Reward systems	In this study, a conceptual and integrative model of corporate entrepreneurship strategy was developed to identify the organizational architectures that encourage entrepreneurial processes and behavior
Antoncic and Hisrich (2001)	Internal (organizational) factors: • Communication • Formal controls • Environmental scanning • Organizational support • Competition-related values • Person-related values	A Cross-national study was conducted using a sample of firms, including Slovenia (141 firms) and the USA (51 firms). The factors influencing intrapreneurship are related to internal and environmental dimensions. Firms that have more than 50 employees were selected for the study. Data were collected through an email survey addressed to a top executive of the firms that are selected randomly from different industries,

Author	Organizational model/study (internal intrapreneurial factors)	Study detail and design/ Methodology/ Sample size
		including manufacturing consumer and industrial goods, construction, retail and wholesale trade, engineering, research and development, consumer and business services, transportation, and public utilities
Hornsby et al. (2002)	• Management support • Work discretion • Rewards/reinforcement • Time availability • Organizational boundaries	The study investigates the organization's internal factors that influence middle managers to engage with intrapreneurial activities. The study sample comprises 761 middle managers in 17 organizations recruited from different industries such as manufacturing, service, and financial throughout the USA and Canada. Five significant organizational factors were found that influence middle managers to foster entrepreneurial activity within established firms
Antoncic and Hisrich (2004)	Organizational factors: • Organizational support represented by o Management support o Work discretion o Rewards o Time availability o Flexible intra-organizational boundaries • Formal controls • Numbers of alliances	The model integrates the external environment conditions and internal organizational factors, which are collectively found to be strongly conducive to intrapreneurship and have a direct effect on enhancing the firm performance and wealth creation. The sample includes 477 Slovenian firms with 30 or more employees. These firms belong to industries such as manufacturing consumer and industrial goods, construction, retail and wholesale trade, engineering, transportation, and public utilities. Data were collected using an email survey addressed to a top executive of the selected firms
Christensen (2005)	• Communication • Culture • Process • Rewards • Top management support • Resources • Organizational structure • Risk	The study aims to explore the various factors that enable intrapreneurship in established firms. A single case study of a knowledge-intensive company representing a Danish industrial company was selected. Data were collected through four interviews with employees from different positions and two days of on-site observations
Hornsby et al. (2009)	Examine the five factors (management support, work discretion, rewards/reinforcement, time availability, and organizational boundaries) to explore the relationship between managers' perceptions of the organizational environment and the number of entrepreneurial ideas implemented. Only three factors were found relevant: • Management support • Rewards/reinforcement • Work discretion	The sample includes 458 managers at different levels in their firm, including first, middle, or senior-level management. Data were collected through a survey and included a wide range of industries, such as manufacturing, construction, finance, real estate, and retail
Bouchard and Basso (2011)	• Manager owners' personalities and attitudes toward their employees • Organizational characteristics such as informality and decentralization • Scanning activities	A conceptual study was conducted to explore the relations between the EO and the adoption by their employees of entrepreneurial attitudes and behaviors (intrapreneurship) in the context of SMEs. The study formulated three related propositions that influence intrapreneurship
de Villiers-Scheepers (2012)	Examine the five factors (management support, autonomy, rewards, time availability, and organizational boundaries), and only three factors were found relevant: • Management support	The study aims to show how the antecedents to strategic corporate entrepreneurship influence the entrepreneurial intensity of emerging economy firms in South Africa. A quantitative study was conducted using a telephone survey to obtain responses from 146

Author	Organizational model/study (internal intrapreneurial factors)	Study detail and design/ Methodology/ Sample size
	• Rewards • Autonomy of employees	established firms of all sizes in the ICT industry. Firms were selected as those having more than 100 employees
Ahmad et al. (2012)	The study examines the effects of five organizational dimensions on intrapreneurship. Only four factors were found relevant: • Management support • Work discretion • Reward and reinforcement • Time availability	Among the five organizational dimensions of intrapreneurship, only four factors were found to have significant positive effects on intrapreneurship. Organizational boundaries were found non-relevant. The study includes Malaysian manufacturing companies operating in sectors like manufacturing semiconductors, hard drives and personal computers, and two-way radio production. A sample of 263 employees consisting of engineers and managers participated in this study
Kuratko et al. (2014)	• Top management support • Work discretion/autonomy • Rewards/reinforcement • Time availability • Organizational boundaries	A theoretical study of the internal organizational dimensions to promote and support an environment for innovation for the purpose of developing the tool CEAI that diagnoses and measures the organization's internal environment for entrepreneurial activity
Hughes and Mustafa (2017)	Examine the five factors (top management support, time availability, rewards/reinforcement, work discretion/autonomy, and organizational boundaries), and only two factors were found relevant: • Top management support • Organizational boundaries	The study aims to examine the five organizational factors in the context of SMEs in the developing economy. Four case studies were selected purposefully from various industries operating in the services sector in Kenya
Orchard et al. (2018)	The leader and employee relationship significantly and positively influences the entrepreneurial environment through the perception of the employee of the degree and level of the presentation of five factors within the firm: • Organizational boundaries • Work discretion/autonomy • Time availability • Management support • Rewards/reinforcement	The study examines the factors influencing the environment for intrapreneurship in the UK as perceived by the company employees. Data were collected using a survey from 162 participants from 9 SMEs randomly selected from the UK technology industry
Badoiu et al. (2020)	Examine the five factors (top management support, work discretion, rewards and reinforcement, time availability, and organizational boundaries) across managers and employees. The most highly valued dimensions for both founders and intrapreneurs are: • Work discretion, followed by • Top management support • and Rewards The least valued dimensions for founders and intrapreneurs are: • Time availability • and Organizational boundaries Founders score higher positive perceptions than intrapreneurs on the below factors, while they have a lower perception of time availability:	A single case study of a New Technology-Based Firm (NTBF) was selected. The firm operates in the ICT sector in Spain. It is a five-year-old with a total staff of 37 employees. Data were collected through interviews and questionnaires as primary sources of information; semi-structured interviews were conducted with the founders and top managers of the firm and with intrapreneurial employees

Author	Organizational model/study (internal intrapreneurial factors)	Study detail and design/ Methodology/ Sample size
	• Management support • Rewards/reinforcements • Organizational boundaries	
Toksöz (2021)	Examine the five common factors that impact intrapreneurship (organizational boundaries, work discretion/autonomy, rewards/reinforcement, time availability, and management support). Three common factors were found important in fostering intrapreneurship behavior within the engineering companies in the USA and Germany: • Top management support • Reward • Communication	A comparative study using a mixed-method (quantitative data were collected through questionnaires, and qualitative data were collected through two interviews from each country) to examine intrapreneurship culture in the context of engineering firms in the USA and Germany. Fifty firms were utilized in this study from different sizes in each country. The findings show that the extent of the intrapreneurship perception among USA employees is greater compared to employees from Germany

Table 3.1 Review of intrapreneurship models

Building on the discussion above and reviewing the intrapreneurial factors (summarized in Table 3.1), it is evident that a wide range of models and studies have emerged from the literature, reflecting the variety of intrapreneurial factors resulting from studies with different focuses and conducted in different contexts. This shows research work with different conceptual and empirical studies where some followed various research designs, including a range of sampling choices, such as the number of firms, and informants' details and their levels within the organizations, company sizes, types, and conditions. Many models have different focuses on the level of intrapreneurship; either on the organization or individual level or both of them. Many authors from surrounding management and organization fields incorporated other domains of innovation, organization culture, strategic management, and individual entrepreneurial behavior while developing their models. Therefore, these models and studies vary to a large extent on what enablers can foster intrapreneurship within firms, leading to a lack of common agreement on the factors.

Some of these emerging factors were based on conceptual models, and many of them have not been tested empirically to validate their applicability (Groenewald, 2010). For example, the model provided by Antoncic and Hisrich (2001) provides organizational factors as a proposition and does not include to what degree they can be useful and effective; their application seems to be very general. Additionally, when some of these conceptual models were tested empirically in a different setup of environment and organizational context, some of the factors were found to be irrelevant or non-effective in reality. For instance, according to Christensen (2005), some of these studies were conducted for the wide application and generality of the model that includes firms from different sectors. However, these factors change when it comes to a specific industry. In this context, Galván-Vela et al. (2021) suggest exploring and developing new models in specific sectors and territories. *"Such variables as organizational age, size, overall strategy, and industry may influence relationships in the model"* Antoncic and Hisrich (2001, p.505) note, and these are the ones that affect the emerging factors. The

study by Christensen (2005) proved that the internal factors that enable and encourage intrapreneurship, specifically in knowledge-intensive firms, are different from the ones provided in common models and theories on intrapreneurship.

Furthermore, some of the studies show that the effectiveness of intrapreneurial factors varies to a large extent to the geographical areas and the power of the economy. This indicates that the factors that work in western economies may not always be consistent with those that emerge in developing economies. This is also more evident among the models that utilized the five common factors when tested in different contexts. For example, some of these factors were not applicable to SMEs.

One of the noteworthy results is that, within the same organization, the intrapreneurial factors were perceived differently by different participants; higher managers, middle managers, and employees, as well as across managerial levels and positions (Hornsby et al., 2009). This implies that a holistic study including different participants will give a better understanding of intrapreneurship and their influential factors within the organization.

There is a need to study intrapreneurship in the context of technology organizations and the role of engineers in enhancing and advancing innovation within these firms. This will be discussed in the next chapter.

CHAPTER 4: THE ROLE OF ENGINEERS IN FOSTERING INNOVATION IN TECHNOLOGY-BASED ORGANIZATIONS

4.1 Defining an engineer

In technology firms, engineering is a crucial profession that acts as the backbone for many of these firms. Engineers who work for these organizations come from various technical engineering fields or have experience in various technological industries such as ICT, Nanotechnology, financial technology, biotechnology, advanced materials, and advanced services (Farsi et al., 2018).

Different definitions and concepts about engineers have been developed across different countries and institutions that are based on particular regulations, laws, and rules. In the literature, there are no specific definitions for an engineer, and the term has been developed in different contexts. An engineer has been recognized as a combination of a mixture of factors related to academic qualification, occupation, professions, and nature of roles and tasks, or certain kinds of skills and characteristics they have to possess (Morelock, 2017).

Considering the base of this study in the UK, the concept of 'engineer' was derived from official engineering organizations in the UK. The classical definition of an engineer, as defined in the Cambridge dictionary (2019), is *"A person whose job is to design or build machines, engines or electrical equipment, or things such as roads, railways or bridges, using scientific principles".* According to the Engineering Council (2022), the UK regulatory body for the engineering profession, there is no legal definition of an engineer in the UK, but *"An engineer is very often taken to mean anyone who is in some way associated with engineering, including the design, manufacture, maintenance or operation of a technical product or system".* This definition is utilized in this research and is more related to the engineering roles characterized by engineering job functions where they apply scientific principles and knowledge to solve problems, design, and build and test systems and structures. This definition is not restricted to engineering backgrounds but can include people from non-engineering backgrounds who are actively involved in engineering functions or have been trained to carry out technical responsibilities.

4.2 The relevance of engineers in technology firms

Engineers are considered a highly relevant resource for technology organizations because they have the potential to enrich innovation dynamics by taking more intrapreneurial roles. A large body of the literature highlights the value of engineers and emphasizes their role in leading innovation as they are occupied with specialized capabilities among employees within technology firms. According to Hoffman et al. (1998), qualified engineers are one of the main sources of innovative efforts in technology firms. Hage (1980, cited in Lumpkin and Dess, 1996) suggested that the greater number of

experts and professionals in a company, such as engineers, the greater degree of innovation the organization would have. According to Fayolle et al. (2005, p.228), *"Entrepreneurial engineers seem to be innovators and creators of economic wealth: they contribute heavily to the renewal of social and industrial structure…, it seems that, worldwide, the engineer is a key element in technological innovation"*. Menzel et al. (2007) see that engineers, due to their professional background and technical skills, can play a significant role in technology innovation. *"With their education and professional experience, they (engineers) have the ability to think conceptually and in terms of systems, believe in the laws of physics, and have respect for technology, computations, materials, and designs"* (Menzel, 2008, p.39). Kriewall and Makemsom (2010) emphasize the promising contribution of engineering to leverage the knowledge of technology and the ability to develop the global economy and revolutionize the world, with significant importance to improving the lives of people, particularly in the areas of new or disruptive technology and high technology-based designs. Russell (1999) focused on the contribution of intrapreneurial engineers toward innovation. By driving themselves hard, spending long hours, and being involved in new venture projects, they can contribute to developing innovative ideas (Russell, 1999). The creative ideas of engineers and the knowledge, skills, and ability to implement them are essential for driving technological development and advancement in established organizations (Alam et al., 2019).

Organizations today seek engineers with more intrapreneurial roles to drive technology development. According to the National Academy of Engineering (2004), engineering professions are expected to envision the future and lead various industries to achieve more success. Engineers, more than any other kind of employee within an organization, are often seen as one of the main strategic assets by their employers, and this segment of the workforce should be carefully monitored and managed (Mignonac and Herrbach, 2003). Williamson et al. (2013) clearly explain the current challenges in today's business, requiring more engineers to take on additional roles, such as intrapreneurship, advocating for technology change, and acting as innovation co-facilitators. Engineers in their roles are required to contribute directly to enriching intrapreneurship by bringing high technology-based designs, incorporating more right-brain creativity and function, and developing value-added products and processes, which will expand their business core competencies into new markets and increase market share (Kriewall and Makemsom, 2010).

The industry requirement for highly competent engineers is an important topic of discussion among many scholars in the field of intrapreneurship and management. There is an increasing demand from the industry for engineers to perform beyond their technical expertise and engineering education to have a more effective role in creativity and innovation processes within organizations (Alam et al., 2019). This is related to the growing demands for their vital contribution to technology development, empowering the innovation process, and the significant role they play in all phases of new knowledge

creation (Martínez-León et al., 2018). In the views of Kriewall and Makemsom (2010), the demands from the industry require more engineers with intrapreneurial thinking and skills who can add incremental development to existing products, resulting in positive cash flow and generating profit for their employers. Despite the fact that engineers excel at understanding science and mathematics, as well as working with machines, systems, designs, or electronic boards, they are also expected to be involved in innovations and creativity and take part in other non-technical functions such as management, leading of engineering teams, negotiation skills, financial decisions, and ethical judgments (Martínez-León et al., 2018). Technology companies increasingly need their engineers to contribute to the innovation process and maximize their creative productivity. For instance, Ericsson, one of the largest technology firms in the telecom industry, considers their engineers the superpower who have generated thousands of innovative ideas that maintain successful innovation over the years and develop the future business of the firm, *"In the 1800s, we did start out by manufacturing some of the first telephones, but today, we actually build and manage mobile networks that support a hefty chunk of global data traffic. Without innovation, Ericsson – along with a staggering number of the world's most successful businesses – would no longer exist. Innovation is not a fluffy concept. It's a powerful tool for increasing business competitiveness, profitability, and employee retention"* (Carlstrom, 2020).

The organization is responsible for retaining talented and competent engineers and increasing their motivation (Martínez-León et al., 2018). Engineers require a great degree of freedom in order to be creative and proactively engage with any innovative activities (Osman et al., 2017). Managing engineers and their intrapreneurial roles and capabilities are crucial for improving organizational performance. Intrapreneurial engineers benefit from using the firm resources and capabilities to facilitate the creation of new ideas and deploying their innovation projects. Organizational support is a key principle in fostering intrapreneurial initiatives from engineers. Therefore, this shows the significant role of engineers in increasing the capacity of their organizations for technology innovation through intrapreneurship. Thus, if engineers are given the platform and opportunities within their role to act more intrapreneurial, then this will be an added competitive bonus for the organization. However, in order for this to happen organically, the organization should be willing to create an overall supportive internal environment in all its parts that motivates engineers to engage with intrapreneurial functions. This underpins the main interest of this research to investigate intrapreneurial organizations within technology-intensive sectors and explore how they can foster intrapreneurial initiatives among their engineers.

4.3 Do engineering education programs facilitate the intrapreneurial skills of engineering graduates?

Many authors highlighted the importance of engineers being educated and trained for innovation and intrapreneurship as part of their education so that they can fulfill the requirements of their future

employers (Baruah and Ward, 2014a). In this perspective, *"The typical engineer coming out of today's university programs does not have all of the skills required to create innovative solutions for the public"* (Galloway, 2004, p.127). Menzel et al. (2007) highlighted that engineers who are expected to be involved actively in innovation sometimes lack specific skills to perform intrapreneurial roles. Many engineering students are trained in a traditional way predominately based on traditional models of strict technical depth, which require orientation in course curricula toward instilling the entrepreneurial mindset into engineering education and equipping them with the right skills to meet the needs of the global industry (Kriewall and Makemsom, 2010). In a similar perspective, Galloway (2004) explained that engineering graduates tend to be more focused on technical facts, but the industry requires them to have the capabilities which are necessary for finding creative solutions and innovative ideas. Another study conducted by Back and Sanders (1998) focused on identifying the industry expectations for engineering graduates. Representatives from the engineering industry have identified several personal, technical and business-related skills as being necessary for graduates to possess so that they can add value to the engineering profession as well as to their respective companies (Back and Sanders, 1998). Therefore, engineering students should be taught and trained to develop such skills.

Several educational programs have emerged to address this issue. The Kern Entrepreneurship Education Network (KEEN) is a program designed for engineering undergraduates in USA colleges and universities. The program focuses on four main areas (Kriewall and Makemsom, 2010):

- Technical fundamentals: which focus on the creative side of engineering by developing creativity and innovation principles. The program also focuses on the practical side of engineering, which covers teaching-related elements of product design and tests for commercialization, product innovation, and proof of concept designs, including design verification, characterization, qualification, validation, and standardization for long-term sustainability.
- Customer awareness: such an area of the program focuses on developing the skills of engineers on how to judge their ideas and think in terms of product benefits for their customers, learn how to contact customers, ask questions and be active listeners, and the ability to identify customer problems and recognize opportunities that have a technical solution for them.
- Business acumen: the program focuses on enhancing skills in the area of financial and organizational management, how engineers can express their product story in business language, managing projects and applying commercialization process, and managing conflict situations.
- Societal values: this area aims to show engineers how their work and the problem they solve are connected and beneficial to people around the world, as well as to promote high standards of engineering and business ethics.

In the UK, the University of York has developed a unique educational program to strategically enhance the intrapreneurial skills of students enrolled in the MSc Engineering Management. All curriculums have been developed based on a unique combination of active and practical learning techniques (Baruah and Ward, 2014a). Some of these skills targeted in the programs related to *"Creativity and innovation, capacity for analysis, problem formulation and solving, planning and time management, communications (written and oral), team working and interpersonal skills, research skills and activity management"* (Baruah and Ward, 2014a, p.3). Therefore, the modules in this program have been designed to develop such generic transferrable skills gradually. This is accomplished by putting engineers in real situations analogous to those they will face in the real world of engineering so as to give them a practical experience in situations similar to industrial scenarios. Engineers will be more familiar with the real environment of an organization and its culture while studying so as to have a pre-professional experience. This has been reflected in the overall curriculum of the program, such as lectures, workshops, assignments, work schedules, and group work. For instance, the final project is designed based on group work to solve a real industrial and engineering problem and propose a solution in terms of technical and business aspects. Such group projects require students to engage in critical thinking, analysis and evaluation. These projects acts as a practical scenario for the development of skills such as working effectively and being an active member among others from different backgrounds and capabilities, enhancing communication skills and coordination among team members, learning how to manage the project, resolving conflicts and work with their peers as one unit toward achieving common goals.

Although some educational programs have evolved to develop intrapreneurial, management, and business skills among engineers, they are limited in scope and applied in a few universities. More efforts need to be carried out, and there is a high need for change and a shift in the focus of such engineering education and training toward more comprehensive teaching and learning approaches. The field of engineering education must rethink its present technique and curricula toward teaching the practices of engineering in order to integrate the skills and characteristics of an intrapreneurial mindset without losing technical depth. In this context, a recent study by Daley and Baruah (2021) revealed that leadership skills need to be integrated into the engineering curriculum to prepare engineering students to be leaders and business managers of organizations in their future careers. Such leadership skills for engineering students encompass various management and business-related skills that are explained below (Daley and Baruah, 2021):

- Business skills: including areas from accounting and finance, business strategies, economics, law, and marketing
- Management skills: including skills for project management, resource management, time management, risk management, and change management

- Interpersonal skills: such as communication skills, peer evaluation, communicating data effectively, and the ability to articulate complex ideas to an audience
- Intrapersonal skills: include analysis skills, innovation, problem-solving skills, and self-evaluation

Furthermore, Daley and Baruah (2021) emphasize the development of the character of leaders to exhibit and demonstrate ethical, moral, and professional qualities where their actions concern environmental issues.

Organizations need to continue educating and training their engineers that complement their initial study and specialization at school and open the opportunities for expertise in new areas. In this perspective, Fayolle et al. (2005, p.11) emphasize such training for engineers to be able to undertake managerial responsibilities in their future career path, *"So, many authorities underline the need to train engineers in economics and management as quickly as possible in order to prepare them to carry out the executive functions that they will face sooner or later, and to acquire certain professionalism in their area of activity. Management training and the openings, which it offers, allow engineers to move out of their profession and head toward other careers. Management training could be seen, from this viewpoint, as a 'career accelerator' for engineers"*. To improve the knowledge of engineers about a particular technology, they should be educated and given a broad knowledge and experience about related innovation activities and the innovation process so that they can drive their creative ideas for implementation (Weissenberger-Eibl and Kugler, 2014). Galloway (2004) raised the question of how engineers and graduates from engineering study courses can be enabled to become specialists in the field of innovation. Galloway (2004) highlighted that engineers are not trained for the necessary skills the engineering profession needs.

4.4 Successful intrapreneurship in technology-based firms

Nowadays, technology companies hold a key role in modern economies, acting as a primary driver for economic development and enhanced productivity. The future economy of the various industrialized sectors is dependent on their technological innovation capabilities, where organizations consider technology as one of their most valuable assets (García-Morales et al., 2014). Technology-based firms are differentiated from others by placing a greater emphasis on innovative and technology product-related activities (Grinstein and Goldman, 2006). Technology businesses like Google, Apple, Amazon, 3M, and Salesforce.com prove that achieving sustained success requires companies to embrace intrapreneurship and develop a culture that fosters it (Shah et al., 2015). Some of these firms have successfully delivered some of the most innovative products and solutions, which have made a significant contribution to the wealth and standard of living we have today. Technology firms strive not only to innovate but to speed up innovation in response to increased customer demands for improved

products and solutions (Orchard et al., 2018). *"Intense competition and a growing rate of technological change are making innovation ever more important in most industries, with the effectiveness of innovation efforts becoming a determining factor of a firm's performance. It is no surprise that the chances of SMEs successfully competing with large firms largely depend on their innovative capabilities"* (Revilla and Fernández, 2012, p.609). This compels organizations to strategically prioritize discovering, cultivating, and retaining employees who can take more intrapreneurial roles (Davis, 1999).

Numerous leading and pioneering technology organizations that embrace intrapreneurship have successfully developed breakthrough products on a global scale. For instance, PlayStation, iPod, Post-it® Notes, and Gmail are some examples of successful products of intrapreneurship (Pinchot and Soltanifar, 2021). Over the years, engineers have brought in some of the most successful innovations like Gmail, new interactive features in Facebook, Bluetooth, and PlayStation. Haller (2009) called intrapreneurship the 'Secret Weapon For Success' that has provided successful business for many technology companies, such as 3M, Anaconda-Ericsson, Sony, Apple, Corona Data Systems, Data General, DuPont, GE, Genentech, Lockheed, Prime Computer, Rubbermaid, Texas Instruments, Toyota, and other successful businesses. Their success in innovation and intrapreneurship is not only related to their business model but mostly to their unique approaches through their supportive culture and continuous managerial support.

Schawbel (2013) presents two examples of intrapreneurial firms, describing how each encourages innovation within the organization. At LinkedIn, employees are encouraged to generate new ideas, work in a team, and demonstrate them to the executive team every three months. For accepted ideas, the relevant team is supported and given dedicated time for three months to transform their idea into a beneficial outcome. Facebook has established hackathons programs where engineers are encouraged to think, brainstorm, try new ideas, and collaborate with other teams in a fun environment. Facebook hackathons serve as a platform for some of the best ideas generated in the company's history. For instance, the 'Like button' was one of the most important innovative products initiated by one of the engineers through a hackathon event.

In Sony, one of the prominent Japanese electronics makers, engineers are the primary source of product innovation. Engineers are empowered to pursue their ideas regardless of the associated cost where they daily generate, on average, four product ideas (Jones, 2013). Walkman and Trinitron TV are some of the blockbuster new products that were initiated and successfully developed by their engineers. Kutaragi, an engineer, created the PlayStation video-game console, which contributed to 60% of the company's operating profits in 2003 (Jones, 2013). Kutaragi explained his interest in joining the company as *'It was the best in terms of encouraging creativity and offering researchers freedom'*. This success is attributed to the unique firm culture, called the 'Sony Way', which places a strong emphasis

on communication, cooperation, and harmony across the various product engineering teams (Jones, 2013).

In Google, many innovative products have been originated through intrapreneurship programs, such as Gmail, Google News, Orkut, and AdSense. Paul Buchheit, a computer engineer, came up with the revolutionary idea of Gmail, which is one of the most successful products of Google. Buchheit also prompted the company's AdSense program, which is Google's second-biggest revenue resource. The company has established Google's 'Innovation Time Off' as a formal intrapreneurship program to support ongoing innovation and creativity by their employees (Haller, 2012). In this program, employees are allowed to spend 20% of their work time on their intrapreneurial projects. The program has a clear process for selecting, evaluating, and monitoring intrapreneurial projects for greater support. The process of the program supports bottom-up initiatives where engineers can start by sharing their ideas with their fellow Google engineers, not with their managers or executive team, so as to avoid organizational bureaucracy. This, according to Haller (2012), *"Allows good ideas spread fast, encourages collaboration, fosters constructive input and this unique product creative method minimizes technical, product positioning and marketing mistakes".*

In 2012, Samsung established the creative lab (C-lab), an in-house venture program for their employees to cultivate their own business ideas and develop them into production, regardless of whether or not such ideas are compatible with the core business of the firm (Samsung, 2016). The program encourages progressive thinking and experimentation, helps them think outside the box, and unlocks their potential by trying new things they have never done before. Employees can participate in the program by providing genuine innovative ideas and getting approved by other colleagues. Any employee can suggest an idea which is then evaluated according to how innovative, specific, and sellable they are; a group of voters, who are experts, reviews and decides which one can move to the next stage. The project is then presented to a team acting as venture capitalists who decides whether it is worth investing in it. The successful project is supported by the C-lab to develop the product/service out of it. On average, 15-20 ideas are selected every year that become a C-lab project.

One of the main rules followed by Huawei, a pioneering ICT firm, is to support their engineers to engage with intrapreneurship by giving the opportunity to both new and old graduates and engineers to engage in R&D activities centered on customers' needs. This has been seen as very effective for improving current products and technologies (Shah et al., 2015). Ericsson, the giant telecom solution provider, has created the 'Ericsson ONE' program as an effective innovation accelerator process with clear stages for rapidly creating, testing, and validating intrapreneurs' prototypes (Ericsson, 2022). The program aims to provide everyone the opportunity to innovate and guide them along their innovation journey by securing the proper support and dedicated resources, such as coaching, financial support, access to subject matter experts, and connecting them with customers to test product prototypes.

Ericsson targets to engage all engineers and employees in this program. A simple online tool has been developed so that any employee can submit their idea at any time. A dedicated team of experts from various parts of the organization will review ideas and select the most potential one to build the business out of it.

These examples show that engineers can actively contribute to their firm's success and generate innovative business opportunities when they receive full support from their organizations to facilitate and realize their ideas and transform them into meaningful results. Engineers are seen as extremely relevant staff and useful assets for their organization. If the engineers' initiatives and suggestions are not taken forward or adequately supported within the organization, then the firm might potentially lose out from reaping the benefits of some great ideas. It is evident from the above examples how technology organizations benefit from adopting intrapreneurship as a key strategy to facilitate their engineers' initiatives and transform them into commercial products. Eventually, sustain innovation and maintain a competitive advantage.

4.5 The different research streams on the intrapreneurial initiatives from engineers

The literature focuses on the anticipated role of engineers to be experts in the field of technology innovation within an organization. They are employees who require support from their organization that orients their efforts to go beyond the traditional role and toward intrapreneurship. The study of intrapreneurship among engineers is very scarce in the literature and current research lacks an empirical investigation on how engineers contribute toward intrapreneurship. One of the main studies in the field of engineering and intrapreneurship was conducted by Menzel et al. (2007). This theoretical study, with a particular focus on large firms, started with a detailed review of the relevant literature, then explained how technology innovation can be promoted in the intrapreneurial behavior of engineers. The study conceptualized five significant elements that empower intrapreneurship in an engineering context: (1) a physical environment conducive to actions and collaboration, (2) a flat organizational structure, (3) high management support, (4) stakeholders advocates, and (5) sufficient resources.

Another stream of research focuses on the individual level of engineers through exploring and analyzing their intrapreneurial characteristics and personalities. One of the earlier studies on the main profiles of intrapreneurs was conducted by Lessem (1986). He defined seven profiles of intrapreneurs based on their characteristics. These types are: 'adventurer', 'innovator', 'designer' ('enabler'), 'leader' 'entrepreneur', 'change agent', and 'animateur'. One of the main profiles associated with intrapreneur is 'innovation', where an intrapreneur can turn the original vision into creative action. Engineers with intrapreneurial skills within an organization will potentially act as an innovator and create new ideas and business opportunities that flourish the business. Williamson et al. (2013) conducted a study on the

key personality traits of engineers and their role in innovation and technology development. They aimed to answer the question of whether engineers differ from other occupations in the context of intrapreneurship. The research sample consists of 4876 engineers and 75892 non-engineers. Using thirteen personal traits for the comparison presented and explained in Table 4.1, engineers were found to vary on eleven personality traits. In more detail, there were no significant differences between engineers and non-engineers on Openness and Teamwork. Engineers scored significantly lower than non-engineers on Assertiveness, Conscientiousness, Customer Service Orientation, Emotional Stability, Extraversion, Image Management, Optimism, Visionary Style, and Work Drive, and significantly higher on Intrinsic Motivation and Tough-Mindedness. The study concludes that engineers are special employees with unique personal traits differing from other occupations.

	Personality trait	Personality trait definition
1	Openness	Receptivity/openness to change, innovation, novel experience, and new learning
2	Teamwork Disposition (Agreeableness)	A propensity for working as part of a team and functioning cooperatively on workgroup efforts
3	Assertiveness	A person's disposition to speak up on matters of importance, expressing ideas and opinions confidently, defending personal beliefs, seizing the initiative, and exerting influence in a forthright, but not aggressive, manner
4	Conscientiousness	Dependability, reliability, trustworthiness, and inclination to adhere to company norms, rules, and values
5	Customer Service Orientation	Striving to provide highly responsive, personalized, quality service to (internal and external) contacts, putting the person first; and trying to make him or her satisfied, even if it means going above and beyond the normal job description or policy
6	Emotional Stability	The overall level of adjustment and emotional resilience in the face of job stress and pressure
7	Extraversion	The tendency to be sociable, outgoing, gregarious, expressive, warmhearted, and talkative
8	Image Management	Reflects a person's disposition to monitor, observe, regulate, and control the self-presentation and image he or she projects during interactions with other people
9	Optimism	Having an upbeat, hopeful outlook concerning situations, people, prospects, and the future, even in the face of difficulty and adversity; a tendency to minimize problems and persist in the face of setbacks
10	Visionary Style	Focusing on long-term planning, strategy, and envisioning future possibilities and contingencies
11	Work Drive	Disposition to work for long hours (including overtime) and an irregular schedule; investing high levels of time and energy into job and career, and being motivated to extend oneself, if necessary, to finish projects, meet deadlines, be productive, and achieve job success.
12	Intrinsic Motivation	A disposition to be motivated by intrinsic work factors, such as challenge, meaning, autonomy, variety and significance (as opposed to extrinsic factors such as pay and earnings, benefits, status, and recognition)
13	Tough-Mindedness	Appraising information and making work decisions based on logic, facts, and data versus feelings, values and intuition

Table 4.1 Clarifications of the terms of personal traits from the study of Williamson et al. (2013)

According to the results of the study concerning engineers' traits and personal attitudes, engineers are not showing promising results toward integrating intrapreneurship in their engineering roles (Williamson et al., 2013). This imposes more responsibilities on their organizations to take further actions to facilitate intrapreneurship and promote their engineers to take on more intrapreneurial roles.

Ferguson et al. (2014) conducted a study to compare traditional and innovative engineers. Traditional engineers, the term describing a non-innovative engineer, have certain characteristics associated with them. They were found to be non-collaborative and non-active in finding new approaches to problem-solving. They prefer to use established and existing solutions, focus on a narrow domain of knowledge and become experts in a specific technical domain rather than building a wide scope of knowledge and expertise. They tend to think short term instead of long term, work less hard, and spend less time to overcome barriers. Such characteristics inhibit engineers and limit their capabilities to translate their creative ideas into beneficial innovations.

Menzel (2008) reviewed the literature about engineers' characteristics that may impede intrapreneurship. They found that engineers lack the skills of management and leadership, estimating the cost, time management, and other personal skills such as written communication and teamwork. Although engineers are scientific and technical-oriented and emphasize facts that enable them to solve technical problems, they show less interest in business aspects and lack how to apply their innovative abilities to solve managerial issues (Menzel, 2008). They tend not to take risks and avoid making decisions based on little information. Engineers are more introverted and are less aware of real-world problems. Menzel (2008) suggested improving engineers' overall performance toward a less engineering-centric worldview, including developing management, communication, and negotiation skills.

4.6 Research gap

It is clear that engineers have the potential to contribute and make a difference to the intrapreneurial dynamics of the firm if they are given the support and platform. However, organizations struggle with this and are unsure of which factors could effectively enable intrapreneurship, along with the associated practical steps and actions for them to implement.

While there are nascent conceptual and theoretical studies on innovative activities of engineers, which are essential for successful intrapreneurship and technological innovation, there is a lack of empirical research studies with little evidence found in the existing literature (Williamson et al. (2013), Alam et al. (2020)). Menzel et al. (2007, p.741) noticed this and called for more empirical research in the domain of engineering and intrapreneurship, *"To effectively promote intrapreneurship in engineering settings, directions for further research and action concern both the individual, the organizational and—taken together— the cultural sides of intrapreneurship…, more effort has to be made to implement*

intrapreneurship in the settings of existing companies and in engineering and R&D settings in particular". Alam et al. (2020) conducted one of the most current systematic literature reviews and the first of its kind on intrapreneurship concepts for engineers. They revealed that the phenomenon of intrapreneurship among engineers remains fragmented and inconsistent.

A review of the literature indicated a scarcity of resources that address the main organizational factors that enable engineers to engage with intrapreneurship both in volume and scope, thus, leaving a critical gap in the field of intrapreneurship and engineering. This is combined with the ever-increasing demand to develop intrapreneurial capacity among engineers, where technology organizations seek to accelerate the intrapreneurial process initiated by their engineers. This PhD research is one of the first empirical studies to address this gap by exploring the factors promoting intrapreneurship among engineers within a specific sector and company size in the UK.

As discussed in the previous chapter, despite the fact that many studies focused on numerous factors contributing to or enhancing the development of intrapreneurship within organizations, there is no clear agreement on which key factors promote intrapreneurship (Hornsby et al., 2002). The existing factors among different studies in the literature represented by different conceptual theories, empirical studies, and developed related models vary to a large extent. This is related to the fact that intrapreneurial activities within an organization are heterogeneous. Intrapreneurship is a context-specific phenomenon (Narayanan et al. (2009), Nason et al. (2015)). Those factors that emerge vary according to geographical areas and regions, industry conditions, firm size, and the setup of the organization itself. In this perspective, Zahra and Wright (2011) express that many studies have not engaged fully with the nature of the context the organization operates in when studying intrapreneurship. Hughes and Mustafa (2017) demonstrate that the importance of these factors varies according to the organizational conditions. Therefore, many researchers have questioned their applicability to different industries and organizational settings (Fry (1993), Rigtering and Weitzel (2013)), across different company sizes (SMEs and large organizations) (Urbano and Turró, 2013) and across different regions and economies (Hughes and Mustafa (2017), Huang et al. (2021), Toksöz (2021)). The study by Christensen (2005) shows that factors from previous studies are insufficient to understand intrapreneurial behavior in a knowledge-intensive company such as technology firms. She found that intrapreneurial factors that foster intrapreneurship in knowledge-intensive firms are different from the ones provided in common models and theories of intrapreneurship. This indicates that firms from different sectors and industries might require different intrapreneurial enablers and setups. She called for more studies on intrapreneurship in technology firms to explore the enabler factors of intrapreneurship, how they might be related to each other, and how they can be utilized to adjust the intrapreneurial level up and down.

There is currently limited research on the intrapreneurial nature of established technology-based SMEs. Such tech SMEs are flexible, change with the market, and have immense potential to innovate. Many

of them, whether they are a startup or already established organizations, operate in advanced and dynamic sectors and are always on the lookout for new opportunities to develop technology-based solutions, products, and services (Saemundsson and Candi, 2017). The intrapreneurial process within organizations can vary based on their size or capacity, and therefore different intrapreneurial elements may emerge explaining employees' intrapreneurial behavior in SMEs and those of large organizations (Moriano et al. (2014), Hughes and Mustafa (2017), Badoiu et al. (2020)). This indicates that results from large firms related to intrapreneurial enabling factors may be applicable in a different context to that of SMEs and may not necessarily be replicated for SMEs. Intrapreneurship within the context of SMEs is a less explored phenomenon (Covin and Lumpkin, 2011) and remain significantly under-researched in terms of intrapreneurial activities (Nason et al., 2015). Bouchard and Basso (2011) and Van Der Sijde et al. (2013) reported that the knowledge of intrapreneurship in SME-based organizations remains limited and has received little attention. It is generally agreed that small firms are at a disadvantage in terms of their operational and technical resources, assets, finance, and innovative capabilities compared to large firms so as to support their intrapreneurial process (Newbert et al. (2008), Revilla and Fernández (2012), Bierwerth et al. (2015)).

The literature has different measures regarding how SMEs can be more innovative and which variables can be considered as possible predictors for innovative efforts. Keizer et al. (2002) conducted an exploratory study among SMEs in the mechanical and electrical engineering sectors. They found three main internal factors which contribute significantly to innovative efforts: using innovation subsidies, having links with knowledge centers, and the percentage of turnover invested in R&D. A recent study by Fernández-Olmos and Ramírez-Alesón (2017) emphasizes the importance of Technology Collaboration Networks (TCN) for SMEs to develop technological capabilities and more abilities to innovate, by which the firm can access technological resources without the need to acquire these through traditional channels. Such studies within the literature that focus on achieving more innovative capabilities within organizations do not indicate employees' initiatives through intrapreneurship as a source of opportunity recognition and innovative ideas.

As discussed in this chapter, a large body of literature shows the significant role of engineers in facilitating and creating innovation, and there is an increasing expectation from organizations for their engineers to engage with intrapreneurship. However, there is no empirical research that explores how this can be facilitated and what organizations can do to get the best out of their engineers within an intrapreneurial setup. This research study, therefore, seeks to address this main research gap through an exploratory study. The main research question of this project is:

- **How can technology-based SMEs drive intrapreneurship and nurture innovation by harnessing the intrapreneurial capabilities of their engineers?**

CHAPTER 5: RESEARCH METHODOLOGY

This chapter discusses the details of the research methodology utilized in this study, beginning with an explanation of the philosophical assumptions, research design, and theoretical sampling criteria. This is followed by a discussion on the data collection method and process, data analysis procedures, and ethical research considerations. Finally, the chapter concludes with an outline of the measures utilized in relation to the qualitative research assessment criteria to ensure validity and reliability.

5.1 Research philosophy

Research philosophy refers to the researcher's beliefs and assumptions about the development of knowledge, which will inevitably influence their understanding of research questions and interpretation of the study findings (Saunders et al., 2016). It guides the overall research approach, design, and methods to be applied (Creswell, 2014). According to Bryman and Bell (2011), business research is impacted not just by what happens in the real world of business and management but also by philosophical concepts and beliefs that shape how business research can be conducted, as well as how organizations are understood.

The research stance of any researcher expresses their scientific positioning regarding ontological and epistemological assumptions. Ontology refers to the nature of reality and is related to assumptions we make about what it means for something to exist. Bryman and Bell (2011) identify two ontological positions concerning social research, 'objectivism' and 'constructionism' based on the relation of reality to social actors. According to Bryman and Bell (2011), objectivism entails that reality exists independent of human abilities and perceptions. Based on these objective assumptions, the organization is viewed as a tangible object where each organization has its own specific variables, such as the vision, processes, and rules and regulations. Therefore, it has a reality that is external to the individual who inhabits it. In 'constructionism', they take into account that the social phenomenon and its meanings are continually being performed by social actors that are subject to constant change. In constructivism's position, organization and culture are socially constructed entities made real by human actions and understanding.

This research study believes that reality exists independent of the researcher's and social actors' perceptions. Therefore, this research subscribes to an ontological perspective of objective reality. Based on this ontological position and conducting the study on the firm level, this research considers the organization, hierarchy, structure, processes, and strategies exist independently of social actors or the existing knowledge about them. So, the organization has a reality that is external to the researcher who is investigating it. Epistemology concerns our knowledge about reality and raises the question of what is regarded as acceptable knowledge in a discipline (Bryman and Bell, 2011).

The thesis adopted 'Critical Realism' philosophy based on an objective ontology, a comprehensive concept that was initially established by Roy Bhaskar in 1975. Critical realism is a 'layered ontology' (Price and Martin, 2018), and according to Vincent and O'Mahoney (2018), it is a 'stratified' or 'depth ontology'. While critical realism is primarily an ontology (what is real), it accepts an interpretive epistemology (what we know about this reality) (Bhaskar, 1998) and insists that our object of study exists in a layered reality (Bygstad and Munkvold, 2011). This epistemological perspective is related to social actors' perceptions which mediate knowledge about reality and where human knowledge captures only a small aspect of a larger and more complex reality, as explained by Fletcher (2017). The researcher's perception also plays a major role in the formation of the knowledge of this reality shaped by his theoretical bases and the research context. O'Mahoney and Vincent (2014, p.2) further explain how critical realism combines ontology and epistemology, *"Critical realism holds that an (objective) world exists independently of people's perceptions, language, or imagination. It also recognizes that part of the world consists of subjective interpretations which influence the ways in which it is perceived and experienced"*. This double acknowledgment of critical realism is important and relatively novel in social science (O'Mahoney and Vincent, 2014). However, critical realist researchers attempt to resolve this odd dualism of objectivism or subjectivism by distinguishing between ontology (what is real) and epistemology (what we know) (Vincent and O'Mahoney, 2018). Fletcher (2017) emphasizes in this context that one of the main essential assumptions of critical realism is that it is fundamentally an ontology (the nature of reality) and cannot be reduced to epistemology (our knowledge of reality). Therefore, critical realism gives priority to questions of ontology (questions about what exists) rather than questions of epistemology (how we might obtain knowledge of what exists).

The two basic assumptions of Bhaskar's (2013) version of realism (critical realism) are: first, reality exists independently regardless of how humans interpret it; second, this reality has its own structures. Critical realism is explained further by Bryman and Bell (2011, p.616) as a *"Social phenomena that are produced by mechanisms that are real, but that are not directly accessible to observation and are discernible only through their effects"*. Table 5.1 below summarizes the critical realism assumptions for this research.

Dimensions	Critical reality
Ontology (nature of reality)	Reality is stratified into three levels
Epistemology (nature of knowledge about reality)	Reality is affected by the researcher and participants

Table 5.1 Critical realism ontological and epistemological assumptions for this research

To have more understanding of critical realism, we call the iceberg metaphor model by Fletcher (2017), illustrated in Figure 5.1. According to him, reality is stratified into three levels:

- The first or top level represents the empirical level related to events that we can experience. At this level, events or objects can be empirically measured and are usually described through 'common sense'. Such events include social ideas, meanings, decisions, and actions. However, these events are always mediated by human experience and interpretation.
- The middle level represents the actual reality. At this level, events take place regardless of whether or not we experience or interpret them. These actual occurrences are often different from what is observed at the empirical level.
- Finally, the third one is the real level. Causal structures or causal mechanisms exist at this level. These are the ingrained properties in an object or structure that act as causal forces to produce events that appear at the empirical level.

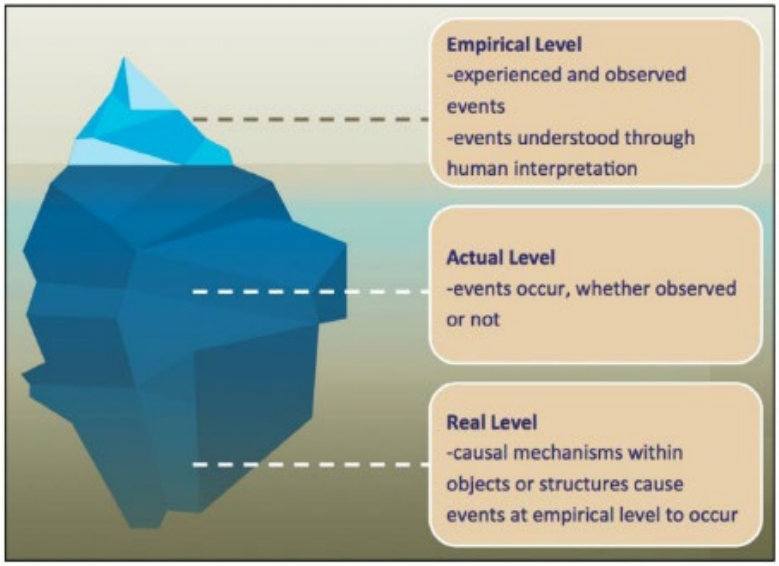


Figure 5.1 The iceberg metaphor for ontology (Fletcher, 2017)

The core of critical realism is the mechanisms that are described in the literature as 'deep structures', 'deep processes', 'generative mechanisms', and 'causal mechanisms'. Generally, a mechanism is a causal structure that can trigger events (Bhaskar, 1998). Critical realism proposes that actual events (human experiences and perception) are generated by the real or the deep which constitute mechanisms that are invisible to the researcher (Vincent and O'Mahoney, 2018). Mechanisms are related to the nature of the objects of the real that are frequently triggered by the interaction between objects (Bygstad and Munkvold, 2011). These mechanisms lie beneath the surface of presenting events, and the fundamental goal of critical realism researchers is to uncover these mechanisms and acquire more knowledge about them in order to explain how things work (Lawani, 2021).

For this study, critical realism is the appropriate philosophical paradigm. In the context of this thesis and to understand intrapreneurship as an organizational phenomenon and explore the organizational enabling factors for intrapreneurship within the organization context, this thesis investigates empirical and observable events of intrapreneurship, innovation, and organizational culture through management

practices and decisions and engineers' actions. These observable events represent realities that occur at the empirical level and can be observed through the researcher and their informants. These events are generated by the organization's mechanisms related to the structure, vision, strategies, processes, regulations, and rules at the real level, which exist independent of the researcher's or participants' perceptions. These potential mechanisms provide insights into questions about how organizations can be more intrapreneurial. These mechanisms at the real level are neither directly observable nor measurable, but the underlying order must be discovered through the process of interpretation (Walliman, 2011). The technology organization is a complex environment and exposes several aspects that require an in-depth study to avoid utilizing a basic vision or one-dimensional viewpoint. The objective of critical realism is not to explore event-level regularities, but rather to uncover and identify the mechanisms that produced these events (Bygstad and Munkvold, 2011). As such, this research focuses on identifying the mechanisms at the real level that causes events at the empirical level to occur and enable/constrain the actions of employees/managers. These hidden mechanisms when exposed can offer a substantial explanation of how technology firms can facilitate intrapreneurship and, importantly, how they support their engineers to adopt more intrapreneurial roles at 'the empirical level'. The reality of intrapreneurial firms is constructed and demonstrated at different levels and by different actors within the organization.

5.1.1 Critical realism and research methodology

Critical realism is not a methodology that proposes a specific method for how to conduct the research; rather, it is essentially a research philosophy. The research method choice of critical realism is usually highly flexible and adaptive (Ackroyd and Karlsson, 2014). Therefore, a wide range of methods has been embraced by many authors while adopting critical realism within the field of organization studies, including case study (Easton (2010), Lawani (2021)), action research (Friedman and Rogers, 2009) comparative case studies (Kessler and Bach, 2014), grounded theory (Kempster and Parry, 2014), and surveys (Cully et al., 1999). According to Sayer (2000, p.19), the research method for critical realism should *"depend on the nature of the object of study and what one wants to learn about it".* Ackroyd and Karlsson (2014) suggest that the research design of critical realism depends on the research focus and ranges from 'intensive' to 'extensive' research. This scale was originally presented by Sayer (1992) and further developed by Vincent and O'Mahoney (2018), presented in Figure 5.2 below.

	Intensive ß à Extensive			
	What is the mechanism?	*How do context & mechanism typically interact?*	*How do context & mechanism historically interact?*	*What is the context?*
Detached	Case-study	Comparative case-study	Institutional / historical analysis	Surveys
Engaged	Action research	Intensive realist literature evaluations	Barefoot research	Extensive realist evaluation

Figure 5.2 Critical realist research designs by Vincent and O'Mahoney (2018) (amended from Ackroyd and Karlsson (2014))

In more detail, intensive research is a focused one where the issue under investigation is addressed in depth, whereas extensive research, which is on the other side of the scale, focuses on broad characteristics of groups, often the whole population (Ackroyd and Karlsson, 2014). In terms of the relationship between generative mechanisms and the contexts, intensive research focuses on the exploration of causal power where the context is known, and the mechanism is unknown. Extensive research focuses on the broader context in which known mechanisms operate and studies the influence of different contexts on known mechanisms (Ackroyd and Karlsson (2014), O'Mahoney and Vincent (2014)). Therefore, intensive research prioritizes and employs qualitative methods such as case study or action research and produces causal explanations which are specific to the examined scenario. On the other side, extensive research prioritizes the use of large-scale surveys, formal questionnaires, and statistical analysis (Sayer, 2000).

This study selects intensive research for an in-depth study of the intrapreneurship phenomenon within the context of specific organizations (technology-based SMEs). According to Reed (2009, p.439) *"One of the main features of intensive research is that research questions are always context-specific, focusing on the detailed understanding of how underlying generative mechanisms 'work their way through' in a particular case or limited cases"*. This is the case of this research where critical realism allows the researcher to study complex interactions within the case to uncover generative mechanisms (Ackroyd, 2010) and obtain rich explanations of existing mechanisms in the phenomenon of interest (Sayer, 2000).

Qualitative research based on the case study approach is adopted for this research, which is the most common approach compatible with the philosophical assumptions of critical realism. In this perspective, Vincent and O'Mahoney (2018, p.208) explain *"The most common, and arguably most useful, form of critical realism research. In-depth exploration of a case to abduct causal mechanisms from their empirical manifestations. Cases may range from people to companies to whole economies"*. According to Ackroyd and Karlsson (2014, p.24) *" for critical realism researcher, one goal of research is to identify the sequence of causation or causal mechanisms at work. Case studies are a suitable*

vehicle for examining such sequences, with successful designs identifying a context in which a specific mechanism is identified and explored… For the realist, then, a case study represents an opportunity to identify the operation of a mechanism or process in whole or part". A critical realist case approach is particularly well suited to explore and investigate a relatively clearly bounded, but complex organization (Easton, 2010). Easton (2010, p.119) justifies this further, *"Critical realism is particularly well suited as a companion to case research. It justifies the study of any situation, regardless of the numbers of research units involved, but only if the process involves thoughtful in-depth research with the objective of understanding why things are as they are"*. Critical realism also offers the researcher to investigate complex organizational phenomenon in a holistic way (Wynn and Williams, 2012). A case study approach in critical realist studies is effective for contrasting and comparing or correlating diverse scenarios and circumstances and their outcomes, as well as revealing the mechanisms which might influence those outcomes (Danermark et al., 2002). Within the selected case studies, the process of critical realism for this research started with empirical data, and events were observed at the empirical level through in-depth interpretive data obtained through semi-structured interviews with managers and engineers.

Critical realism is not only applied to conduct research within the boundary of a case study, but it also supports a comparative case study, such an approach was followed in this research. This allows researchers to explore how mechanisms operate in different contexts and how some identified mechanisms may produce different outcomes across the cases (Vincent and O'Mahoney, 2018). In addition, a comparative case study allows researchers to study variations in mechanisms and how they exist and work themselves out in particular ways (Ackroyd, 2010). This is based on the fact that the outcome of a mechanism is contextual and dependent on other mechanisms, thus, a mechanism may generate an outcome in one context, and a different result in another context (Bygstad and Munkvold, 2011). Comparing similarities and differences among multiple case studies in the context of critical realism allows processes, generative mechanisms, and conclusions about causes and outcomes to be drawn more effectively (Ackroyd and Karlsson, 2014). Based on this, a cross-case study approach is utilized in this research to investigate and understand how intrapreneurship is supported in different organizational contexts and how different mechanisms across different cases are deployed to facilitate the engagement of engineers with intrapreneurship.

While the objective of critical realism is to explain a social event and the related mechanisms and their potential consequences throughout the stratified 3-layers of reality (Fletcher, 2017), critical realism is relatively difficult to operationalize and therefore many critical realist researchers in organizations do not end up detailing a clear set of entities, properties, causal mechanisms, or triggers (Vincent and O'Mahoney, 2018). By the nature of this study as being exploratory research and adopting critical realism as the main philosophy, this research focuses on exploring the main mechanisms (rather than

testing predefined factors) that facilitate intrapreneurship within organizations and encourage engineers to engage with intrapreneurship.

Building on this discussion, the following sections will provide further detail on the research design and the process of data collection.

5.2 Research design

Research design, according to Saunders et al. (2016), represents the overall plan of how the research will be conducted to address the research question. It will guide the execution of a research method and the associated techniques and instruments for collecting and analyzing the subsequent data (Bryman and Bell, 2011). According to Yin (2017), research design connects the researcher to specific sites, groups, or organizations in the actual world, as well as establishes a link between the empirical data and the initial research question and conclusion. Therefore, researchers need to carefully choose the most appropriate approach that would offer them the most reliable answers to their research questions. This is especially significant for this research, where the concept of intrapreneurship is complex in its nature and described as a multidisciplinary phenomenon that crosses with other domains of the organization, innovation, technology, and engineering. These areas of the intrapreneurship phenomenon reflect the main interest of this study to best answer the related research question.

There are three main steps in designing the research; the philosophical position (discussed in the previous section), research approach, and research methodology (Bryman and Bell, 2011). This research follows a qualitative research approach through a multiple-case study method to elaborate and identify the mechanisms organizations use to act more intrapreneurial.

Research is generally dominated by two major approaches, qualitative and quantitative research. Qualitative research is usually not associated with numbers or numerical measures and prioritizes words above quantity in the data collection and analysis (Bryman and Bell, 2011). It can support obtaining rich and detailed information about the phenomenon under research. Qualitative studies are more likely to be used to investigate, explain, and collect related information that can be utilized to develop a theory rather than to provide statistical generalizations (Saunders et al., 2016). Qualitative studies do not focus on representative sampling to generalize results as in quantitative research, and they can be designed to emphasize specific and limited events or cases to investigate, which is the case for this research about exploring intrapreneurship within technology-based SMEs.

Qualitative research enables the investigation and understanding of the meanings of individuals or groups attached to a social or human problem, as well as interpreting the social reality from the point of view of humans and their experiences (Merriam (2009), Creswell (2014)). According to Bryman and Bell (2011), one of the main reasons that researchers prefer qualitative research is that it enables them

for contextual understanding, such that a researcher can understand the specific environment and conditions in which social actors operate and how it shapes their actions. Furthermore, the qualitative approach provides more flexibility to researchers where they can change the direction of their exploration and investigation more quickly and easily than in quantitative research (Bryman and Bell, 2011). Thus, throughout the research, new points of significance may emerge, which the researcher could examine with others (Saunders et al., 2016).

In business and management research, the case study method is a prominent and commonly utilized research design that gives preference over other qualitative methods, such as observation of participants and unstructured interviews (Bryman and Bell, 2011). It allows the researchers to explore multiple realities that are difficult to measure or quantify (Hancock and Algozzine, 2006). According to Yin (2017), a case study is an empirical exploration of a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. The following Table 5.2 highlights some of the key research studies conducted in the field of intrapreneurship using the case study method.

Author/ year	Case study sampling	Data collection method	Research focus
Christensen (2005)	A single case study represents a large Danish industrial firm (Danfoss)	Data were collected through on-site observations and four interviews, including (a project manager, two functional managers, and an engineer)	The study explores the various factors that enable intrapreneurship in established firms, more particularly in a large knowledge-intensive industrial firm
Zhao (2005)	Multiple case studies including six entrepreneurial and innovative organizations located in Australia. These firms have different ages and sizes and were selected from different industrial sectors, such as electronic, fruit processing, and wine sales	Data were collected through interviews with senior managers	The study aims to explore the synergies between entrepreneurship and innovation and understand their complementary nature, in addition, to analyzing the factors that foster interactions between the two
Haase et al. (2015)	Three cases (firms) were chosen from different sectors of activity and locations and of different sizes in Portugal	Data were collected through interviews with staff members and analysis of documents	Explore in-depth the interface between organizational learning and intrapreneurship, how these two concepts are interrelated and mutually dependent
Smith et al. (2016)	A single case study of Thomas Cook, an international and giant company in the tourism industry	Data were collected through semi-structured interviews with 11 top managers, such as the CEO and Managing Director	Understand how Thomas Cook can turn entrepreneurs into intrapreneurs by looking at the intrinsic and extrinsic motivators as well as the factors in a corporate environment that are conducive to and act as barriers against entrepreneurial behavior
Hughes and Mustafa (2017)	Four SME cases were selected from various industries within the services sector in Kenya (tourism, retail/sales, ICT, and health and safety)	Data were gathered through a series of semi-structured interviews with three to five individuals from each case firm	The study explores how corporate entrepreneurship is achieved and practiced among SMEs in emerging economies by exploring the internal

Author/ year	Case study sampling	Data collection method	Research focus
			environmental factors that are critical for corporate entrepreneurship
Deprez and Euwema (2017)	A single case study using a Dutch ICT consultancy firm	Data were collected through group interviews with 42 young intrapreneurs and 13 leaders	The study aims to examine the leadership expectations of young employees in intrapreneurial jobs
Badoiu et al. (2020)	A single case study represents a new technology-based firm (Soluciones Cuatroochenta). The firm was selected from the ICT sector in Spain	Data were collected through semi-structured interviews with the founders and top managers of the firm and with intrapreneurial employees	To provide a deeper insight into the organizational factors and personal motivations of intrapreneurs which may foster intrapreneurial behaviors of employees
Pinchot and Soltanifar (2021)	Three case studies were selected. One of them is a world-leading mobility and logistics company located in Germany. The other two are anonymized	No details provided	This study outlines numerous ways to foster digital intrapreneurship, including a set of practical methods for managers to identify and empower digital intrapreneurs

Table 5.2 Use of case study method in intrapreneurship research

5.2.1 The rationale behind selecting a case study approach

According to Yin (2017), the case study is an appropriate method when satisfying three main conditions. These are related to:

1) The form of the research question
2) The control a researcher has over actual behavioral events
3) The degree of focus on contemporary as opposed to entirely historical events

Following Yin's (2017) conditions, adopting a case study in this research as the overarching research strategy is appropriate based on the following justifications:

- **First**, this research attempts to explore the intrapreneurial phenomenon by asking **'How'** can technology-based SMEs drive intrapreneurship and nurture innovation by harnessing the intrapreneurial capabilities of their engineers? According to Yin (2017), the case study design is more relevant for addressing 'How' or 'Why' questions seeking to explain a social phenomenon.
- **Second**, in the process of conducting this research, the researcher will not have control over the behavior, responses, and ideas of engineers or the management within the organization. The role of the researcher is neutral and has little control over the empirical events.
- **Third**, this study includes direct interviews with participants who are employees, as well as a range of updated events such as documents and online resources that go beyond what could be available in a conventional historical study. This research focuses on the phenomenon of 'intrapreneurship' which has emerged in the last 40 years, a relatively new area of research. Furthermore, Yin (2017) adds that case study research is appropriate for conducting an in-depth

study to understand the phenomenon in its real world. This research aims to gain an in-depth understanding by exploring the enabling factors of intrapreneurship within the organization's context.

- **Finally**, intrapreneurship within an organization crosses other domains of leadership, management style, corporate culture, strategic variables, and innovation management. This adds more complexity to investigating the intrapreneurial factors for engineers as it includes many dimensions to explore. According to Voss et al. (2002), the case study is appropriate for studying a poorly understood phenomenon and exploring a complex phenomenon in different settings where many relevant parameters are unknown. Merriam (2009, p.50) adds, *"The case study offers a means of investigating complex social units consisting of multiple variables of potential importance in understanding the phenomenon".*

5.2.2 Unit of analysis

Identifying the unit of analysis is a major step in the research design. According to Bryman and Bell (2011), there are different levels of analysis for case study research; individual, group, organization, and societies. The unit of analysis is derived from the research questions and research setting that informs the data collection method and the focus of data analysis (Yin, 2017). According to Patton (2015), one of the most important aspects to consider when making selections regarding the suitable unit of analysis is determining what unit the researcher wants to be able to say something about at the end of the evaluation.

Reflecting on the discussion above, this research focuses on technological organizations, specifically, how these organizations can advance intrapreneurship through their engineers. Therefore, the unit of analysis is the organization. Fletcher and Plakoyiannaki (2008) emphasize the point not to confuse the unit of analysis with the unit of observation, the latter from which the researcher collects the data. Table 5.3 summarizes the unit of analysis and unit of observation for this research.

Unit of Analysis	Unit of Observations
• The organization level	• Managers • Engineers

Table 5.3 Unit of analysis and observation for this research

Being an organizational-level study, data collection primarily took place at the management level. However, data were also collected through interviews with engineers at the individual level so as to produce meaningful results and interpretations at an organizational level. This is consistent with the views of Yin (2017), who explains that data may be collected heavily from individuals while the unit of analysis is the organization; they can provide insights into how the organization functions and why, something which is followed in this research.

This research is an exploratory study. The objective is to explore the organizational factors that influence intrapreneurship; hence, it emphasizes discovering and identifying potential influences instead of a deeper analysis of known influences that differentiates an exploratory from an explanatory case study (Yin, 2017).

5.3 Case study sampling

Sampling is a complicated process and challenging aspect of case study research. Several sampling strategies have been described in the relevant literature. Researchers have come to the conclusion that the aims of a given study should guide the process of selecting cases. According to Fletcher and Plakoyiannaki (2010, p.837), *"Sampling in case study research is largely purposeful, that is, it includes the selection of information-rich cases for in-depth study. Information-rich cases are those from which the researcher can learn a great deal about issues of central importance to the purpose and investigated phenomena of the study"*.

The case study approach provides more flexibility to the researcher regarding the rationale of sampling choices, the number of selected cases, and sampling techniques (Fletcher and Plakoyiannaki, 2010). The following sections explain the case study design for this research and the associated sampling and analysis processes.

5.3.1 Multiple case study research

This research follows a multiple case study design. More specifically, it includes four different companies from the technology sector in the UK. Yin (2017) affirms that multiple case studies are considered to be more robust and provide more persuasive evidence. It might be argued that single cases may obtain more detailed information and provide more powerful breakthroughs and insights compared to multiple case studies. However, single cases are more appropriate for longitudinal research (Voss et al., 2002), when the case represents critical factors (Patton, 2015), or when the case is extreme or unusual (Yin, 2017). In addition, a single case study has more concerns for the generalization of findings.

For multiple case studies design, Yin (2017) explains the rationale for selecting multiple cases, whether individual cases are selected for the purpose of predicting similar results (a literal replication) or predicting contrasting results in which each case serves a specific purpose (a theoretical replication). Multiple case studies allow the researcher to compare commonalities and differences across cases which facilitates exploring the phenomenon under research (Bryman and Bell, 2011). In conducting multiple case studies, Ayres et al. (2003) affirm that the researcher needs to establish the right balance of focus between within-case and across cases.

In light of the above discussion, multiple case studies were selected for this research based on theoretical replication to explore the phenomenon in different organizational settings and display the unique vitality of each case. The focus is on exploring each individual case (within-case analysis) and showing their particular context in empowering intrapreneurship. Bryman and Bell (2011) classified the focus of researchers when conducting several cases; if the focus is on individual cases, then it is a multiple case study, while if the researcher emphasizes producing general findings among cases with little focus on individual cases, it is a cross-sectional design. This research is a multiple case study of four technology-based SMEs. The following sections discuss the criteria for selecting these multiple cases.

5.3.2 Theoretical sampling criteria

Researchers, when adopting case study research, must explain how and why specific case(s) were selected (Goffin et al., 2019). For this thesis, the theoretical sampling strategy was utilized to select the most appropriate firms for this research and maximize the amount of information that could be gleaned from a small number of cases within a certain time allocated. Theoretical sampling refers to the *"selection of a sample of the population that you think knows most about the subject"* (Walliman, 2011, p.178). The objective of the case sampling strategy in this research is to achieve variation across selected cases for the purpose of capturing further potential aspects of intrapreneurship under different contexts. Therefore, cases were selected from different technological industries and had different management and engineering team structures.

Furthermore, cases were selected with reference to predefined criteria to ensure the phenomenon of intrapreneurship and innovation within organizations are actively presented and supported. In this regard, four main criteria were utilized to identify the appropriate cases for this research:

- **First**, all chosen companies are SMEs (the number of employees ranges from 50 to 250). This is related to the objective of this research, where the focus on SMEs is linked to the research question and knowledge gap.
- **Second**, given the emphasis of this study on exploring the engagement of engineers with intrapreneurship, the selected companies have to be engineering-intensive layouts in which the organization relies heavily on engineering roles to function and operate.
- **Thirdly**, the companies need to be technology-based firms that operate in technological industries and are well known for their innovation capability. The technology industry shows many features related to satisfying the selection of appropriate cases. For example, it is characterized by a high level of innovativeness, fast diffusion of technological innovation, a high level of employment of technical people, and the implication of technology knowledge in the form of patents and licenses (Zakrzewska-Bielawska, 2010). Grinstein and Goldman (2006) further distinguish technology firms from other firms based on three main elements:

1) They emphasized an orientation toward R&D activities
2) They focus on innovativeness and entrepreneurship, where employees are more innovative and intrapreneurial
3) They maintain a special pattern of work relations among employees related to the entire organization's culture

This, therefore, signifies the selection of companies operating in a very dynamic and fast pace technology industry.

- **Fourth**, studying intrapreneurship entails that the selected organizations exhibit an intrapreneurial culture. Building on the literature review, intrapreneurial firms are distinguished for creating a supportive intrapreneurial environment to nurture their employees. Many dimensions of the culture, such as having a reward system, freedom, flexibility with job roles, positive attitudes toward failures, and management support for innovation, were utilized to purposefully sample the case organization. Therefore, the secondary information for these organizations was investigated prior to the final selection, crossed with insights from initial interviews.

In addition to the four above criteria, other evidences were applied to validate the innovativeness of selected companies, such as innovation and excellence awards, certificates, number of patents, the investment in developing products and solutions, and the expansion to new markets and industries. Other available evidence shows the success of the firm was also utilized related to the overall growth and success of the organization; the selected firm has to show an increase in their profit and number of employees over the years.

5.3.3 The process of recruiting cases

Recruiting relevant cases is an important step in the research process. As part of it, the researcher gets in touch with managers and engineers in the UK at an early stage of his PhD, starting in Feb 2019. The researcher, for instance, attended a job fair organized by the Department of Electronics Engineering at the University of York, which included over 40 technological firms from a wide range of industries. The researcher targeted specific firms to connect with by exploring and collecting more information about their business structure. Over the course of time, the researcher managed to connect with 20 technological firms by meeting their representative managers and engineers. The researcher starts to draw a picture of these technological firms; how they operate and innovate, and what role engineers play in spurring innovation. Following this, a preliminary study was conducted by interviewing some managers and engineers from the connections made at the job fair as well as the University of York Alumni. The aim was to get more understanding of engineering roles within these technology firms, how they are successful with their current structure and engineering roles, what factors motivate their engineers, and what could be an optimal environment for their engineers to work in. The main objective

of the above activities was to understand and get familiarized with the UK industry and get to know how engineers work in this environment. The researcher comes from a different country where the setup of business and organization contexts are different from those in the UK.

Early involvement in field interaction and interviews, as part of the preliminary study, enabled the researcher to get a better understanding of technology firms in reality in the UK and how engineers are involved in innovation within these firms. This also allowed the researcher to reflect on the theoretical knowledge in the literature and the insights gained from the real world. Eventually, this has supported shaping the main research directions, including the focus on technology-based-SMEs and the research gaps. The researcher also gained practical experience in conducting interviews and expanded his network and contacts at an early stage of his PhD journey.

Once the preliminary interviews were completed and the criteria of selecting firms as part of the research design took place, the researcher started to look for suitable case studies. Different channels and networks were used:

- **First,** the researcher started by contacting potential firms using University of York alumni benefiting from the preliminary study contacts. The database was filtered based on the company type and technology industry.
- **Second**, the researcher got in touch with the external research and business collaboration department at the University of York to link him with potential firms from their list.
- **Third**, using major networks from the Electronic Engineering Department and the 'Engineering Management research group' at the University of York, including the supervisors' network.
- **Fourth,** the researcher explored the LinkedIn database and information using a premium account to have full access to company information and profiles of their employees.

Table 5.4 provides more details about contacted firms in these steps.

Source of firm recruitment	Contacted firms	Responding firms	Accepted to participate	Selected for case study
University of York alumni	8	4	1	1 (C3)
Network of Business Collaboration Department	2	1	0	0
Network of Electronic Engineering Department	3	3	2	1 (C4) 1 (Pilot study)
LinkedIn	65	20	4	2 (C1 and C2)

Table 5.4 Recruiting potential firm details

Potential firms were contacted via email or through LinkedIn messages. For each firm, the researcher gathered details regarding their business, innovation capabilities, and engineers using their websites and other online resources. The initial information was developed and uploaded to an excel sheet and categorized into groups for better follow-up and updates. Follow-up reminders were sent to participants

who did not respond. Initial emails were sent to one of the founders, CEOs, or executive teams, as they will have the authority to decide on their engagement with research projects from a university.

After securing firms to participate, the process of recruiting informants (managers and engineers) in these firms got delayed due to the unexpected COVID-19 complexities. For example, one of the chosen case studies postponed providing contacts for three months. Furthermore, many executive managers who accepted to participate had to reschedule their interviews as they had a busy and challenging time. Some of these interviews were canceled or rescheduled for a later date. Bryman and Bell (2011) raise such concerns and issues when the researcher prepares to interview senior management, making it incredibly difficult to arrange a convenient time for both to conduct the interview. COVID-19 has added more restrictions related to no site visits or face-to-face meetings. Therefore, this limits the researcher's ability to observe participants, team activities, and the physical environment.

In some selected cases, recruiting managers and engineers through contacted executive managers went slower than expected. Some executive managers had proposed a few names to participate voluntarily, but many refused for various reasons related to their role or being busy time or not being interested in such academic interviews. The 'Snowball sampling' method was applied and found to be a successful strategy for recruiting more participants in these firms, in which respondents were asked to suggest additional participants in order to ensure recruiting the 'information-rich key informants' (Patton, 2015).

5.4 Data collection

The primary source for this research was semi-structured interviews. Data collection proceeded over 19 months between August 2019 and March 2021. In addition, other data sources of secondary information also aided in the comprehension of each case context.

5.4.1 Semi-structured interview

According to Saunders et al. (2016), the primary benefit of a semi-structured interview is that it enables in-depth data collection and exploration of diverse experiences. The semi-structured interview provides greater flexibility in the interviewing process by allowing the interviewer to engage in a direct discussion and dialogue with the interviewee in a natural setting; at the same time, the interviewee is given a great degree of latitude on how to respond and answer (Bryman and Bell, 2011). Researchers, by using semi-structured interviews, will have more flexibility to collect open-ended data, investigate participant thoughts, and delve deeper into exciting responses. It enables the researcher to explore other significant subjects that arise throughout the interviews. Therefore, utilizing a semi-structured interview approach in this research seems to be appropriate. A total of 29 semi-structured interviews were conducted remotely due to COVID-19 restrictions. The interviewing procedure proceeded until

theoretical saturation was achieved. This was evident from the most recent interviews, in which no novel information was obtained. *"Theoretical saturation will occur when data collection ceases to reveal new data that are relevant to a category, where the properties or dimensions of categories have become well developed and understood, and relationships between categories have been verified"* (Saunders et al., 2016, p.596).

The interview and data collection were targeted at two different parties, managers and engineers. More details are provided below:

- **Firstly**, interviews were conducted with managers at the executive level representing different functional specialisms (strategy, technology, innovation, and engineering). The list of participants was expanded to other higher management functions and lower-level middle and direct managers according to the style of management in the selected firm, which can provide rich information to the study. According to Covin and Wales (2019, p.13), *"In small, simple firms where individual CEOs/top executives can be expected to have accurate and reasonably complete knowledge of their organizations' operations, a single informant can be appropriate".*
- **Secondly**, a sample of engineers on the operational level was interviewed. Engineers have been selected from diverse engineering backgrounds with varying roles and different years of work experience.

Table 5.5 presents the list of managers and engineers interviewed along with their titles, educational background, and total years of experience. The company and each participant in this study have been assigned a unique code for the purpose of anonymity. The company selected are referred to as 'C1', 'C2', 'C3', and 'C4'. Each participant is represented by the code CxPy, where 'x' represents the company and 'y' the participant. So that the reader can easily differentiate between participants and their related firms. For example, the code (participant C1P2) represents participant 2 in company 1.

Reference code of case study	Reference code of Participant	Job title	Education level	Years of experience
C1	C1P1	Engineering director	BSc, MSc (in engineering)	23
	C1P2	Head of product development and product director	BSc, MSc (in engineering)	17
	C1P3	Anonymized (Management level)	BSc, MSc	5
	C1P4	Engineering manager	BSc in engineering	14
	C1P5	Machine learning engineer	BSc in engineering	4
	C1P6	Lead machine learning engineer	BSc in engineering	15
	C1P7	Software engineer	BSc, MSc in engineering, MBA	6
	C1P8	Software engineer	BSc, MSc in engineering	2

Reference code of case study	Reference code of Participant	Job title	Education level	Years of experience
C2	C2P1	Founder and engineering director	BSc, PhD in engineering	34
	C2P2	Business development director	BSc in engineering, MSc in business management	35
	C2P3	Project director	BSc in engineering	30
	C2P4	Project group manager	BSc, MSc in engineering	8
	C2P5	Project engineer	BSc in engineering	2
	C2P6	Project manager	BSc, MSc in engineering	4
	C2P7	Project engineer	BSc in engineering	3
C3	C3P1	General manager and founder	BSc, PhD in engineering	16
	C3P2	Service delivery and account manager	BSc, PhD in engineering	4
	C3P3	Head of product development	BSc, MSc, PhD in engineering	6
	C3P4	Software engineer	BSc, MSc in engineering	3
	C3P5	Senior verification engineer and technical lead	BSc, MSc, PhD in engineering	4
	C3P6	Field application engineer	BSc in engineering	6
	C3P7	Senior quality engineer	BSc, PhD in engineering	31
C4	C4P1	Head of client relationships	BSc in engineering	25
	C4P2	Business development manager	BSc in engineering, MBA	21
	C4P3	Technology and innovation team lead	BSc, MSc in engineering	11
	C4P4	Technology and innovation engineer	BSc, MSc in engineering	5
	C4P5	High voltage operation engineer	BSc, MSc in engineering	3
	C4P6	Senior consultant technology and innovation engineer	BSc in engineering, MBA	11
	C4P7	Director	BSc, MSc (engineering), PhD	20

Table 5.5 Participants' background and reference code in C1, C2, C3, and C4

5.4.2 Secondary data collection

Collecting secondary information helps in gaining additional information to triangulate with primary information. Secondary data generally includes organization text documents (unlike the spoken), for example, the organization's database, reports, letters, emails, magazines, and non-text materials such as audio and video recordings, pictures, web images, films, and radio and television programs. Secondary data have many advantages for the researcher as it saves time and cost and enables to reach high-quality and rich data (Bryman and Bell, 2011). Content analysis was followed to analyze secondary data, which, according to Saunders et al. (2016), is an analytical technique used to code and categorize qualitative data in order to analyze them quantitatively. Content analysis is a proper way and approach to analyzing and examining mass media items, documents, and reports produced by the organization (Bryman and Bell, 2011).

In this research, relevant information was gathered from official company documents such as annual reports, strategic plans, and policy documents, in addition to product information, case studies, awards-related documents, company websites, internal newsletters, media information, internet resources, and published interviews with CEO and higher management in these firms. Some of the main secondary data sources utilized from each firm are listed in Table 5.6.

Case	Collected documents
C1	Job adverts: 6 documents Media interview with the CEO and higher management: 4 interviews Customer success stories: 2 videos Case study: 5 documents Press and media news: 8 websites Annual global compliance report 2020 Annual industry report 2021
C2	Job adverts: 5 Media interview with higher management: 3 interviews Case studies project success: 6 documents Press and media news: 7 websites 2020's highlights: Internal document Company award: 3 documents Product brochure: 5 documents Published articles: 4 Company innovation newsletter
C3	Job adverts: 5 Press and media news: 9 websites Company brochure: 2 documents Product brief: 6 documents Research projects: 3 documents Case studies: 5 documents
C4	Job adverts: 5 Media interview with the CEO and higher management: 1 interview Strategy and innovation document: 4 documents Annual reports 2020, 2021 Press and media news: 9 websites Case studies: 5 documents

Table 5.6 Secondary data sources and relevant documents

5.5 Data collection preparation

Data collection took place following the development of the interview guide and consent form for the participants.

5.5.1 Interview guide development process

In semi-structured interviews, questions are structured to some extent to make sure that the information can be used to answer the research questions. At the same time, some room is left to ensure the discovery and elaboration of new knowledge (Bryman and Bell, 2011). Open-ended questions help the participants to give additional comments, ideas, and opinions to express themselves. The final developed interview guide has predefined questions to maintain consistency among all participants' responses (Saunders et al., 2016). Two separate sets of semi-structured interviews questionnaire were designed separately for managers and engineers. The rationale for this approach was to acknowledge the role of different parties in the intrapreneurial process. Managers represent the strategy of the firm and how they design an environment that supports intrapreneurship and innovation. Engineers are the ones expected by management to contribute effectively to the innovation within the organization.

The process of developing the interview protocol is illustrated in the diagram below (Figure 5.3). This process was developed in reference to the model created by Bryman and Bell (2011) for 'formulating questions for an interview guide'. The initial interview guide includes a list of questions developed from relevant topics from the literature that are formulated and designed concerning the main research question. The various factors discussed in the literature review (see Chapter 3) informed and guided the formation of initial questions to investigate cultural, strategic, and management aspects. However, the questions are designed on a high level so as to investigate and explore new factors. There is no particular question was designed to test or investigate a specific factor from the literature. This allows the exploration of new factors based on the nature of this exploratory study, rather than testing or investigating the existence of predefined factors. For instance, the question 'How does the organization

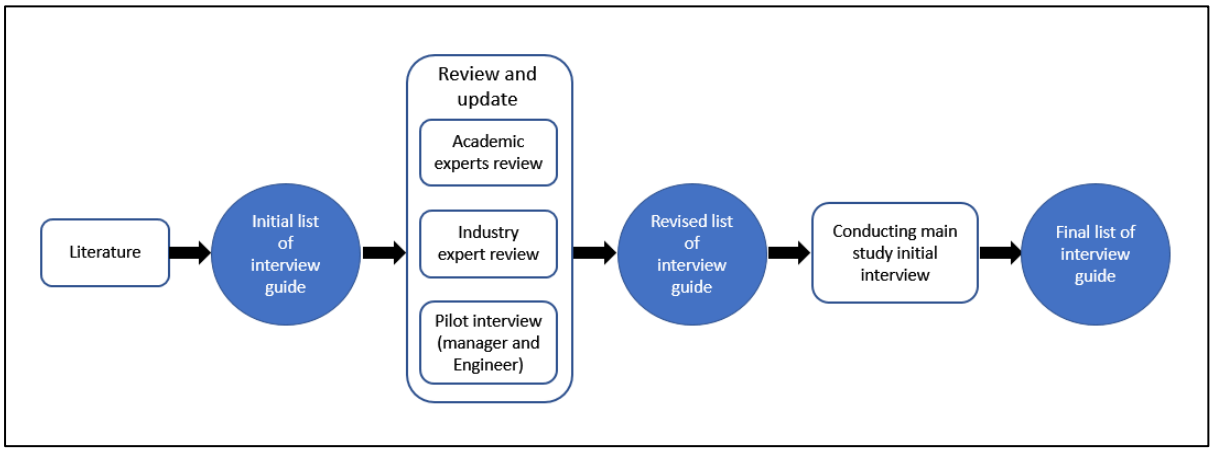


Figure 5.3 The process of developing the interview protocol

motivate and encourage engineers to act more intrapreneurially?' gives the participant the freedom to reflect on many factors within the organization that facilitate their engagement with intrapreneurship, then follow-up questions are asked to explore and get more in-depth information. Another example is related to the internal culture where the question is formulated in a similar way, 'What factors within the organization drive engineers' creativity and innovation? What is the role of culture in this context?'. Participants can reflect on and are permitted to consider any aspect of the organization's culture.

These lists of initial interview questionnaires were revised and further developed through multiple reviews by academic and industry experts and two stages of pilot interviews. Yin (2017) mentioned that the data from the pilot case study would assist in exploring all data collection issues and act as a 'laboratory' in developing relevant lines of questions, where the interview methods and written questions can be modified, updated, and tested before the actual study takes place (Bryman and Bell, 2011).

The final interview guide was adjusted and refined after conducting some of the initial interviews of the main study. For example, additional questions were added to understand the recruitment process and strategies to attract potential engineers.

Table 5.7 illustrates the final interview guide for managers and the main objective of each question. The interview guide started with 'introducing questions', as suggested by Kvale (1996), such as *Can you please give a brief description of your current role and what it entails?* This is considered a warm-up question to engage the participant in the interview. Such an open introducing question will allow the participant to reflect on his/her duties and responsibilities. Questions are categorized into three main themes; understanding intrapreneurship and innovation within the organization, understanding the contribution of engineers to the innovation process, and finally, exploring the factors that influence engineers to engage with intrapreneurship.

Q. No	Interview question	Objectives
Theme 1: General opening questions		
1	Can you please give a brief description of your current role and what it entails? a. How important is innovation in your current role? Please explain.	An introduction question aims to explore the role of engineers
Theme 2: Understand intrapreneurship and innovation within the organization		
2	How is innovation important to the firm success and overall performance (i.e., growth, financial income, competitive advantage)? In which ways is the innovation demonstrated in the firm? What types of innovation does the firm focus on? a. What are the main challenges the firm is facing in adopting and implementing innovation? And how are they addressed?	Explore how intrapreneurship and innovation are related to driving the firm success
3	What are the main sources of innovation in the firm?	Understand the nature of innovation in the firm

4	What is the general strategy of the firm to drive innovation?	Investigate the interaction between the firm strategy and innovation
Theme 3: Understanding the contribution of engineers to the innovation process		
5	How do engineers contribute to the innovation within the firm? a. Can you highlight some innovative activities/projects (development of ideas, products, services, or processes) that engineers have actively pursued and succeeded in?	Explore the role of engineers in driving innovation
6	What are the main challenges engineers face in developing new ideas or implementing innovation?	Understand the challenges engineers face along the innovation process
Theme 4: Exploring the intrapreneurial influencing factors for engineers		
7	How does the organization motivate and encourage engineers to act more intrapreneurially?	Explore the intrapreneurial organizational factors
8	How can the organization build the required knowledge/competencies and develop new skills so that engineers become more innovative?	Understand the process of competence development and knowledge sharing
9	What factors within the organization drive engineers' creativity and innovation? What is the role of culture in this context?	Understand environmental and cultural support for engineers
10	Can you explain how engineers within your organization interact with the management team? a. What is the support system for engineers in terms of driving their innovative ideas forward? b. To what extent can engineers communicate with different levels of management, including higher management? c. How does management react to innovation failures or unsuccessful initiatives from engineers? What were the actions taken?	Investigate management support and managers-engineers relationship
11	How do engineers engage with the company's vision and objectives? a. Does management show/demonstrate clear strategies on how to achieve these visions and objectives to the engineers? b. Do engineers' feedback contribute to this strategy, and how?	Explore the engagement of engineers with the firm vision and strategy
12	To what extent does the management encourage engineers to work beyond their job role toward creativity and innovation?	Proactivity toward intrapreneurship/ Flexible job roles
13	Are there active collaborations between different departments in the organization? Please explain.	Understand teamwork and collaboration
Additional questions developed during initial interviews		
14	1- How are engineers' performance and innovative capabilities measured? 2- What is the general recruitment policy of the firm to attract innovative engineers? 3- How does the existing organizational structure support intrapreneurship?	

Table 5.7 Interview guide for managers

The interview guide for engineers similarly explores some of the topics used with the managers' interviews. The questions asked to engineers centered around how they demonstrate and engage with innovation in their roles, how they contribute to the firm's success, how they perceive the organizational support, and what factors and conditions influence them to be innovative. The detail of the questions of the final interview guide for engineers is illustrated in Appendix 1: Interview guide for engineers.

5.5.2 Ethical considerations

Research studies involving participants always raise ethical concerns related to how to deal with them before, during, and after the research (Walliman, 2011). According to Saunders et al. (2016, p.239),

"Ethics refer to the standards of behavior that guide your conduct in relation to the rights of those who become the subject of your work, or are affected by it". These ethical concerns are related to informed consent, confidentiality, and anonymity (Walliman (2011), Patton (2015)). Accordingly, the researcher follows different steps to maintain research ethics:

- **First**, the researcher follows all the research integrity and ethical procedures recommended by the University of York. This includes attending specific training such as the 'Research Integrity Tutorial', which explains the high quality and robust practice across the full research process. Furthermore, the researcher obtains ethical approval prior to data collection for conducting this research from the Ethics Committee, including reviewing and approving the ethics form and the interview guide for managers and engineers.
- **Second**, all participants were asked to sign a consent form. This consent form (see Appendix 2: Research consent form) is prepared with the recommendation from Patton (2015), who suggested the main areas to be covered in the informed consent protocols:

    - What is the purpose of collecting the information?
    - Who is the information for? How will it be used?
    - What will be asked in the interview?
    - How will responses be handled, including confidentiality?
    - What risks and/or benefits are involved for the person being interviewed?

At the beginning of each interview, the objectives and focus of the study were explained, along with the relevant information about the interviewees' rights. For instance, participants have the choice not to participate in the study or to stop the interview at any point during the interview, and they will have the full authority to skip some questions that they are not comfortable with. Each participant was asked if they had any concerns or questions of any kind at the beginning of the interview. The researcher ensures that each participant understands their role as a volunteer and the confidential nature of the interview process. All participants were asked to fill and sign the consent form prior to or at the start of the interview and provide a scanned copy by email.

All participants were informed as part of the consent form about the project outline, data protection mechanism, the duration of keeping the data, the use of the audio record, and the anonymity of their names or their company names. It was also made clear to the participants that they might be contacted as a follow-up to clarify any point or any unclear research issues.

Confidentiality ensures that all information about the research will be kept secret from everyone except the primary research team (Saunders et al., 2015). This concerns the processes of sharing and storing the collected data and information (Creswell, 2014). For this study, interview audio records, transcripts, and participants' personal information have been saved and stored in a password-protected university server that is shared and accessed only by the supervisors and research team.

Anonymity is part of confidentiality to ensure the participants' identities remain secret (Patton, 2015). This has been achieved by keeping the identity of participants and organizations hidden in response to their decision to protect their identities. Therefore, reference codes were used instead of the real names of the participants and the companies, as demonstrated in Table 5.5.

5.5.3 Data recording, storage, and documentation

Information from interviews is usually recorded using handwritten notes, audio recordings, or video recordings (Creswell, 2014). Recording interviews enables the researcher to not rely on memory and provide repeat checking for accurate transcripts (Walliman, 2011). For this research, all interviews were conducted online via the phone or video call (using skype, google meet or zoom software applications) due to COVID-19 restrictions. The duration of the interview varied subject to individual circumstances, but in general, each interview lasted for approximately more than an hour; the shortest one lasted for 47 minutes, and the longest one was 95 minutes. Interviews were recorded using two external audio devices for dual backup. During the interviews, observations and side notes were taken to capture any interesting topics or any initial impressions and reflections. All interviews were transcribed on a word document, in which the researcher listened to the audio record several times to ensure that the transcribed script completely matched the audio record.

Furthermore, the details about each interview, such as the information about the participant and their organization details, interview comments, signed consent form, and interview audio records, would be maintained and documented in a record log throughout the research period. So, they will be managed in a way to facilitate later stages of data transcript, coding, and analysis. All research data and collected information were saved securely, confidentially, and stored on a university server that is password protected. All hard copies of documents and printed papers related to transcripts, interview notes, and participants' information were securely stored in a locked cabinet at the university. All these confidential records will be maintained for a period of one year after completing the PhD. Afterward, printed records will be shredded, and server-saved information will be destroyed.

5.6 Data analysis process using NVivo

As indicated in the sections above, qualitative data were gathered through interviews, resulting in a large amount of unstructured textual information. There are no structured ways to analyze qualitative data compared to quantitative data, *"Unlike quantitative data analysis, clear-cut rules about how qualitative data analysis should be carried out have not been developed"* (Bryman and Bell, 2011, p.571).

The textual data were analyzed using NVivo, a software program that enables researchers to organize, analyze and derive insights from unstructured text-based qualitative data in a systematic manner.

NVivo's user-friendly functions and features facilitate examining and verifying hidden trends, themes, and divergent information by coding and sorting data at different levels. For instance, see (Appendix 3: Initial NVivo coding for C1).

Interview transcripts were analyzed using thematic analysis. The analysis process followed in this research is developed and formulated according to the coding stages (familiarization, coding, themes, and refining) recommended by Saunders et al. (2016) and the general tips advised by Bryman and Bell (2011) for the preparation of codes. These were further developed to reflect the nature of analysis for within and cross-cases, as demonstrated in Figure 5.4. While the procedure of analysis is presented in a simple linear process, data analysis was performed through multiple stages and rounds of iteration, including coding, categorization, and refining.

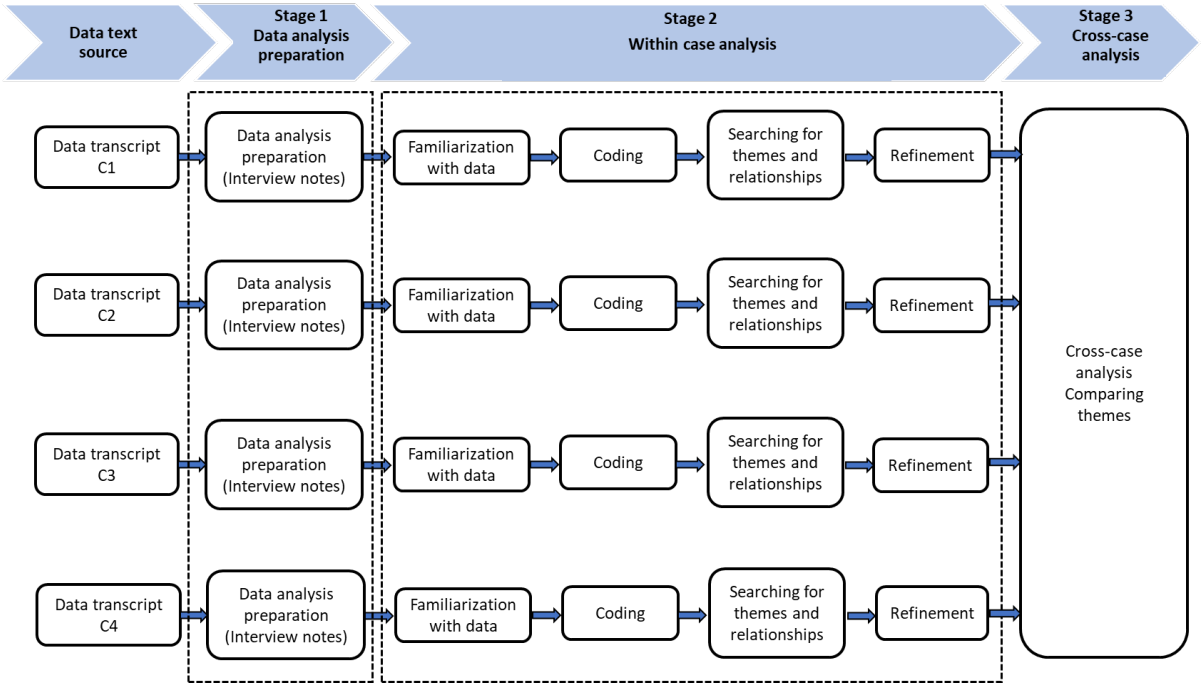


Figure 5.4 Data analysis process, developed from Saunders et al. (2016) and Bryman and Bell (2011)

The details of the data analysis process are explained in the following stages:

Stage 1: Data analysis preparation

During each interview, brief notes were taken about relevant and important subjects, followed by the researcher's initial reflection after completing the interview. The summary included the overall experience and analysis of the main topics discussed, any new insights that could be explored further in the next interviews, a summary of initial similarities and differences in comparison to other interviews, and the relation of the topics discussed with regard to the research question and literature review. This preparation also continued throughout the transcription phase, where the researcher took

notes for each interview. As a result, many reflective ideas emerged that helped the researcher interpret the data and develop a vision toward potential themes.

Stage 2: Within-case analysis to identify the main themes for each case

The fundamental focus of this research is to explore intrapreneurship within the context and individual circumstances of each case. Each case has its own characteristics, particular nature, unique setup, and complexity, resulting in unique emerging patterns and themes reflecting how they embrace intrapreneurship. Therefore, each individual case study was analyzed separately, following the steps discussed below. This enabled a detailed understanding, in-depth investigation, and intensive analysis of intrapreneurship for each case in its real context. At the end of this stage, a detailed description was written for each case, provided in chapters 6-9.

Stage 2a: Getting familiar with data

Saunders et al. (2016) suggest that the researcher becomes familiar with his/her data by reading and re-reading the transcript and looking for meanings and patterns in the data. The researcher followed Bryman and Bell's (2011) suggestions to read through the initial set of transcripts and documents. The first time, the researcher read without taking notes or interpreting, but when they completed reading, they made some general notes about interesting, important, or significant topics. The second time, the researcher read the transcript again and made as many as possible marginal notes about significant remarks or observations. Keywords from respondents were used by the researcher to give names to initial themes emerging from the data. At this stage, the researcher used printed transcripts on paper to get familiar with the data and make initial remarks.

Stage 2b: First round of coding

As defined by Saunders et al. (2016), coding is the process of assigning a code for each unit of data that symbolizes or summarizes the meaning of the extract, where data with similar meanings have the same code to ensure consistency. Coding organizes each piece of data and makes it accessible for further analysis by rearranging and retrieving it under appropriate codes. The researcher kept the list of codes and their definition to ensure consistency along with the transcript. Bryman and Bell (2011) suggest that at this early stage, the researcher must be open and imaginative to not worry about generating too many codes. These codes will be rearranged and organized in later stages. Also, they suggest reviewing the code and removing any code that has a similar meaning to other codes. At this stage, some observations may also be triggered, showing the potential relationship of the code to the literature or, in some cases, the connection between codes.

The researcher utilized NVivo software to assign the first order of codes for each case using participant terms. Some codes were deductive from the literature, and some emerged from the data. Bryman and

Bell (2011) explain the development of initial coding as an exploratory process for the arrangement and rearrangement of codes to generate themes that demonstrate key concepts and relationships in the data.

Conducting exploratory research by exploring many factors and being open to many emerging themes, a large number of initial codes were used. This is consistent with Saunders et al. (2016), who explain that the number of codes will be guided by the meanings the researcher seeks to explore in the data set, the nature of the research approach, and the focus of the research question. Yin (2017) declares that each case study has to address both the phenomenon of interest and its context, resulting in many potentially relevant variables.

Stage 2c: Searching for themes and recognizing relationships

Following the coding stage, the researcher searched for themes, patterns, and relationships among the extensive list of codes to generate a shortlist of themes relevant to the research question (Saunders et al., 2016). A theme is considered a broad category that groups several related codes and implies a relationship to the research question. Searching for themes entails making judgments about data and searching for similarities and differences between underlying codes. Categorizing themes is an iterative development process in which the researcher rereads and rearranges data by continuously reviewing data sets, the emerging codes, and generated themes (Saunders et al., 2016).

Stage 2d: Refining themes

It is critical to refine themes and their connection to other themes to provide a well-structured analytical framework for analysis (Saunders et al., 2016). They note that throughout this process, the researcher organizes and refines the underlying codes and sub-themes by generating new themes, integrating multiple themes containing similar meanings into one theme, breaking a theme into different themes, or eliminating some initial themes. This is a continuous development process, including rereading and reorganizing data that will eventually be structured in a way to address the research question. In this stage, and as the results of different rounds, most of the themes were organized under three broad areas; intrapreneurial culture, leadership and management support, and vision and strategic orientation. These are related to the main research question and are consistent with the literature.

Stage 3: Cross-case comparison

This study focuses on the analysis of individual cases (within-case analysis). However, the in-depth single-case findings supported extensive cross-case analysis by investigating and expanding the understanding of the similarities and differences of the emerging themes across the multiple cases. This enriches the overall findings of this research by integrating the cross-case results in the general discussion chapter of this research (Chapter 10). The comparative data were demonstrated in tables for simplicity and visuality. Cross-case analysis was facilitated by using an excel sheet that utilized

information from the four cases. This involves comparing the main themes across cases and reading related data, sub-themes, and underlying codes from each case study in an iterative manner till the aggregate dimensions are derived. The cross-case results showed some similar intrapreneurial factors among these cases, but some were deployed differently based on the context of each organization.

Considering the main focus of this research on exploring the individual case study, in writing the report on the cross-case analysis, Stake (2006, p.40) states that *"In the final report, the section reporting the cross-case analysis is expected to be shorter than the sum of the case studies, yet it should convey the most important findings from each— somehow combined as Assertions. Some of the important findings from the Cases will be context-bound. Given the load, some oversimplification is likely and perhaps inevitable".* In this research, such recommendations were followed in reporting cross-case analysis results.

5.7 Research quality and rigor measurement

The quality of case-based research is primarily judged by the validity and reliability of the research design (Yin, 2017). According to Merriam (2009), both reliability and validity can be achieved through carefully paying attention and taking considerable steps during theoretical conceptualization, data collection, processing and analysis, and when demonstrating research results. For many scholars, reliability refers to replication and consistency in the research process, while validity relates to the appropriateness of the measures used and the accuracy of the findings, including construct, internal and external validity (Gibbert and Ruigrok (2010), Creswell (2014), Saunders et al. (2016)).

Emphasizing validity is critical for any research that seeks to be conducted accurately and transparently. Construct validity is the most important validity test, which occurs when the researcher identifies correct operational measures and uses adequate definitions and measures of variables (Creswell (2014), Yin (2017)). It guarantees that the case study measurements accurately reflect the studied concepts (Yin, 2017). In other words, it indicates if the research used accurate and acceptable operational procedures to explore what it claimed to investigate. To strengthen construct validity, Yin (2017) suggests that researchers develop a clear chain of evidence that demonstrates the step they took to move from the initial research questions to the final results. Triangulation is one of the main strategies followed to ensure construct validity by gathering information from different data sources and collection strategies (Gibbert and Ruigrok, 2010). This research used multiple methods to collect data, including direct interviews with relevant participants and written information derived from company documents and websites. In this study, data were also collected from various sources, including management from different levels and engineers, as well as secondary sources of information. Another strategy recommended by Yin (2017) to improve the accuracy of the case study is to get the draft of the case study to be peer-reviewed. Accordingly, the first two case studies were presented at two conferences

and got different reviewers' feedback and comments that have been useful to strengthen the presentation of the case studies in this thesis.

This study ensures that the selected cases match the predefined sampling criteria that have been assigned at the start of the sampling phase, in which selected cases present a supportive culture and a competitive profile of innovation for investigating intrapreneurship. Accordingly, additional validation and confirmation of the initial assessment of the chosen organizations were continued and obtained during the initial phase of data collection. Following this, the first two interviews from each case study were analyzed before proceeding to other interviews to ensure having a supportive culture and high innovation profile within the firm. For the selected four firms, analysis of initial interviews and secondary data provided enough evidence to validate case selection, as illustrated in (Appendix 4: Validating case selection). This supported the researcher in avoiding non-relevant cases. For example, one of the purposefully selected cases was dropped from the study after conducting a few interviews. The analysis of initial interviews showed results that contradict selection criteria number 4 related to ensuring a supportive culture. For instance, participants in that firm were demotivated and complained about the organizational culture and micromanagement styles. Their intrapreneurial efforts are usually not recognized by the management, and they work in isolated teams in a bureaucratic climate. Hence, this case did not fit the research criteria.

Internal validity, also referred to as 'logical validity' in the literature, aims to establish a causal relationship between variables and results. Gibbert and Ruigrok (2010) defined three main strategies to ensure internal validity; develop a clear research framework, pattern matching of empirical patterns with predicted or existing patterns from previous studies, and theory triangulation to verify findings using various perspectives and different theoretical lenses from the literature.

The external validity of a case study is concerned with whether and how the findings might be generalized (Bryman and Bell, 2011). Yin (2017) stated that the generalization of case study findings is an analytic generalization to other similar cases and is not a statistical generalization as in quantitative research. In the case of critical realism research, Ackroyd (2004, p.145) explains *"in realist case study research, the aim is to generalize about mechanisms, and so the procedure recognizes and accepts that the contexts in which they work themselves out may indeed be partly contingent"*. Merriam (2009) explains that the person who reads the case study can decide whether the findings can be applied to his/her particular situation.

Research is judged to be reliable when it presents identical results every time it is replicated. The reliability of data can be improved by using multiple data sources on the same phenomenon (Voss et al., 2002).

Researchers in methodological design have identified different actions and approaches to judge and enhance the quality of case study research in terms of validity and reliability. Therefore, the literature has proposed different strategies, test methods, and quality criteria. The actions taken by the researcher to maintain high-quality research are illustrated in Table 5.8. The actions were informed by different scholars such as Voss et al. (2002), Merriam (2009), Saunders et al. (2016), and Yin (2017).

Quality test	Description	Actions were taken by the researcher
Construct validity	Refers to the validity of the research procedure and process and approval of results	• Following a clear methodological plan based on philosophical assumptions has led to formulating well-considered steps of action. This increased the transparency of the analysis and coding process and chain of evidence (starting from the research question to sampling criteria, research protocol, interview guide, data collection, etc.) • Information was collected from different sources (interviews, documents, and archival data). • Data were collected from informants at different levels, including higher management, direct managers, and engineers. They represent different functional specialism • Review of transcript and analysis draft by key informants • Review of transcript and analysis draft by academic peers
Internal validity	Refers to the existence of causal relationships between variables and results	• Validating results through cross-case analysis • Replication logic • Following an iterative process through the data analysis process, including coding and categorizing • Participants' feedback on analysis results • Verify data by collecting different perspectives of participants
External validity	Refers to the generalization of findings and whether they might be applied to other contexts	• Multiple case study was utilized, including four technology-based firms • Companies selected in this study belong to different technological industries • Cross-case analysis
Reliability	Refers to providing stability and consistency in the research process. The research design should yield the same results when repeated	• Using a pilot study to test for reliability. The interview questions were tested, reviewed, and updated before conducting the main research case study • Review the interview protocol with experts in the field, both academic and industry experts • Well-designed interview protocol using a semi-structured interview method that gives more freedom to the researcher to investigate issues that emerged during the interview as well as add or remove questions as appropriate • The questionnaires in the interview guide were designed and formulated to be asked in an objective way to avoid unreliability • Questions were designed in a way not to lead the response in a particular direction • The interview took place at the most appropriate time for the interviewee • Companies' information and databases were developed during the case sampling process • Each case study was analyzed separately and had its own information folder in the NVivo software

Table 5.8 Actions taken by the researcher to ensure research quality and rigor measurement

The following chapters will now discuss the case studies starting with C1.

CHAPTER 6: C1 – CASE STUDY OF A FINTECH LEADER FIRM

6.1 Background and overview of C1

C1 is an Information and Communication Technology (ICT) company and a technology leader in Financial Technology (Fintech) industry. The core business focuses on producing and developing Anti-Money Laundering (AML) solutions, compliance products, and transaction screening and monitoring automated solutions for banks and financial services. C1 offers financial crime risk data and detection solutions and technologies driven by Artificial Intelligence (AI). It is transforming the compliance industry through cutting-edge innovation in Machine Learning (ML) and Big Data. The company owns and develops complex software that identifies tens of thousands of risk events daily from millions of structured and unstructured data sources.

C1 was established in 2014 as a startup SME by the founder and four employees to equip compliance professionals with effective financial crime-fighting tools and automated AML data generation. From the outset, its strategy focuses on growth, market expansion, and the development of unique products. Despite being a relatively young company, C1 has become a fast-growing firm with revenue rising by 300% between 2018-19 and serving more than 500 enterprise clients across 75 countries.

Nowadays, C1 is a benchmark company in the UK and globally and a leader in AI-driven fraud and AML risk detection. The firm was awarded for its incredible work and success. For instance, in 2018, it was named by 'CB Insights' in the annual ranking as one of the world's 100 most promising AI start-ups. In 2020, the company was honored as a 'Technology Pioneer' by the World Economic Forum. The company was also listed in the 'Sunday Times Tech Track 100 Awards' in 2019 and won the 'Digital innovation Award' in the same year.

6.2 The nature of innovation in C1

C1 is generally regarded as both very innovative, focusing on integrating new technologies with their products, and very knowledge-intensive, focusing on applied research. The continuous introduction of new and improved products means that C1 gives technological innovation a great deal of importance. For instance, participant C1P1, who is the engineering director, explains the value of innovation to the business, resulting in the development of unique products with the potential to lead the market. He notes, *"Innovation is very important because what we are trying to do is make something that nobody else has done before"*. Participant C1P4, who is an engineering manager, highlights the complex technology used in their products and the importance of generating advanced technological innovation. This, according to them, is a core function necessary to develop their business and keep it competitive in the market, *"It is the AI-driven system the way we position ourselves, and ML is the main component*

around it. We cannot make progress if we are not innovative... So, the core of the company is around innovation. This is an integral part, specifically when working on technologies or areas where no one has worked before. Innovation is the core where we start with some greenfield projects and experimenting on new technologies". In a similar view, participant C1P6, who is a lead engineer, expressed how innovation today has become a mandatory approach while working in fast-paced technology areas to stay competitive.

The innovation of C1 revolves around a central vision that inspires and motivates everyone in the company to develop innovative products that significantly contribute to society and people's lives. The firm has been established with a clear vision to solve and fight financial crimes on a global scale by neutralizing the risk of money laundering, corruption, terrorism financing, and other global financial crimes. This is clear from the statement of participant C1P5, one of the engineers working with machine learning, *"Our CEO had a very interesting vision when he started the company, and many of the innovations are sort of born from that particular vision. and this complete vision has not yet been actualized".* Participant C1P3, a manager within C1 whose title is anonymized, explains this further and highlights the role of engineers in achieving competitive advantage through innovation. They add, *"We need our engineering team to be super innovative and keep building on the ML technology in order to be unique in our industry. That is what sets us apart and helps us become leaders if we are innovative and try to do and implement new things and new ways of working across the tech industry".*

One of the key approaches for engaging all engineers in the innovation process is related to C1's business strategy. The company is not adopting any formal strategy for innovation where there is no specific team responsible for innovation. Participant C1P2, who works as head of product development and product director, illustrates this further and explains how innovation relates to the firm strategy, *"We do not have a separate innovation strategy. We have a company strategy for how we are going to grow. The innovation work we do is the work where we explore opportunities and ideas as to how best to execute that strategy".* The benefits of this are clear for engineers to be more innovative, as explained by participant C1P2, where they can think clearly and reflect on the link between the problems being asked to solve and the company's core growth strategy. In the view of participant C1P4, who is an engineering manager, the strategy can provide a framework for innovation to occur where engineers are given the freedom to suggest interesting ideas, conduct experiments and try new things. They add, *"I believe it does not help where we want to apply a strategy for innovation. It does not have to be very strict, as you would lose the essence of innovation. There have to be some guidelines, definitely, but that is not a way strict policy"*. Participant C1P2 believes this is the best and the most effective approach to having a company strategy to drive business growth and innovation works in this context. This allows the firm to be flexible to adapt to market changes and find the best approach for innovation. As a result,

engineers will have the flexibility to explore a wide range of opportunities and be granted more freedom to select and decide the best ways to solve market challenges.

One of the main events to drive innovation organized by C1 is the quarterly meeting which is an innovation workshop involving technical and non-technical parties. All engineers are allowed to voice and present their ideas and initiatives. This innovation workshop plays a major role in driving the innovation plan and the firm's objectives for the coming quarter. Managers explain and share the strategy and overall business updates for the whole company and decide, plan and announce the main agenda and objectives to be achieved in the next quarter. Managers during this meeting define a specific problem with clear boundaries and constraints, which makes a clear roadmap for engineers to work on for the next three months and innovate accordingly. In the next meetings, the winning ideas of engineers will be taken forward and integrated with the business plan for the coming quarter, which indicates how engineers' initiatives are necessary to define the firm strategy and future goals.

To ensure successful results and outputs of the event, it has a clear process. The ideas submitted by engineers in response to the defined problems are assessed and classified. The best two or three ideas will be selected to develop into business opportunities, which will then get full support for successful implementation. Engaging all engineers in this event using a clear process will encourage them to be more productive through their initiatives and proactively feed the innovation process with specific ideas to be implemented.

One of the main ways to trigger potential ideas in this firm is through a 'paper session'. Any engineer can initiate a group meeting to discuss an interesting new piece of paper in some related technology fields by inviting engineers from other teams to discuss the potential of applying this knowledge in new innovative ways. These sessions are usually concluded with brainstorming activities on the best potential ways to utilize and implement this new knowledge.

6.3 The significance of engineers in driving the innovation process

C1 is an engineering-intensive firm. Currently, it has around 200 employees, and approximately half of them are in engineering roles. The engineers in C1 come from diverse educational backgrounds, such as computer software engineering, electronic engineering, AI, and ML engineering. The company's success depends on their employees' competencies, particularly that of the engineers because their contribution is significant toward driving and implementing the innovation within C1. Hence, engineers can be classified as one of the most important professions within C1. They play a pivotal role in creating new ideas and concepts, exploring new opportunities, and deploying innovation to produce meaningful outcomes. This is evident from participant C1P3, who emphasizes, *"I think the engineering team probably brings the most adventurous ideas and the most exciting innovation to the business".*

Engineers play a crucial role in both directions of the innovation process, either top-down or bottom-up process. Participant C1P4, who is an engineering manager, notes that most of their innovation is initiated by engineers through a bottom-up process. In the top-down process, even though some ideas are generated from executive management or the founders based on the company's strategies, the innovation on how to exploit and transform these ideas into real technology products relies a lot on their engineers. Participant C1P1, who is the engineering director, explains this process by citing an example from one of their latest products where engineers made substantial contributions, *"[Product name] that complies with the whole mission of the company comes from our founder…, the details of which database technologies will be used? How will they be joined together? What will be the technology for mapping? That definitely comes from the engineering team".*

Furthermore, engineers contribute significantly to promoting both incremental and radical innovation, shaping the products, and maintaining sustainable innovation delivery. This is explained clearly by their head of product development, participant C1P2, who says, *"We encourage engineers to come up with new ideas to develop new products. Also, many ideas are coming incrementally to do something that we already have but better, faster, or cheaper as part of the core product development process. Eventually, delivering a product substantially more efficient".*

The mechanisms, according to the analysis of C1, are related to various cultural mechanisms driven by Kaizen[3] principles, strategic recruitment process and competence development mechanisms, and leadership and management support mechanisms. The following sections will discuss these mechanisms and the intrapreneurial environment within C1, which represent the overall setup of the entire organization that facilitates intrapreneurship.

6.4 How is Kaizen driving C1's intrapreneurial culture?

The intrapreneurial culture driven by Kaizen is the most crucial factor for the intrapreneurial activities of engineers within C1. Engineers perceive this culture as the main influence to embark on innovative activities and solve customer challenges. According to participant C1P3, who works as a manager (their title is anonymized), *"The culture that motivates engineers will help them progress the product and make the customer happy".* Participant C1P6, who is a lead machine learning engineer, reflected on his experience in the company and explained how he was influenced by the culture that instilled a sense of loyalty in him, *"Working in this culture, you will have a strong sense of product ownership because*

[3] 'Kaizen' refers to a Japanese word which means 'improvement' or 'change for the better'. Kaizen is defined as a continuous effort by each and every employee (from the CEO to field staff) to ensure improvement of all processes and systems of a particular organization. Today Kaizen is recognized worldwide as an important pillar of an organization's long-term competitive strategy. The implementation of the principles of Kaizen in any organization is fundamentally important for a successful continuous improvement culture and to mark a turning point in the progression of quality, productivity, and labor-management relations.

you are the one who is responsible for building, designing, and testing functions. It is like your baby, so you want it to grow, and this push always the efforts to think of new ways to improve or polish it".

Kaizen supports the improvement of existing activities and ensures continuous contribution to the development of the firm by every engineer in the form of new initiatives and suggestions that add value to the products, process, their team, and the entire company. This is clearly stated in one of the firm internal documents, *"Our company culture makes everything we do possible. It drives our innovation and nurtures our personal growth. It helps us change the world"*. Kaizen drives an internal intrapreneurial culture through different mechanisms to empower engineers and increase their motivation, so they can flourish and excel in their roles. Some features of this culture are discussed by participant C1P3, *"I think we successfully managed all different tribes and squads on different levels. And the reason we can do that is we have created a safe culture where engineers are able to have that two-way communication and are able to make mistakes very quickly and able to feel comfortable as experts in the field that they want to share their ideas"*. It is clear that Kaizen guides the overall innovation route within the firm. The following sections discuss the key organizational factors derived from Kaizen principles that are crucial for creating an environment for intrapreneurial culture to thrive in C1.

6.4.1 Freedom at work

It is clear that engineers are given the freedom to explore potential opportunities. As explained by the engineering director, participant C1P1, *"The way to motivate engineers is to give the space to innovate, provide them the problem and give them the freedom on how to solve it within the right constraints"*. This freedom on how to implement innovation gives engineers more innovative options to explore new ways and new technologies. They can make decisions on their own for the best way to execute and do their work. Participant C1P4, an engineering manager, adds, *"To have some kind of autonomy, it actually motivates everyone. By encouraging autonomy, it will encourage engineers to work independently and have their own decision as long as it is aligned with the vision"*. Participant C1P1 reflects on this by an example, *"When we write the product requirements and what the product will do, we never say how the product should do it. So, I think it is very important to give the freedom to the engineering teams to work on their own solutions and their own designs so they can innovate"*.

The benefits of freedom for engineers are obvious in providing them the space for being creative and proactive in coming up with continuous suggestions and proposing new solutions that make innovation happen. As noted by participant C1P4 *"Autonomy is the principle that enables engineers to come up with new ideas and solutions"*. Furthermore, engineers can engage in innovative activities without referring to their managers for authority or permission. In this regard, participant C1P1, as a manager, clarifies, *"I am empowering engineers within the teams to have autonomy. I am very clear that if*

somebody spots a problem, my first response is, can you fix it? People do not need to ask my permission to do or try something sensible. Even if it is something that ultimately fails, they do not need to seek my permission to try or do it. They need my permission if they want to go far off the roadmap or to miss customer commitments". This encourages engineers to enjoy finding their own ways of doing things, managing their work, and taking ownership without consulting their leaders.

This freedom is given with particular constraints and conditions to ensure its effectiveness and will lead to promising outcomes. In this perspective, participant C1P2, who works as head of product development and product director, explains the importance of providing a balance between freedom and responsibilities toward innovation so that innovation will be compatible with the firm's direction. He clarifies, *"It is about giving that freedom within known boundaries and conditions; here is what we have got to achieve this quarter or this month, and within that, we can do as much innovation as we want. There is a responsibility to leave the space and some gaps there so that interesting things can happen".*

6.4.2 Flexibility with job roles

In C1, flexibility is provided at every level and in every part of the organization. Therefore, it helps facilitate creative thinking and innovation from every engineer. Participant C1P6, a lead engineer, explains why he moved to this flexible environment compared to his previous experience in a large firm, *"I enjoyed working in a startup and SME environment. The level of flexibility in everything around opens the horizon to be proactive and innovative".*

Although the firm has general goals for the business direction, engineers are flexible in creating their own goals at the team level. Engineers are a key part of assigning and discussing their team goals, and they are part of the decision on releasing the final goals of their team that are compatible with the company's vision and strategic direction.

This flexibility is also related to the dynamic processes and working rules that enable engineers to move around with their ideas as there is no stoppage or rigid process to follow. Participant C1P7, who is a software engineer, complements, *"There are no traditional rules to follow while innovating, so you just find out your own ideas and start to innovate on top of them. You are given enough amount of bandwidth and support".* As a result, ideas can be transferred to others to get immediate support. Participant C1P6, who works as a lead machine learning engineer, comments on the result of having this flexibility *"You can quickly spread the idea, easy to get people on board, get support, and move the idea forward".* Similarly, participant C1P5, who is a machine learning engineer, adds, *"There is no specific process for taking the idea forward. There is a general non-formal procedure by taking the idea and discussing it with the manager, then depending on the case what further actions are needed and what kind of support is required".*

The nature of a flexible environment at C1 is also inherited in the job role specification. Despite that engineers have specific defined duties and responsibilities, they have more dynamic roles and can easily go beyond their job responsibilities and gain new skills and knowledge in other domains. This is related to the team structure within C1 based on the Spotify[4] model. Engineers work in teams of six to eight engineers called squads, which comprise engineers from different expertise and disciplines assigned to work on a specific part of a product. A group of squads, called a tribe, works on a particular product line. This structure adds more flexibility to the roles of engineers by allowing them to work in multiple squads. They are authorized to join different teams and squads to upskill their abilities and broaden their horizon. Participant C1P5 summarizes, *"I was excited to work in a more flexible environment where I can take on a lot more roles".* He added that his job is clearly defined, but there is also a lot of freedom and flexibility to do things outside of that specifications, *"I can take the initiative to learn other expertise, so the specification is clear, but it is flexible at the same time".* Participant C1P6 explains that working in a startup SME and within a dynamic environment, job roles are changed quite quickly, there are no set boundaries, and engineers are learning very fast. Participant C1P7 points out that having flexible roles will build more experience and reduce routine work *"I was hired for some certain goals, but also, keeps changing. It is flexible and semi-structured. This provides me the flexibility to work on different projects and domains. Otherwise, you fall to a certain set of work that you keep on doing again and again".* This keeps engineers who have a hunger for new knowledge and experience very satisfied with such a flexible job setup. Furthermore, the company has flexible working hours that allow engineers to choose the best time to work and effectively handle their job.

The company has decided to gradually move to a hybrid working model based on the positive employees' experience of remote work during the lockdown period of COVID-19. The model allows employees to have more flexible choices to either work from home or the office for a better work-life balance. Based on Kaizen principles, the hybrid working model will be implemented in phases, with the option open for all employees. Policies will be developed based on employees' feedback and evaluation of the impact on teamwork, collaboration, and other aspects of the business before structuring the final setup.

6.4.3 Recognition, appreciation, and reward system

The company has appropriate, attractive, and competitive reward systems with various benefits and incentives. Based on the engineer and managers' feedback, engineers have different preferences for what type of reward or recognition might motivate them. Accordingly, the firm secures a wide range of

[4] Spotify is a Swedish music streaming company founded in 2006. They applied a creative approach to accommodate the new scale without losing its Agile culture just when business took off and new hires started flooding the office. Their creative solution was called the Spotify model. The model is an autonomous and people-driven approach for scaling Agile. This approach highlights the importance of culture and network. It helped Spotify and other famous businesses to boost productivity and innovation by focusing on autonomy, communication, accountability, and quality. Teams are structured based on autonomous squads where a group of squads are organized into a tribe.

monetary and non-monetary rewards. This is linked to Kaizen, where the management continuously looks at new ways to improve their reward system and recognize their talents that motivate engineers and accommodate their different preferences. For instance, some engineers are satisfied with the recognition they receive from their manager, while some other engineers prefer simple rewards such as an Amazon voucher. Participant C1P5, who is a machine learning engineer, highlights the importance of spreading good achievements to the rest of the organization to motivate engineers *"We have a quarterly top management team meeting where if anyone has done something particularly exceptional, then it is announced to the organization".* Such management appreciation also takes place on the team level, as explained by participant C1P8, a software engineer, who affirms the importance of allocating a specific time of the tribe meetings to appreciate engineers for their good efforts. *"There is actually a specific section of the tribe meeting that is specifically trying to call out someone who has done something good or exciting or like who has worked extra hard on something and then they will be thanked".* Other forms of rewards were also described by participant C1P3, *"We have lots of fun ways to recognize in place, either through a monthly newsletter or a shout out in the town hall from the senior leadership team to acknowledge people that have done some great work. We also do give incentives such as a bonus, and it is all recorded in the performance management so that they get rewarded on a monthly and annual basis for their success".*

The firm provides a fair reward system based on engineers' achievements and contributions to innovation. According to participant C1P3, *"We ensure that all compensation and benefits are in line, and we are not offering to pay unfairly. So, if somebody who constantly keeps bringing new projects and innovation into the business, even though you are a senior software engineer, you may be paid very differently to another senior software engineer who has not submitted any projects or not gone above and beyond"*. In this firm, it is clear that the level of rewards and salaries is not only granted for good technical skills and work achievements but is related to the innovation created and the extra performance shown within the business. This transparent approach is followed across the company where engineers are aware of the salaries, but they know they can increase their own compensation and benefits if they submit good ideas.

Two major techniques are followed in this firm to ensure an effective rewarding system. First, rewarding is done very fast. In the view of participant C1P3, *"We recognize them immediately as it is very important to appreciate them very quickly".* Recognizing and rewarding engineers the soonest will keep them positively charged, energized, and motivated to continue working with the same passion throughout the innovation process and empower others to follow the same attitudes. Secondly, there is a balance of rewarding both individuals and teams for their contribution to innovation. Participant C1P2 mentioned the equal importance of recognizing the team and appreciating group work as well, *"It is a mistake to reward one person who creates the idea, as he/she needs other teams to exploit it. Innovation*

is fundamentally a team sport. While the idea of innovation is successful or rewarded on an individual level, but the success comes as a team".

6.4.4 Open communication

Flexible and open communication channels are well established throughout the entire organization, supported by a friendly culture and flexible hierarchy structure. Managers at different levels are open to connecting and interacting with engineers, which opens the door for successful communication and relationship. Engineers can communicate not only with their direct managers but also vertically and directly with higher management and executive team. Participant C1P4, who is an engineering manager, elaborates on this, *"Managers walk around frequently and may start talking to anyone. We have a flat organization, we do not have barriers to reach others, and I have never seen anything that limits people to talk to managers".* Engineers can easily approach top managers and discuss relevant thoughts directly with them. Participant C1P5, one of the machine learning engineers, supports this and adds that he can discuss any idea directly with the CEO. Participant C1P7, who is an engineer, believes that direct interaction with decision-makers on top levels will increase flexibility and accelerate the innovation process by having a shorter decision chain, *"When the firm is flexible, your ideas are well recognized by higher positions of the hierarchy. So, if you have flexibility, then you have a fast track for innovation to convince decision-makers. Otherwise, you will move from multiple steps to actually innovate, and that might be a blocker".*

The firm ensures open communication among different engineers through multiple structured meetings that take place on the squad, tribe, and organization levels. On the squad level, every day, there is an opening and closing meeting session for 15 minutes to organize and plan the work for the whole day and get updates from others on their progress. A weekly meeting with open topics and agendas is also held at the engineering team level. In this meeting, and according to participant C1P1, who is the engineering director, engineers often talk about an idea they have had and how they realized and got all the team involved to be part of developing the idea. It was clear from participants that the more engineers and teams are involved in the idea discussion, the less cost of resources and time to invest in trying out that idea. On the tribe level, there is a sprint meeting scheduled every two weeks where engineers communicate with each other, discuss any blocking issues and get support from others.

Internal technology tools facilitate communication and socialization between employees so as to keep everyone involved and connected. According to the C1P3, *"We ensure that the teams have got the right tools to be able to communicate effectively with each other. We have a lot of fun using these tools".* Interactive tools are also used to share knowledge between different disciplines of engineering teams. If an engineer faces some difficulties in their work, they can post it using the tool. So, others can reply by suggesting solutions or providing advice and feedback and may go through a discussion about it

supported by the same tool. Furthermore, engineers use special tools to give feedback about anything they want to raise to management. As illustrated by C1P3, *"We have a weekly survey that goes out that encourages people to give anonymous feedback around everything".* This gives them the freedom to offer suggestions and raise any concern of any type.

The organization has effectively minimized the impact of remote working during COVID-19 by successfully managing a good level of communication among all levels within the firm while keeping the values of the Kaizen culture alive. To adapt to new ways of working and continuously develop online working processes, the firm has enabled the feedback loop by sending frequent surveys to get employees' responses and concerns about what was working well and what could be done better. Managers also were more dedicated to allocating time for continuously interacting with their engineers. Participant C1P3 explains how the level of communication increased through more structured interviews using online tools, resulting in more interaction between managers and their engineers, *"The engagement survey shows that engineers can communicate with either the executive managers or their direct line managers, which is increased by 22% during the first six months of the pandemic. So actually, working remotely has encouraged people to feel more comfortable. So, you have to set up a time, and it is not just a quick conversation".*

6.4.5 Collaboration among multidisciplinary teams

In C1, one crucial factor that brings success to their innovation is the collaboration between business and engineering teams as a multidisciplinary joint effort. In this regard, participant C1P2, who works as head of product development and product director, explains, *"The business people have some view of engineering and engineers have some view of the business, and that is what creates the opportunity to innovate as a multidisciplinary team because actually, both sides have some understanding of the other, and that can be brought together".*

In this firm, success is defined on the team level, where they deliver and execute innovation as a team. Analysis from the interviews indicates that innovation is pure teamwork activity that fundamentally requires technical collaboration between different teams and squads so as to make an idea move forward. Collaboration is the spirit of work within teams and across multidisciplinary teams as well. The firm's teamwork is characterized by strong information sharing, consistent interaction and strong communication, close relationship, and a valuing of team contribution. Participant C1P7, who works as a software engineer, comments on his team, *"I have a very supportive team; we can do offline discussions, we can do formal discussions, and then I think there is a fair amount of support in this company for innovating on things".* Participant C1P8, who is a software engineer, discusses the teamwork on the squad level particularly, *"So we have a morning standup, which is about 10 to 15 minutes every day and then we also have a stand-down about 10 to 15 minutes end of the day. And they*

are both the exact same thing. Everyone gets an update on what they have most recently done since the previous one and like an update on what they are about to do for the rest of the day. These are the main crucial meetings for identifying blockers or where people can help out with other people's work. Or if people are stuck trying to figure out a solution. And those happen every day".

6.4.6 Handling failures in engineering roles

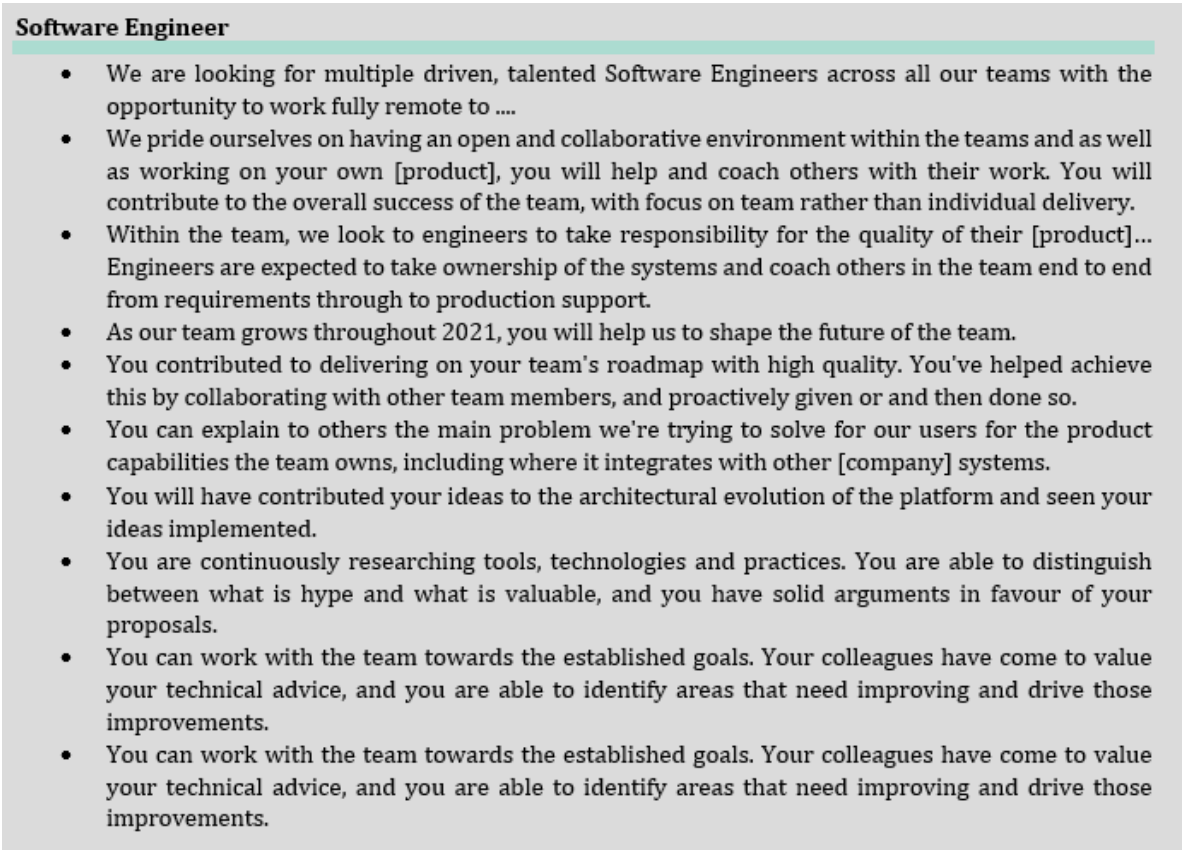
Most of the interviewees consider failure as an expected result associated with innovation activities, and it is the way to experiment with new things and learn from them. Participant C1P1, an engineering director, explains how failures are a natural part of innovation, *"If some creative work failed, it is not a failure because I have never seen the goal of innovation is to have a successful product. The goal of innovation is to learn something even if it fails… You learn how to ride a bike by falling off a lot".* Management supportive practices, reacting positively, and avoiding any punishment for such failures encourage engineers to continue trying on innovation and never give up. According to participant C1P4, who is an engineering manager, mistakes are analyzed, documented, and taken as a lesson learned for the future, *"If one idea failed, management would not be upset about it. They give full support to overcome".* Participant C1P7, a software engineer, cited an example where he failed to develop a product out of an innovative idea. He explained how it is very important not to take the failure personally and keep trying and iterating to the next best idea. Participant C1P1, as a manager, described that his engineers are not required to justify why they failed in a project; they do not even have to ask for authority to try new things if they fail, *"I think innovation has to come in a place of psychological safety. It has to be okay to fail if you are going to expect people to have innovative ideas".*

As part of the development by Kaizen, more opportunities are given to engineers in their early career stages to make mistakes with some flexibility to take risks in the play environment and during the experiment phase. Participant C1P3 notes, *"Because we tried to bring to life Kaizen, especially at the first three years of someone's career, we will give engineers a lot of room to make mistakes so as to learn quickly in this environment and progress the product further".*

6.5 Skills emphasis during the recruitment stage

In C1, one of the main strategies to drive innovation is the emphasis on recruiting relevant engineers who are talented, technology-driven, and willing to develop and improve their skills. This is related to their work on complex technologies, as explained by one of the managers in an interview with the media in 2018, *"ML, AI and distributed systems are relatively new areas that offer great potential but require intelligence, curiosity, and passion to master. We want experts in those areas who are able to push the boundaries of what is possible, as well as others who have a strong interest in these technologies but want to gain experience"*. The company always looks for engineers with team spirit to work in an open and collaborative environment. The recruitment process generally targets subject-matter expert

engineers willing to spread the knowledge around the team and share their experience with others. A sample of job adverts for 'software engineer' and 'senior frontend engineer' is illustrated in Figure 6.1 and Figure 6.2. The focus is obviously on areas of teamwork, collaboration and mentoring, technical support and knowledge sharing, product ownership, continuous development, and being initiative. C1 values such features and skills of new candidates that are expected to be demonstrated once they begin working. For instance, potential engineers are expected to *'participate in shaping the future of their team'*. This shows the value C1 place on their engineers to be active members within their teams, drive the team forward, and plan their agenda for the future. Furthermore, potential engineers are anticipated to identify areas of improvement and drive these improvements, which is part of Kaizen for ensuring continuous development.



Software Engineer

- We are looking for multiple driven, talented Software Engineers across all our teams with the opportunity to work fully remote to ....
- We pride ourselves on having an open and collaborative environment within the teams and as well as working on your own [product], you will help and coach others with their work. You will contribute to the overall success of the team, with focus on team rather than individual delivery.
- Within the team, we look to engineers to take responsibility for the quality of their [product]... Engineers are expected to take ownership of the systems and coach others in the team end to end from requirements through to production support.
- As our team grows throughout 2021, you will help us to shape the future of the team.
- You contributed to delivering on your team's roadmap with high quality. You've helped achieve this by collaborating with other team members, and proactively given or and then done so.
- You can explain to others the main problem we're trying to solve for our users for the product capabilities the team owns, including where it integrates with other [company] systems.
- You will have contributed your ideas to the architectural evolution of the platform and seen your ideas implemented.
- You are continuously researching tools, technologies and practices. You are able to distinguish between what is hype and what is valuable, and you have solid arguments in favour of your proposals.
- You can work with the team towards the established goals. Your colleagues have come to value your technical advice, and you are able to identify areas that need improving and drive those improvements.
- You can work with the team towards the established goals. Your colleagues have come to value your technical advice, and you are able to identify areas that need improving and drive those improvements.

Figure 6.1 A sample of a job advert for a software engineer in C1

Senior Frontend Engineer

- We are looking for an amazing Senior Frontend Engineer to join our diverse, collaborative, and fast paced engineering team. You can decide if you would like to be fully remote, or work a few days in the office each week.
- We're looking for someone who loves challenges and has an eye for approaching problems from numerous angles. You are someone who advocates for the end user, someone relentless in proposing and developing solutions that keep users at the forefront of our products... Someone who loves collaboration, and understands that success happens in the context of a team.
- We're committed to investing in passionate people who are experts in their field and our culture and working environment is second to none.
- You'll be working closely with product owners, back-end engineers, designers, both in cross-functional teams and also across the business as a whole.
- You have to delivered new features and improvements on time with outstanding quality. You've been a collaborative and enthusiastic team member, working with people across the team and beyond.
- You are continuously researching tools, technologies and practices. You are able to distinguish between what is hype and what is valuable, and you have solid arguments in favour of your proposals.
- You can guide the team towards the established goals. Your colleagues have come to value your technical advice, and you are able to identify areas that need improving and drive those improvements.

Figure 6.2 A sample of a job advert for a senior frontend engineer in C1

C1 follows a clear recruitment process that helps to achieve the firm's cultural values. Participant C1P1, who is the engineering director, explains, *"We are very clear on our hiring process. It is our company values that we want to hire people who are curious and proactive and who pull our company values. If you succeed in that, I think we just give them the space to do it. Then innovation will happen"*. In this perspective, the organization aims to ensure that all employees joining the company follow the same ways of working and conform to the firm's culture. To do so, the company controls the recruitment process through direct hiring rather than through agencies. In addition, new potential employees will be allowed to discover the culture and meet different engineers and people across the business during the recruitment process. So they can make sure they will fit in well with the company culture. Participant C1P3 expresses this further *"Everybody who joins the business has to go for a culture interview so that everybody is working in the same way. It is about creating an inclusive and diverse environment, but we are all working in very similar ways. So, we are making sure that we are all people-focused. Everybody is treated the same and got the same values"*. Participant C1P6, a lead engineer, reflects on his experience when joining the company, *"During the recruitment process, I have talked to various engineers and teams. They have a very young and dynamic team. People were smart, and the product was quite interesting and complex. So, I thought I could help here"*.

C1 is keen on recruiting engineers who have a passion and a desire to develop their skills and are willing to take on more responsibilities quickly. It is about giving them the opportunity to be promoted and supported by the wide organization mechanisms.

6.5.1 Competencies and skills development

C1 is keen to build the competence of all engineers and expand their expertise in different technologies so as to integrate and combine their knowledge, skills, and talents that drive innovation. In this context, it focuses on creating and spreading new knowledge within the firm. Competence development combines formal education with tacit knowledge and skills acquired through working experience. The firm is working on advanced and complex technologies, and part of the Kaizen process is to provide the opportunity for engineers to continually learn and build new competencies. The structure of teams based on cross-functional teams of multiple squads and tribes allow the management to quickly build teams and provides the opportunity for engineers to move between different squads. As explained by participant C1P3, *"If an engineer is willing to expand his experience in a specific area, we can easily respond by mixing up the tribes and squads".* The knowledge and experience gained can be used and deployed in other technology domains in the form of innovation. C1P3 adds, *"We have subject matter experts in all the different solution areas. Teams are mixed across different tribes and squads. So that encourages innovation. They might spend a couple of weeks or months on one part of the product. Then they use that knowledge to build something in another area so that they can share that knowledge more easily".*

The firm is running formal mentoring and coaching programs and providing an engineering buddy scheme. When new engineer joins the firm, they will be paired with an expert to support them and make sure they quickly adapt to the new cultural values. This is illustrated by C1P3, *"As soon as you join the business, you will be paired with somebody who can support you on your journey and mentor you in some of the areas that you did not score quite as high, not only from a cultural point of view but from a technical point of view".*

Another aspect of building competence in the latest research areas and newest technologies is through training programs. Participant C1P1 highlights the opportunities provided to engineers for developing their skills by allocating a specific budget for everyone, *"Everybody has £2000 per year as a training budget for learning and development, and they can spend on whatever they want".* Participant C1P7, who works as a software engineer, further explains this support, *"We have a budget for learnings, which you can spend to go to various kinds of events, various kinds of meetups, to actually meet people and learn from them… The management is doing a lot on how we decide to upskill".* The organization also offers educational grants for engineers to explore and expand their knowledge in new areas and emerging fields of technology. One of the engineers, participant C1P7, in this regard explains, *"We are also given a sabbatical to go and study for a year. The organization wants to learn more in a different college or a different course".*

6.6 Leadership and management support

Leaders and Managers in C1 play a pivotal role in promoting and facilitating intrapreneurship through managing engineering professionals and supporting them in engaging with the organization's culture and strategy. The results indicate that continuous management support from every level is required to facilitate the intrapreneurship process, starting from the idea generation, idea development, and implementation stages.

During COVID-19, leaders and managers successfully managed their engineers remotely while working from home, giving them adequate support and guidance to maintain the progress of their ideas and innovation despite all the pandemic-related challenges. The results show that the level of productivity and general performance of engineers increased while working from home. This is evident and justified by the manager, participant C1P3, who explains, *"The past three months we had our best quarter ever. And the first three months, engineers were just working nonstop because there was nobody to tell them to stop working. They were just getting tired away".* Therefore, many innovative initiatives and ideas came from engineers while working at home and some of the ideas corresponded to developing internal working processes that would save time and effort and facilitate their daily work in an efficient manner.

The following sections will discuss the emerging themes of management and leadership support that facilitates intrapreneurial engagement from engineers.

6.6.1 Clarity of organizational vision and business strategy

The clarity of the strategy articulated by the executive team seems to be critical for promoting innovation as a way to deploy the strategy successfully. As explained previously, innovation is not driven by a specific innovation strategy, and the strategic elements are more related to the firm's vision and the overall business approach. Participant C1P2 emphasizes this and states that innovation will start once engineers have clarity on the company's vision and business strategy, which feeds the innovation process with explicit constraints and boundaries. In his view, when more useful constraints are provided, then engineers have more clarity about their choices and focus their innovative activities better toward executing the company strategy. These constraints are related to customer requirements and market needs, technology choices that determine the future growth of the firm, the best opportunities to execute, and which engineering innovative solutions to take forward.

Activities such as doing market validation to evaluate the market needs of the potential ideas are the best to know and understand these constraints, as per participant C1P2, which might lead to building a solid business case and getting much greater confidence that will align the engineering innovation to fit into the business strategy. It seems that as more constraints and clarity of the vision are provided, more innovation success takes place. This is also complemented by participant C1P6, who works as a lead

machine learning engineer, *"The management encourages innovation, but in the end, it is a business. So, whenever the manager says to you that you are free to innovate, what they are saying is that you are free to innovate with certain boundaries".* Explaining these boundaries at the level of engineers and providing a clear vision will align innovation and engineering initiatives with the overall business strategy.

According to the experience of participant C1P4 in previous companies, many organizations were not very clear about their vision and goals to drive innovation which scatters the effort of engineers. They add, *"You do not really need to have a specific strategy for innovation. You need to have a very clear vision from the organization and what exactly they are trying to achieve"*.

During the COVID-19 pandemic, leaders are keen to keep everyone in the firm updated and informed on a daily basis about changes in business priorities, changes in customer needs and requirements, the latest market news, and any updates on current rules, ways of working, and processes. Participant C1P5 values open communication and being fully involved in the reaction and response of the organization to the pandemic circumstances, including strategy changes and business focus. He also emphasizes his managers' actions to organize open discussions to explain their teams' priorities. This clarity about the business details aligned everyone to work toward new business priorities and common goals during the pandemic.

6.6.2 Demonstrating and sharing the strategy with engineers

In this company, the management believes in sharing the vision and associated strategies across all employees to facilitate their execution. The yearly goals are classified into specific themes quarterly and shared in advance with engineers. Participant C1P1, who is the engineering director, expresses that *"Managers share the goals for engineers every three months, share it very early so that engineers have enough time to think about it, understand what is coming in advance so they can start to think about it early".* Participant C1P4, who is an engineering manager, describes their role in sharing the strategy to their team of engineers *"My role is not to dictate the vision. My role is to communicate the vision and make sure that goals are very well defined, and convince engineers that it is the right one that will take the company in the right direction"*.

To ensure that every engineer clearly understands the objectives, the higher management level is also involved in delivering these objectives and being transparent in discussing them with their engineers. Participant C1P5, who is a machine learning engineer, explains, *"Management would often have meetings with the whole organization to explain what is happening, where they are going, get all the market and clients updates, etc. Therefore, the vision is clear, and everyone has access to it".* According to participant C1P7, a software engineer, *"Our entire work is based on the company's objectives so that*

it is being shared and discussed across the company, not only on the higher level but also on every level of hierarchy".

Sharing and translating the strategy with engineers is not a straightforward process. The business people assign the growth strategy that is expressed in the contexts of markets, competitors, and business aspects, and it is a challenge to translate that directly into what specific problems engineers need to solve. Participant C1P4 emphasizes the role of managers to clarify the vision for their engineers, which will be the base for their innovation, *"We make sure that everyone has the vision and what exactly is the goal, what we are striving for and we are open for ideas. So, everyone has an autonomy that if there is something that they think can help us achieve that goal, we welcome those ideas".* Managers will open many discussions about the goals and objectives that engineers want to achieve and the priority to deliver. Part of achieving this is that managers involve engineers in many details about the market needs and customer feedback. As a result, this will convince engineers to be part of the strategy as they consider themselves partners in charting the organization's direction. Hence, this enables engineers to commit to and demonstrate these goals in their daily work. For instance, participant C1P1 points out an example, *"If the company goal is to make 20 million pounds in a year, engineers need to reflect this goal in what they are working on. For a graduate engineer, he/she needs to have visibility from the code he writes all the way to how is that going to help the company get the 20 million"*.

One aspect of supportive management practice is how they deal with engineers who are excited about new ideas related to their subject matter expertise but may not fit with the company strategy or is out of the core business. According to participant C1P3, *"The manager checks the feasibility with the executive team then takes a conversation with the engineer and justifies why this idea is not aligned with the general strategy"*. Managers in this firm are responsible for investigating any further causes if this was attributed to poor communication from the manager or whether it is just the misalignment from engineers.

6.6.3 Securing supportive resources

The organization is very supportive of providing various resources for engineers to motivate them and facilitate the process of innovation. This encompasses securing financial support for experimentation and testing and allocating professional expertise. Participant C1P2 highlights, *"Our management support to secure the required expertise from engineering teams and bring non-engineering resources to the equation of innovation to exploit it. They pull all sort of resources to make it a success"*. Similarly, participant C1P5 explains that *"Managers support to involve other teams and grasp their efforts that could take the initiative to the next step".*

In C1, engineers have access to most of the firm resources when embarking on innovation. They have the freedom to use the existing tools and software and lab facilities to support them in working on their

own ideas to pursue innovation. Participant C1P2 mentioned that validating and testing the idea in the market requires many resources, money, and teamwork. Managers, to a large extent, are committed to providing relevant support and the funding needed to validate the idea.

The most important resource mentioned by participants is time availability, where engineers are granted enough time once their idea is clear and discussed with management. Participant C1P3 explained that the firm has recently introduced the 80/20-time rule where engineers can benefit from the 20% to work on innovation, *"80% of the time is assigned for day-to-day work, but also engineers are required to spend 20% of their time on making sure that old code and old things that were in place are still very well documented and very clean. And then they can do the innovative stuff too. So, 20% of the time that either cleaning up or being a venture thinking".* This has led to increased job satisfaction among the employees as they had the flexibility and the time to focus on and pursue their own innovative ideas.

6.6.4 Encouraging new ideas

Managers encourage their engineers to come up with new ideas to guarantee a steady supply of ideas that feed the innovation with real opportunities to explore. According to participant C1P5, *"My direct manager or his manager always encourages new ideas and suggestions. They are coming from an engineering background and have a sense of engineering ideas".* He adds that managers are always receptive, welcome, and listen to new suggestions and ideas regardless of their potential value. On the other side, managers who are not receptive to new ideas will hinder innovation and prevent it from proceeding further. Participant C1P1, an engineering director, justifies this, *"You can definitely teach somebody not to be innovative. If you are a very bad manager who constantly rejects new ideas and constantly sucks people down, you can very quickly kill some of these abilities to innovate because they lose confidence".* Furthermore, managers support their engineers in preparing their ideas to be shared in the quarterly meeting and guide them through the way till their idea is ready for demonstration at the event. They explain to engineers how ideas are going to be judged, so engineers are aware of the process of idea selection. Participant C1P3 explains, *"It is really important that we make the decisions as to why different projects which were in different ideas be chosen, and how people can next time suggest different ideas so that they will be selected".*

6.6.5 Challenging engineers in the initial phases

It is important that managers discuss ideas and challenge engineers when they bring new ideas. Participant C1P1, who is the engineering director, explains that a good manager always explores and reviews the idea with their engineer and asks challenging and critical questions to shape the idea better, so the engineer has useful feedback that gives him/her a better direction on how to work further to strengthen their idea. Managers play a coaching role in this perspective, which according to participant C1P6, will make the idea better to convince higher management. Management support is extended for

taking further steps and actions such as feasibility study, clarity about the value of the idea, and how it fits within the firm strategy. Then they can take the idea forward and convince executive management and the business team.

The engineering and technical backgrounds of managers are seen as an advantage to C1's intrapreneurial success. This background is a key for managers in being receptive to engineers' ideas, understanding them technically, moving them forward, and increasing their capabilities to mentor and coach engineers in this technology-based firm. This allows managers to have a logical mind to understand and involve in the technical aspects of their teams' initiatives. According to participant C1P1, an engineering director, *"I think because I have come from an engineering background, I can understand the engineers when they explain their ideas. Managers need to have the same mind as engineers and be close to speaking the same language, so engineers can easily communicate with them".* Participant C1P5, an engineer, cites his direct manager and upper manager's background as being crucial as they are AI experts, and this enables them to have a sense and recognize the creative ideas in this field. This technical and engineering background is very important to value, judge, and provide feedback to engineers' initiatives. He also added that managers in lower positions are younger than executive management. Therefore, they are usually more exposed to the latest technologies and can provide technical support in their subject matter field.

6.6.6 Facilitating the adoption of ideas with business process

Managers play dual roles in both the engineering and business processes related to idea generation and adoption. As illustrated by participant C1P2, who works as head of product development and product director, it is difficult for engineers to demonstrate their idea outside of an engineering context. He explained further that it is a mistake to expect engineers to explain their idea in a business and commercial context, which is one of the main sources of frustration and demotivation for them. Also, participant C1P6 as an engineer, explains the challenge of the business side for the idea initiated by engineers, *"Because naturally when you bring an idea to the table, they will say, have you considered project B and C, why not do this?... So, we need to be a little bit more preemptive… So, from a high management point of view, the goal might be in terms of how much revenue you are generating or what new business you attract. In a technical space, the metric is completely different".* Managers sponsor their engineers and support them in making their ideas accessible to and accepted by the firm's business part and leadership team. According to participant C1P1, *"Innovation is costly, and business managers need to be convinced that it is worth the risk and will add great value".*

Participant C1P5, who is a machine learning engineer, explains the importance of management support to link engineers with the rest of the organization and involve non-technical teams such as the sale and marketing and other business people to better understand new initiatives *"Our core product is based on*

ML. If our sales team and other non-technical entities in the organization have a better understanding of what we are actually doing and what AI is about. That probably helps us project the correct image because we are not the face of the company. It is usually business people who are the face of the company".

C1 expects its rapid growth and fast expansion to continue over the next years. There will be an increase in financial crimes in terms of volume, velocity, and complexity. More investment will be carried out to keep up with the pace of innovation and market opportunities. Therefore, C1 aims to solidify its position as a leader and a global partner of choice for firms in the Fintech sector to accelerate their digital transformation.

Summary of key points of C1

- C1 has successfully integrated a Kaizen model to maintain continuous development and improvement that is reflected in their culture, ways of working, and overall procedures and systems within the firm.
- The team structure is based on the Spotify model, which is a key for organizing multidisciplinary teams dynamically and independently. This is considered the base along with Kaizen principles for improving team spirit, sharing experience and knowledge, developing competencies, and working as one team toward common goals. Thus, C1 maintains a learning culture where every engineer can develop, improve, and share their experiences.
- The culture is reinforced by a clearly communicated vision and strategy and management supportive practices that are oriented toward facilitating their engineers' ideas during the innovation process. Managers also act as sponsors and mentors for their engineers, benefiting from their engineering and technical backgrounds, which helps in developing engineers' skills and competencies in a positive and trust-based relationship.

CHAPTER 7: C2 – CASE STUDY OF A PIONEERING FIRM IN THE PHARMACEUTICAL INDUSTRY

7.1 Background and overview of C2

C2 is a world-class engineering and process automation company operating in the pharmaceutical industry. The firm's core business focuses on designing, developing, and manufacturing advanced machinery and provides automation solutions from lab-scale to commercial scale for pharmaceutical, medical, and the Fast-Moving Consumer Goods (FMCG) industrial sectors. C2 develops innovative custom technologies by providing the optimum mix of tailored solutions based on specific customers' requirements but with proven and robust technologies. These complex technologies include robotics, vision systems, web processing, cutting and sealing, and containment. Their specialisms include designing and developing assembly and test automation equipment, powder and liquid filling, device filling and finishing, specialist aseptic processing, and web-based material (long, thin, and flexible materials) handling and converting by offering tailored solutions in the following: paper, plastics, woven/non-woven webs and provide custom integration of web and sheet material processing, including wrapping, punching, cutting, heat-sealing and welding. Furthermore, the firm provides other services, including high specification manufacturing equipment, special purpose and custom machinery, engineering services and support, consultancy, and project management.

C2 was founded in 2006 by a group of like-minded engineers passionate about quality engineering, high-performance machinery, innovation, and collaboration under a clear mission to ensure products are developed, launched, and commercialized faster and at a lower cost. The firm has grown rapidly with a 15% year-on-year profit increase. It holds over 300 patents and has delivered more than 500 global projects.

The firm is now a global leader that has developed some breakthrough technology solutions that are some of the world's most flexible and powerful in dosing and filling systems. It has a strong track record in supporting multi-national clients in developing and commercializing new products and assisting them in building a competitive advantage, getting their products to market faster, and delivering much higher volumes in shorter timescales. Based on their contribution toward innovation, C2 has been awarded the 'UK Business Hero 2020' by the British Chambers and has won the 'Queen's Award for Enterprise' twice, one in 2020 for innovation and the other in 2021 for international trade.

7.2 The nature of innovation in C2

The company is a project-based business, and innovation is the main basis for running these projects. Participant C2P5, a relatively new project engineer who has been working in C2 since 2018, explains, *"So, by being innovative in a project obviously that is a must because you have to be…, when you are*

designing a project product for a brief, you have to be innovative". These projects have different challenges, requirements, and processes to develop and implement. Having extensive engineering experience and capabilities help with the implementation of these projects through innovation. One of the managers, who is not from the interviewed participants, in one of the internal documents says, *"Innovation is one of our core values that helps us to succeed with the most demanding engineering and manufacturing challenges".* Innovation is the basis for satisfying customers to ensure their manufacturing processes are cost-effective, efficient, and future-proof by offering a wide range of possibilities to improve their production line. In this context, the firm describes innovation in one of their product brochures, *"Innovation is who we are. It is woven throughout the entire business and steers the direction of our product, process, and production ethos. We pride ourselves on providing our customers around the world with a competitive advantage by bringing innovation to all areas of their product development".*

One of the main approaches to drive innovation within C2 is the use of brainstorming as a common practice among engineers in their daily operations, which is the main technique to continuously generate ideas and come up with creative solutions to address customers' challenges. Here, engineers make a strong contribution to the innovation culture within C2.

7.2.1 Brainstorming sessions as a fundamental working style

Brainstorming is one of the work styles engineers follow in C2 to find creative solutions to the main challenges and problems they face and accordingly come up with new improvements and suggestions. Ideation sessions are well structured and organized through a multigroup effort where engineers from different backgrounds and experiences participate. In this regard, participant C2P4, who works as a project group manager, confirmed the importance of including new young employees to take part in these sessions. Even if their idea is weak, it may trigger new ideas from other experienced engineers or managers. This mixture of experience is a powerful and effective mechanism for generating ideas, as explained by participant C2P5, who is a project engineer, *"We always start out the project with brainstorming sessions with multiple engineers of different backgrounds. So, you will have a young graduate and a more experienced one… Obviously, senior engineers have more experience, but then the younger graduate engineers might bring something new. So, we always have a brainstorming session with a mixture as well as management. And then obviously, you have tended to break it down and pick the best ideas, and that is what you then take forward".*

Brainstorming is a well-defined working process, and a major innovative activity followed along the project lifecycle. Projects are usually run by a series of brainstorming sessions, including engineers and managers, where the best idea emerges as a collective work. Technical problems and challenges found along the projects are also solved mainly by cascaded brainstorming sessions. Participant C2P5

concludes, *"I find these brainstorming sessions most useful for me, and I like to hear everyone's ideas. So even if it is a blue sky design or an idea, it may trigger another route to the solution... I do actually find them the most useful, especially in the early stages of the project"*. For instance, the idea of one of the New Product Development (NPD) that is today considered a breakthrough innovation in C2 was triggered by an engineer through a brainstorming session. Engineering teams followed the raw idea through multiple brainstorming sessions to outline how they could shape the original idea and take it forward.

Engineering teams are multidisciplinary within C2 that enable cross-fertilization of ideas. Most participants emphasized the teamwork spirit and the effective process of selecting ideas to have promising outcomes out of these sessions. Ideas follow a clear process to be recorded, then conceded, compared, and ranked against each other. Participant C2P6, a project engineer, explains further how they conduct and manage brainstorming sessions in terms of incorporating engineers and managers across groups to get excellent results and have successful outputs, *"Depending on the size of the project, you will break it down into multiple ideation sessions... It is encouraged that we call in someone from the management team, not our boss, but someone else. You call an engineer from a different group, a project manager from a different group. I am going to try and get that mix of ideas. And because everyone is working on different stuff, trying to cross-pollinate all those ideas"*. Furthermore, participant C2P1, who is the founder and engineering director, explains the importance of involving and integrating engineers from diverse knowledge and varied expertise in different sectors in these sessions, which enable the re-use and adaptation of some ideas and technologies applied in one sector to be modified, transferred, and naturally applied to another sector. He called the process the 'horizontal innovation', which is the success behind expanding the business to different new sectors. For example, the firm recently entered the food industry by focusing on producing 3D printers for chocolate factories.

Brainstorming sessions are not only designed to work within the organization. Engineers in C2 are also involved with brainstorming sessions held jointly with customers to create new ideas and solutions for their problems. In this perspective, participant C2P2, who is a business development manager, explains, *"Brainstorming is very often done internally, but we do with customers. So, when a customer has a problem… We will have a brainstorming session to help them and generate new ideas"*.

7.3 The significance of engineers in driving the innovation process

C2 is a company that is primarily led by engineering staff. Approximately 90% of their 80 employees are engineers who come from diverse backgrounds in the areas of electronic, software, and mechanical engineering. What sets C2 aside is a powerful combination of intellectual talent in their teams, high-quality engineering, and cross-industry knowledge. Fundamental to their growth and success is a dedicated strategy for investing in the development of the skills and competencies of their engineers.

Engineers' initiatives and creative ideas are a significant source for driving disruptive and incremental innovation within C2. In this context, the project group manager, participant C2P4 explains, *"Engineers constantly change standard product lines. And they can definitely come up with ideas to improve them, which are often implemented".* The company recently has developed its own standards and created new products characterized as world-leading and 'first in human' innovation. A lot of these ideas came from engineers and were implemented by applying technologies in a new and novel way. One of the managers, who is not from the interviewed participants, in one of the internal documents says, *"We like to think of our team of engineers as the intellectual horsepower that powers everything we do".* These creative ideas and initiatives by engineers to develop solutions and products are key to maintaining a competitive advantage. Participant C2P4 linked hiring talented engineers and motivating them to the success of their innovation while working in complex technologies and machinery systems. He notes, *"I think if you do not keep hiring engineers who can innovate or come up with ideas to improve products and do not keep on allowing them to innovate within certain parameters… I think eventually stagnate a company, and eventually, products will fail".*

The founders believe in their engineers to lead the success of the firm. Therefore, the firm is in the process of transforming into an employee-owned company by applying the EOT[5] business model (Employee Ownership Trust). One of the founders, who is not from the interviewed participants, commented on this transformation in a media interview in 2021, *"Businesses that move to employee ownership are renowned for having a family-like, open, collaborative culture, characterized by customer focus, innovation, independence from corporate control, agility, and a sense of social responsibility".* This signifies the important role of engineers as a partner in driving the business of the firm.

C2 has recorded one of its most successful years during the pandemic, achieving annual growth of almost 40% and recruiting more engineers. They have received many new orders and increasingly perform larger projects for their clients. Engineers successfully and productively handled the increased demands in the health industry during COVID-19. They have shown high commitment and dedication toward the company and the wider community to save people's lives during this unprecedented time. Engineers managed to complete several large projects for international customers despite all the pandemic-related challenges. The founder, participant C2P1, commented on their 2020 achievements, *"Despite the economic strain due to the pandemic…. We are proud to be celebrating 14 years of*

[5] The legal concept of an Employee Ownership Trust (EOT) structure was introduced in the UK in 2014. The government's aim was to promote more sustainable and diverse ways of running a business in the UK through the encouragement of employee ownership. Employee ownership has long been recognized as a way to provide employees with a significant and meaningful stake in their employer organization. They work by handing majority ownership of the business to a trustee company, which runs it for the employees' benefit. At least 51 per cent of shares must be controlled by the trust.

continued growth. As we continue to receive new orders and inquiries, we are thrilled to be able to create new job opportunities across a spectrum of roles".

In C2, engineers are the main power to create and sustain innovation and are the driving force behind the firm's success. The main strategy in C2 to enable intrapreneurship among their engineers is to have customized engineering roles that suit every engineer's interests and capabilities and to form 'well-rounded engineers' who possess diverse skills from the different competencies within the firm. This strategy is reflected in their hiring process focusing on talented new graduate engineers and having a specialized professional development program designed to allow them to gain wide knowledge. The culture in C2 is designed to support such an approach by having flexibility and freedom where teamwork across different groups is fundamental for knowledge sharing and expanding experience in different fields. Management support is at the center, and they prioritize equipping their engineers with the breadth and depth of experience necessary to become well-rounded engineers. They act as technical references, mentors, and sponsors for them.

The mechanisms, according to the analysis of C2, are related to customized engineering roles mechanisms, competence development and recruitment strategy mechanisms, and various mechanisms related to intrapreneurial culture, and leadership and management support mechanisms. The following sections will discuss these mechanisms and the intrapreneurial environment within C2, which represent the overall setup of the entire organization that facilitates intrapreneurship.

7.4 Customized engineering roles

While C2 focuses on the medical technology sector, engineers are working on a wide range of diverse industrial sectors and complex technologies such as confectionery, FMCG, defense, and tobacco/e-cigarettes as well as inhalers, injector pens, drug delivery devices, and pharmaceuticals. To handle these, intrapreneurship within C2 is designed around having successful well-rounded engineers. The company focuses on creating exciting, challenging, and meaningful roles for engineers in which they can learn and get involved with a diverse range of projects, customers, and technologies so as to gain a comprehensive experience. Therefore, one of their strategies is to design a customized role according to engineers' interests and willingness to take on additional responsibilities and tasks. According to participant C2P1, *"The better engineers in truth are those who get more rounded experience".* This broad knowledge and experience are some of the main factors that make engineers more innovative and being creative in their roles. According to participant C2P4, who works as a project group manager, *"… What we try and make sure to do, we give engineers a good balance of tasks, which will develop all those (technical) skill sets and make a conscious effort to make sure they get a good range of experience… If you have seen more things, you can sort of adapt to create something new and involve innovation as kind of built on something else you have seen… So, one thing I am quite conscious of to*

do my best that people make money for the business is to make sure that they are getting a good range of experience".

Managers are eager to structure roles according to what engineers are good at. Therefore, they designed roles around their engineers' ambitions to broaden their professional expertise in new areas and pursue endeavors in domains where engineers believe they can excel. In this regard, participant C2P1, the founder and engineering director, confirms this approach, *"We have been able to construct roles around individuals as opposed to having a role and then forcing somebody to do that job".* For example, participant C2P5 explained that she was interviewed for the mechanical engineering role, but after the interview stages, she was also given the opportunity to work on design when the management discovered she was passionate about it. She explained, *"I saw this role come up, and it was for a mechanical graduate engineer… And then, after the interview stage, they realized I have a bigger design background as well. So, I was put into a team with a more product-based emphasis as well. So, I am a project engineer and mechanical engineer, but I also cover the product design science side of the company as well. So, if a smaller product-based opportunity comes in, then it tends to be assigned to me".*

One of the main strategies the company follows to make sure that engineers work in challenging and exciting roles, which is the basis to keep them motivated in their jobs, is to be very selective about what type of projects they accept from customers. Participant C2P4, a project group manager, explains this, *"We have got different types of projects, I guess, to try and keep people interested, which is another way we actually pick up projects. One of the criteria we go for is actually going to be interesting for people… If you lose those people, then you are going to suffer at some points".* According to participant C2P3, *"Most people are very interested in what they do. So, they are always looking to improve things".*

7.5 Professional competence and skills development

As the firm focuses on recruiting graduate engineers, they pay more attention to developing their experience, skills, and knowledge very fast. In one of the related career documents of C2, it is mentioned, *"The development of our graduates is just as vital to us as the development of the company, and they go hand-in-hand".* The firm strategy revolved around creating a well-rounded engineer who is not only equipped with technical skills but involved with the business, commercial, and financial aspects. Engineers are getting broad management and professional skills by working on multiple projects in various industries and involve actively in all phases of the projects, from the proposal to the delivery stages. Accordingly, the management has designed and created specific training programs so that engineers gain a wide breadth of comprehensive experience and knowledge to develop a well-rounded engineer who fosters innovation. These programs are the Graduate Development Program (GDP) and business development program.

7.5.1 The GDP

The GDP is a self-led and competency-based scheme designed to be completed in two to three years to equip newly-qualified engineers with a wide range of technical skills from around the firm. They will gain a breadth of experience rather than being restricted to one specialism. This program has a wide range of advantages by addressing skills issues that may hinder growth. The benefits of the GDP in achieving firm growth and how it fits into the strategic vision of the company are explained in one of the internal documents, *"Since its launch, the GDP has led to yearly average revenue growth of 23% and a 16% decrease in staff turnover whilst expanding the skill sets of our graduates and enabling them to excel at their chosen specialism within (C2)… This uniquely self-led scheme is managed by the participants and supported by senior management acting as mentors".* GDP has been developed internally by higher management and expert engineers and has been awarded the 'Princess Royal Training Award 2021' in recognition of its commitment to the professional development and training of young engineers.

The program focuses on specific core competencies, which are valuable to all engineers to expand their skillsets and accelerate their development as professionals. They learn by joining other teams and working on different equipment, tools, software, and technologies. The program ensures that graduate engineers get exposed to as many aspects of the business as possible; at the same time, it is flexible, encourages personal progression and development, and enables engineers to manage their training at their own pace. Participant C2P5, as an engineer, commented on her own experience with the GDP *"They want you to see as many parts of the company as possible. So, you have got certain targets to meet with different disciplines. So, you get skills in pneumatics, electrical drawings, manufacture, product completion, and product development. Get these different categories in your first two to three years… So, they try and keep it broad. You get to see as much of the company as possible… they definitely allow you to do a mixture of skills".* Participant C2P4, who works as a project group manager, considers the program as a knowledge tool, *"So engineers are not only rotating around different teams and working necessarily with different people. We are trying to make sure that engineers are getting a wide experience in terms of what skills they are learning".* In the view of participant C2P6, who works as a project engineer, GDP opens the horizon to join other exciting projects, *"If someone cannot put a tick in pneumatics box, a project manager can turn out to you and ask you to do a pneumatics design for a machine… So, it (GDP) made me go and explore different machining methods, different designs, different mechanisms, and different components within them".* He mentioned how this comprehensive experience enabled him to gain many skills that can be applied to solve technical challenges more quickly.

7.5.2 Business development program

In addition to technical competencies, C2 integrates business, market, and commercial skills with engineering roles. In the first six months of the engineer's first year, they are exposed to the business department to learn about the market, customers, and the overall business aspects. Participant C2P1 explains, *"We force them to go and work for our head of sales and marketing for three to six months. So, they were forced to meet the customers. They were forced to write proposals and to give costings. They are forced to understand actually it is about making money… And they always come back and say, what a great time that they have in that role. Simply because they are exposed to things they have never been exposed to before. And it gives them a better vision of what engineering is about, how the business work, and who our customers are… because when they would go to their place, quite often, they do live in a bit of silo".* Participant C2P6, as an engineer, reflects on his experience in this program, *"I did a rotation in the business development team for four months. And I learned a lot… there are design reviews, seeing the commercial side of the project, and making those decisions. And there is a lot more that goes into it than just engineering know-how… it is the risk management, and how we evaluate customers, that was really eye-opening on".*

These two programs complement each other and represent embedded training within the culture of the firm to create successful, well-rounded engineers who are technically skilled and equipped with the commercial, business, and project management aspects.

Besides these two programs, managers support engineers in developing their skills in all project phases. Managers believe in the way of working in the full cycle when working on projects and not only in one specific role or phase of the project. Participant C2P3, who works as a project director, highlights, *"To give an engineer experience, designing a machine does not give them the experience. It is making it work. So, build the machine, design it, and then build it and then make it work… This development experience, I think, is the biggest steepest learning curve, I guess, of the biggest experience".* Participant C2P7, a project engineer, explains this full involvement with the whole project phases, *"So I think it is good having a sort of well tied into the entire project and sort of having a feel for everything that is going on".* Project managers monitor engineers' performance and suggest any skills that engineers need to pursue to their line manager. As explained by participant C2P1, they assign engineers to the right project so that it fits with the required experience the employee wants to develop. Moreover, engineers are encouraged to highlight any area they need to get some experience in or when they need extra support/guidance. According to participant C2P6, *"I had not done much design for about a year. And then I informed my boss… There was a project that had a module for a new design that I have got the opportunity to join. So, you just have to raise it, and they will try their best".*

7.6 Recruitment strategy

What is remarkable in this ever-growing and successful engineering organization is the focus of the recruitment strategy to get creative and energetic graduate engineers, who like learning about multiple technologies, can demonstrate a genuine passion for engineering, and enjoy a technically challenging environment. Executive managers interviewed in this study confirmed that it is quite hard to find suitable mid-career engineers with work-ready competencies to handle the complex technology they use. Therefore, the firm focuses on raw talent and newly graduated engineers with high academic achievement from well-ranked universities. According to participant C2P1, the founder, *"What we do is actually quite intellectually challenging. We find that even people with the smattering of B or A levels struggle to do what we do, not everyone but to a large extent… We do go for the very top qualified engineers. Everybody in our business that succeeded has got A star to A level and the first class or two from one of our better universities in the UK or Europe… There are certain universities that are well suited to the kind of work we do… We joke that we employ nerds and geeks".* Participant C2P1 justifies why he is going to recruit talented graduate engineers and not experienced engineers as per the suggestion of his manager in the previous company, who told him, *"Given in any day we were approaching problems that we have not seen before. You get smart people, and they will learn how to do it. But if you get somebody with the experience without the smart, they can only do that one thing".* Participant C2P2, who is the business development director, confirms that hiring talented employees will boost innovation, as this approach seems to have been applied successfully in this firm. It is also evident from their distinctive innovation outcomes and results, *"We recruit some really capable top engineers, to be honest, we go for the best engineers who will be able to come up with many ideas… This might take a few years to get some experience and to learn".*

The firm is very selective when it comes to the recruitment process and focuses on hiring engineers interested in and passionate about engineering. This is reflected in the screening process to identify those kinds of engineers, as discussed by the founder, participant C2P1, *"So when we are interviewing, we are kind of recruiting a certain type of a person, and what we are looking for; are they more rounded as human beings than just an engineer?... Is there anything in that CV that says they have got a passion or an interest in engineering? So, anything about hobbies that sounds a bit tacking…, that is our screening process… We have got people with little sports cars, Motorbikes they tinker with. We have got quite a few who actually play with big full-sized steam trains. So, and these are the kinds of people that suit our environment".* Participant C2P2 agreed with this view and commented, *"Some people really actually want to have an enjoyable job, right, from a young age. You know, we select people who are interested in their roles and who are interested in engineering".* For instance, an engineer who is passionate about steam railway locomotives and has good knowledge and experience about train mechanics has transferred and used his knowledge to bring new solutions for some of the technical mechanical issues in automation.

Moreover, the firm has created a well-designed 12 months internship with well-ranked universities and three years of extended apprenticeship programs so as to recruit potential engineers after completing these programs. According to participant C2P1, *"So we go to select a number of good universities, and we actively look for people to come in for 12 months. At the end of 12 months, they usually do a really good job of work for us… a number of those will come back".* Engineers in these designed programs receive comprehensive training in a wide range of tools, systems, and technologies and work across different disciplines to gain quality and vital experience. This is combined with providing them the freedom and flexibility to develop their personal skills within the team they joined. This has benefited the firm where they can utilize the best of their engineers involved with these programs. This strategy allows the firm to diversify their recruitment sources and attract engineers who are capable and are seen to fit with the organization's culture.

7.7 Intrapreneurial culture

The established culture of C2 stemmed from the founders' vision when they first set up the firm, which reflects a feature of innovation, technology, collaboration, and development. Some of the participants describe how this intrapreneurial culture influences innovation. For instance, participant C2P3, who works as a project director, explains, *"It is a culture with intrapreneurial spirit to discover opportunities and seek a potential solution and create a business out of it"*. Participant C2P2, who is the business development director, adds, *"Trusting engineers is a big part of the culture, showing the trust but also setting a high expectation… you know, we expect engineers to come forward with ideas and contribute and challenge"*. This intrapreneurial culture supports the strategy of having well-rounded engineers and motivates them to be proactive in the pursuit of innovation, in which training is an embedded feature within the culture. Therefore, this culture acts as the platform for engineers to grow, develop, and build professional competencies, sharing knowledge and giving them the flexibility to work independently. The following sections discuss how the organization has created an intrapreneurial culture for their engineers.

7.7.1 Flexible working environment

Part of securing an enjoyable work environment is providing freedom to engineers with their roles. This takes many facets; according to participant C2P1, who is the founder and engineering director, engineers can decide how they do their job and have the freedom to perform additional tasks they believe would benefit both themselves and the organization. Participant C2P2, who works as the business development director, adds, *"In our business, engineers have a good level of autonomy, you know, they are in charge of their own work, which keeps people interested in what they do… not everything is about money. It is about self-determination".* In the views of participant C2P7, one major factor that contributes to allowing this freedom is that engineers are not subjected to any

micromanagement style. However, the nature of project-based work sometimes limits engineers' freedom, where they have to meet customer requirements, deadlines, and qualities, associated with more controlled processes. Participant C2P5, who works as a project engineer, explains, *"Obviously, freedom depends on the project… So, you have got the freedom for innovation, but you are allowed to innovate within reason, such as to meet the brief. It is all about the user requirements, what the client needs and what the product brief is".*

Engineers are also permitted to join different teams on a regular basis as they have flexible roles which support them in their route to becoming well-rounded engineers. According to participant C2P1, *"We allow engineers to move between roles, teams, and get varied experience… What we encourage within the business is that everybody does a bit of everything. It does keep us quite sharp. It is the downside you never quite become a master of anything… So, you have to jump from technology to technology, from industry to industry. And everybody in the business needs to be sharp… We have mechanical engineers who have decided to move to the software department. We have got electrical engineers who decided that they want to go and do software. We have had mechanical engineers go off and do electrical engineering"*. Tasks are frequently changed; this supports engineers to get a wide experience hence making their role more dynamic, as highlighted by participant C2P7, *"I was very interested in working for a smaller company, I guess you get a better feel for the entire business as a whole, which I think is valuable… I would not be interested in, you know, spending my entire life designing a blade for a turbine or something like that. Yeah. I value the sort of variety in tasks and projects".*

The company provides flexible working hours, similar to C1, where engineers have the freedom to decide on the working hours that suits their needs. Participant C2P2 explains, "*We had flexible working hours, and you can choose within some core hours that you need to turn upon, and then you can choose your start time and finish time".* Participant C2P5 adds, *"So we do have flexible working hours, but you choose your fixed hours and then stick to them… and I guess that works well for your personal life".*

7.7.2 Reward, promotion, and recognition systems

Similar to C1, the company's reward system has wide options of monetary and recognition mechanisms that are very important to acknowledge and appreciate the innovative efforts of engineers. Participant C2P2, the business development director, explains that *"If there is a really talented engineer, who is making a mark for themselves and making a difference, it could be due to innovation or they just do a really good job in their project, the two often go hand in hand with innovation, or you are finding a way to solve challenging problems that have not been addressed before…, we have discretionary bonuses at the end of each year for these innovative efforts".* Moreover, monetary rewards include salary adjustments and increases at the end of the year and an employees share scheme, as mentioned by participant C2P7.

Participant C2P3, who is a project director, confirms that other types of rewards such as recognition and appreciation are mandatory, whereas monetary rewards alone are not the main source of motivation for engineers, *"We find that money remuneration is not the most significant driver for engineers. I mean, it is up to a certain point… some people are very money-driven… That (monetary) usually sort of short-term rewards, but being associated with something or having your name associated with a solution, I think that is the kind of recognition that lasts".* Similarly, participant C2P2 highlights the importance of other forms of recognition *"I think a big part of recognition is the personal recognition… We acknowledge the engineer and tell them that they did a good job, by their manager, or the Managing Director".* Part of acknowledging engineers' achievements is to spread them throughout the entire organization community as explained by participant C2P3, *"When somebody has achieved something, there will be an announcement… There would be an email that goes out to everybody"***.** Such recognition will motivate the engineer and naturally inspire others to express their innovative ideas, show their maximum efforts, and go the extra mile. Participant C2P4 emphasizes the continuous rewarding and recognition of engineers throughout the COVID-19 period so as to value their efforts and keep their performance high.

The discussion above indicates that managers appreciate the excellent work of their engineers, which encourages them to keep up the good work. Participant C2P6 agrees with this view and highlights that a few words from a manager could mean a lot for engineers, *"Having feedback from people when you have done something good, someone just says you have done a good job. I think that is really important".*

One of the recognitions of the high-performing efforts in this firm is that engineers are given the opportunity to be promoted to the next level of career development or a management position. The company is a project-based business and can offer engineers to be upgraded to a project manager position. Participant C2P1, who is the founder and engineering director, explains, *"So we are probably quite weak from a managerial perspective because we do not go looking for good managers, we go looking for good engineers. And then the better ones of those tend to get promoted into managerial positions… So most of the people that are in senior positions at (C2) actually came in at a very junior level, and they grow with the business"*. For example, participant C2P6, who is a young engineer, was promoted to project manager after three years of experience. Such a position is always offered to a mid-level career in other companies. Having this promotion as part of their career development helps them to have clear expectations with their role and a plan toward their future managerial career. As an example, participant C2P5, who recently joined the firm, has a clear plan to go for a managerial position in the coming years, *"For me, yes. I would like to move up to a manager eventually. But in the early days, managers here have started as graduates…, and I can definitely work toward it".*

7.7.3 Open communication to support engineers' involvement

Engineers are involved in the whole company and business updates through open communication with higher and direct managers. They feel they are an integral part of the firm, and their scope is not limited to the news of their team or group. There is effective communication between group heads and their teams of engineers on a monthly basis. Participant C2P1 explains, *"Each group head will then give information on a monthly basis. It became where we are heading as a business, what projects are coming in, which projects are going well, and which projects are not going well. So, there is a lot of open communication"*.

There is a quarterly business update meeting on the organization level that involves all employees. According to participant C2P4, who works as a project group manager, *"Every quarter, so we have a business update meeting against the finances and things like that. But we also got each group head to talk about all the projects that were going on in the group at that time. So, you get some visibility of the whole ongoing projects".* Participant C2P1 adds that during this quarterly meeting, all employees are updated about the strategic direction of the firm and the priorities of engineers in the coming quarter, *"Every three months, the Managing Director will stand up in front of the whole company and say, look, this is roughly where we are heading and these things we are looking for from you as individuals".* From the perspectives of engineers, they consider this involvement crucial to have a big picture and have a sense of what is going on in the business and other groups. Participant C2P6, who is a project engineer, reflects on the details provided in the quarterly meeting that engage engineers in the overall business news, *"We get a presentation on sales updates, what projects are going on, where we are in terms of business development. Like we get a big overview of the company, and they tell you how much the company has got in the bank, how much of the cash reserves we have got, and I think that is really good because it makes you feel engaged".* Engineers are engaged and aware of other groups' work, their progress, and achievements. Participant C2P7, who is a project engineer, confirmed that direct managers ensure that engineers are updated frequently with other teams and group projects and have some awareness of what is happening in other departments.

Communication was one of the challenges during COVID-19 while engineers worked from home. This setup was new to everyone, and most of them may not have experienced before. A new process was developed to organize and manage remote work. Managers are keen to update engineers about the frequent changes in the business and market and give them clear business direction, including the priority of their work, so as to align them with business targets. According to participant C2P5, *"... So for example, for COVID-19 at the moment, that is where all the company updates are given weekly, you get all the information, and then obviously we get emails throughout the week".* To facilitate the communication between engineers, the firm has introduced a specially designed program with multiple

interactive features that support engineers to chat, communicate, socialize, and create groups while working from home.

7.7.4 Positive working environment

In C2, engineers have a setup that allows them to regularly and freely interact with their direct managers and upper management team without any hierarchical boundaries. The key thing is around open communication and a friendly environment facilitated by a large open-plan office layout. The physical place is designed with central locations like reception and the kitchen, which act as focal points for open communication, discussion, and exchanging ideas. In this context, participant C2P3, who is a project director, highlights, *"We have an open-plan office. So, I think with the open-plan office is an open culture, where people communicate directly".* This physical environment enables continuous interactions with the management, getting their immediate support and accelerating the flow of information with them on both sides. Participant C2P5, who is a project engineer, explains this further, *"So you are given all the support that you need... obviously the managers and directors are sat in amongst us. So, you can get help from anyone at any time, which I think is quite critical to the development of the company… If you have got a new employee who is less experienced, they can then easily contact and integrate with all of the senior engineers and managers to get all the information they need".*

Participant C2P3 affirms the importance of informal engagement and non-formal ways of communication with managers and the open and friendly channels with them. Managers are always happy to speak to engineers outside of formal meetings and discuss verbally any topic of their interest or any new suggestions. Engineers can catch them in the corridor or call them for a coffee or small meeting chat. According to participant C2P5, there is a frequently scheduled meeting with line managers for general discussions, *"Once a week, you have a meeting with your line manager as a team, and that is where you are given all the updates… You get all the information, and then obviously we get emails throughout the week".*

The founders and managers are easily reachable and interact directly with engineers. As a result, engineers develop more trust with their managers and are encouraged to voice their ideas directly to them. Participant C2P7, a project engineer, explains, *"I would feel very comfortable with bringing in those ideas if I had them to management".* Therefore, as most participants described, a high-quality relationship between employees and top managers is represented by having mutual confidence and respect. Participant C2P1 comments on the relationship between managers and engineers, *"I think one of the key things is around communication. So, a lot of people that have joined C2 from other companies, one of the things they say is that they are not used to an open management team as we are now; of course, we do not know any differences because it is what we do".*

7.7.5 Social life and group events

C2 focuses on maintaining a good work and life balance by encouraging their staff to live happily. Therefore, social events are frequently held and planned throughout the year to maintain a friendly environment and a rich social community. Participant C2P1, who is the founder and engineering director, states that every time they win a large order, they celebrate by taking a day off, organizing a social event, or going out for lunch or dinner in a venue. Participant C2P3 mentioned that all staff gather at the yearly meeting or after Christmas and spend a day together. Throughout the year, they go out for frequent sports days or outdoor events.

Participants interviewed clearly value the social work environment at the workplace, which keeps them connected and open to talking in a friendly way. Participant C2P3 mentions, *"We still recognize that we go to work to do a job. We try to have good work ethics. So, when we are at work, we are focusing on work. We talk emotionally about work and sometimes about our home, family and interests, and most people are motivated in that way. I think the social thing happens anyway".* This friendly culture is based on the behavior of social interaction between employees, which motivates participant C2P5, *"So the culture in the office is very open. To be honest, the people make you try and perform better".* Participant C2P6 summarized the social environment and concluded, *"It is like a family, you still know everyone's name, you know their partner's name, and you know much stuff about them".*

7.7.6 Handling failures

One of the motivational factors for engineers working in C2 to pursue innovation is that their failures and mistakes are accepted and not criticized. According to participant C2P1, *"… The other joke that you will hear within [C2] is, do not ask for permission, ask for forgiveness…. we do not want people who are constantly asking for permission. We want people who ask for forgiveness when it goes wrong… So, we were a believer in 'fail early, fail fast'… Nowadays, with rapid prototyping, if we have an idea today, we could probably test it tomorrow".* Participant C2P2, who is the business development director, explains the internal culture in this regard and says, *"It is not a blame culture really... I think failure very much happens yet… You learn from it and move on…, we do not tend to have many shouting matches, and people are not punished… I do not think in our organization we have ever got rid of anybody because of a mistake he did".* He adds that in the process of innovation, they try to fail very quickly by trying a variety of experiments and demos so that they can learn very fast.

In C2, making mistakes is considered part of the learning process and can be a positive approach while working on new designs, demonstrations, experimentation, or testing functions. Participant C2P3, who works as a project director, explains the importance of providing this opportunity to younger engineers by letting them work on projects that are not related to customers, so they can make mistakes and learn, *"We say that younger engineers have to make mistakes, and I always maintain that. The best way to*

learn is obviously to make some mistakes. Engineers have to find out for themselves. If you tell them how to do everything, you give them all the answers, and they do not really learn, but they have to make something weak, see it break, or make something that is not engineered correctly". This approach of thinking builds confidence among their engineers and motivates them to try new ideas and concepts, thus enhancing the overall intrapreneurial culture and productivity. In this context, participant C2P4, who works as a project group manager, explains how the fear of failure can negatively affect employees' motivation to embark on innovation, *"People who work for me understand that mistakes can be made sometimes, which hopefully gets through that fear of innovating… Engineers are not afraid to make mistakes or make decisions for themselves, and therefore they are not afraid to innovate at a certain level".*

7.8 Strategic alignment to innovation

Similar to C1, there is no specific written strategy for innovation in C2. A general business strategy is formed, and innovation is considered the way to execute this strategy. As discussed by the founder, the company is still an SME and operates in an agile way that does not require a specific innovation strategy. This adds to the flexibility of the firm to increase its ability and remain open to innovation in new areas since they deal with a number of technologies and operate in a variety of industrial sectors. Therefore, all engineers are empowered and encouraged to be active contributors to boost innovation. According to participant C2P2, who is the business development director, *"We have not written innovation strategy. To be honest, as the company grows and gets bigger, there is a need to standardize more and to kind of implement more processes and controls on people and bring everybody along so that people operate in similar ways".*

The firm has a clear vision that is transferred down to engineers in terms of clear group targets and what engineers are expected to achieve. The company strategy focuses on doubling its sales in the next three years, expanding to new markets to achieve remarkable international growth, and entering new sectors. The group head updates their engineers quarterly about the group target that are aligned with the business strategy. Participants clarify that engineers have a firm grasp of the company's direction and overall business strategy and are aware of their role in successfully implementing them. However, as an innovative firm centered on customer projects, engineers sometimes find it challenging to execute the firm vision and strategies due to dramatic project changes, which frustrate them and scatter their focus. In this perspective, participant C2P5 explains, "*Projects are subject to change, sometimes the nature of the project change, priorities are changed, and sometimes it can be in a reactive position".* She adds that this requires dynamic engineers who accept and adapt to project changes, *"Engineers cannot be uncomfortable with changing what they do. You have to be ready to change and go with the flow. Almost engineers need to be flexible and accept change".* The findings show that engineers show a high commitment to the project plan and deadline and work their best to satisfy their customers.

7.9 Leadership and management support

In C2, high management, group heads, and managers play a major role in supporting engineers in their innovative initiatives. They facilitate innovation, encourage new ideas, and act as technical references and sponsors for their engineers. They expose engineers to market research and support them in interacting directly with external customers and suppliers.

7.9.1 Encouraging new ideas

Managers are encouraging engineers to be active contributors to innovation by creating and sharing ideas. With their attitude toward handling suggestions from engineers, they do not classify any idea as weak or bad; any idea may open discussion and trigger further ideas. According to participant C2P2, *"We are making sure to create a safe environment for people to voice ideas…, and people do not feel threatened when suggesting new ideas"*. Participant C2P4 agrees with this perspective and says, *"It is definitely up to the manager to allow people who are very unsure about their ideas and sometimes say things like- this is a stupid idea… So, managers want definitely to get that enthusiasm up as well"*. Managers welcome and accept any kind of ideas or suggestions, especially at the beginning of a project before ideas are narrowed down and selected. Participant C2P5, who works as a project engineer, adds, *"So managers welcome any innovation. So, if you have an idea of any sort, you can tell your managers, the directors, etc., and they will listen. And then, obviously, weigh up whether it is beneficial or not to the company. All ideas are welcomed no matter what they are…, everyone there with open ears and welcome ideas for the company"*.

Managers also encourage ideas that pop out during the project life cycle and push them forward for further implementation. For example, participant C2P6, a project engineer, explains how he got a new idea after a conversation with one of the customers. He sent the idea by email to his manager, and the next day, he walked to his manager's desk and had a further discussion about it. It was an excellent opportunity that was successfully implemented, which added value to the project and satisfied the customer.

7.9.2 Technical background of managers

All managers in C2, including the founders and higher management, come from a technical and engineering background. The policy of the firm is to promote current engineers to managerial positions rather than recruit external managers. This is a unique strategy applied by C2, and it seems to be making a difference to their innovation setup as the technical background of their managers allows them to understand their engineers and manage projects effectively. So current managers have built technical knowledge and experience in different fields for many years. Managers are involved in detailed technical discussions with their engineers, and they act as mentors to many of them. Even the founders

and executive team attend and actively engage in technical meetings to provide support to their engineers. Participant C2P3, who works as a project director, explains, *"I still get involved with technical projects, and I will help projects where I can. Typically, I will point out where there might be some risks, and it is just through experience".* He adds*, "Well, I still get involved in the detail…, the detail is really important. It is important to have that level of in-depth knowledge and give high-level guidance and make sure they are not going in the wrong direction".*

The technical management background is very useful for engineers to get constructive feedback and a clear direction for further steps when bringing new ideas. This scenario is similar to C1, where managers' technical capability enables them to judge and evaluate engineers' ideas, see their value and decide which potential ideas can be adopted and developed. Participant C2P5, who works as a project engineer, explains, *"If you come up with an idea and the manager likes it, they will definitely give suggestions… So, they never want to shoot you down. They will always want to bring you up, but they were really good at suggesting ways to improve the idea".* From a management perspective, participant C2P3, who works as a project director, explains how they criticize ideas, *"So you can question it, you have the capability. And so, if somebody is telling you something is wrong, you will question it. And I think it gives us credibility in the marketplace and credibility with the people that work for us".*

7.9.3 Support engagement with market research

Managers encourage and support their engineers to get involved with market research and get direct experience of working with their clients and stakeholders. Engineers are given the opportunity to attend external conferences and the latest trade shows. According to the founder and engineering director, participant C2P1, who explained the firm strategy to make engineers proactive in spotting new opportunities, understanding competitors, and going beyond their technical roles, *"In terms of developing products, one of the things that we tend to do is expose bright engineers to the marketplace at a very early stage in their career. So, a lot of engineers are very introverted and very shy and hate going out to competitors… So, our best playground for sales and marketing is technical conferences… And we will normally send senior engineers and junior engineers to understand a little bit more about our market and to spot opportunities… So, one of the things that we have just put together is a new product platform called [product name]. And that has come directly from some relatively young engineers who have gone to trade shows and spotted this opportunity… He comes back and says, everybody is talking about the lack of a low-cost, low-value machine…".* This idea has led to the development of one of the fundamental products in the firm. Participant C2P3, who works as a project director, says, *"Everybody has the opportunity to generate business and to grow the company. People recognize that they need to see what the competitors are doing and what the industry needs… The industry does not advertise what they need or what they focus on… So, engineers have contact with*

customers, but they need a level of knowledge and confidence to be able to explore customers' problems. We try to give everybody that exposure".

Engineers in C2 also help with marketing functions and take on some related tasks by exploring new opportunities and interacting directly with customers. Participant C2P2, the business development director, explains that despite allocating a project leader to each project, all team members are allowed to contact customers, *"There is a single quick contact for each project team. We have project managers, senior and lead engineers, but all engineers could be in touch with customers asking questions or sitting in meetings with the client, with customers, and with suppliers"*. According to participant C2P3, *"Everybody should be able to deal with a customer… Most people are good at working with customers… The customer-facing role is important because that is where they really learn… By the nature of engineers, some are not good at meeting customers and do not perform well in front of them. So, if they continue to do that, we try to guide them and help them to improve… But then if they are not, then they tend to get more technical, internal work and less customer-facing".*

Participant C2P3 emphasizes that contacting customers makes engineers understand their perceptions, open their eyes to exciting things, open new conversations, and understand their demands and the challenges they face. As an example, participant C2P5 comments on how this may help innovation *"If you get that first interaction with a customer, obviously you will then get more of a personal note and know what they need. And then for innovation as well… If you are talking to them, you may come up with ideas, and you can explain to them prior to going away in formalizing the design".* Another example where interaction with customers led to new innovative ideas was mentioned by the project engineer participant C2P6. He explains that he had a technical discussion with the customer while installing a machine at their site. The conversation led to a new idea that prompted a new product feature, which then became a successful selling point for the company.

Now, C2 is working toward expanding its UK and international operations as part of its future initiatives. To accommodate continued growth, C2 is investing heavily to double the size of their current premises by building new workshops and offices. This will allow them to realize future objectives of housing more projects, hiring more engineers, expanding pharma equipment and custom automation brands, and entering new industrial sectors.

Summary of key points of C2

- C2 is a successful technology-based SME where innovation is at the heart of the intrapreneurial endeavor driven by engineers who are the ones to initiate, design, and execute innovative projects.

- The organization focuses on recruiting talented and newly graduated engineers, then develops ‘well-rounded engineers’ through specifically designed in-house programs. These programs equip them with a wide range of experiences and competencies and integrate business and market skills with their engineering roles.
- The intrapreneurial culture of a flexible environment, open communication, rich social interaction, and a positive attitude toward failures are key to supporting the fast development of engineers’ wide experiences through the GDP and business development programs.
- Engineers show high commitment to business success, and they are actively involved with the business vision and strategy. They are exposed to market research by engaging directly with their customers, where they can understand customer challenges, identify opportunities/gaps, and develop new ideas.

CHAPTER 8: C3 - CASE STUDY OF AN ICT-BASED COMPANY

8.1 Background and overview

C3 is a high-tech Information and Communication Technology (ICT) based company that specializes in providing software verification tools and services globally to the automotive electronics and embedded aerospace industries. The high-tech products test critical software used in space-based applications and in automotive electronics by producing data needed to verify functional testing and optimize timing behavior to meet safety standards. Their innovative verification products and solutions help their clients increase software quality, deliver evidence to meet safety and certification objectives, and reduce project costs. The firm is an industry-leading supplier of revolutionary verification tools that has helped some of the world's best-known aerospace and automotive companies with their verification needs. C3 has expanded its service offerings over the years to provide first-class support, integration, training, and software verification services.

C3 was established in 2004 as a spin-out of a university by three postdoc software engineering researchers who are the founders and executive leaders of the firm. It was founded on very cutting-edge research technology that was commercialized to provide industry-leading innovative solutions for verifying critical systems, including software for timing analysis, structural coverage analysis, and functional testing.

C3 is a fast-paced technology company and is considered today an international brand that has expanded their business into different global markets. The firm has grown fast over the years and succeeded in innovating rapidly and consistently by expanding the product lines, including different systems and tools. Throughout their journey, they have developed their reputation for innovation by providing custom solutions for the complex challenges in the market. Recently, they have launched new innovative and complex products and solutions through the involvement of their cutting-edge research programs.

8.2 The nature of innovation in C3

Innovation is the core strategy in C3 for developing new tools and customized solutions to address market challenges and customer needs. Innovation revolves around everything the company does, as per the view of participant C3P2, who works as a service delivery and account manager, *"Innovation is the essence of the company since it was founded, it is really in the essence of how our tools operate, the scientific theory behind them, and the way we do what we do is very cutting edge".* According to participant C3P1 who is one of the founders, *"Innovation is central to everything. It is what we do… We target ourselves at the premium end of the market. So, we solve the problems that other people*

cannot solve. We do not provide an out of the box product that you can just pick off the shelf and use. We provide something of a more customized solution where we solve the real customer problem ... So, we spend a lot of time trying just to understand what the real problem is, and then providing a high tech innovative solution to achieve the customer's needs". Participant C3P6, a field application engineer, supports these views and explains how innovation helps the business of C3 to maintain competitive advantage, *"Innovation is extremely important… Otherwise, you end up in a place where it becomes complacent and stagnant, and companies no longer start moving forward and maybe end up wasting resources… Our tools are in themselves a form of innovation that help automate a lot of the work that testers and other companies have trouble with".*

Innovation helps C3 differentiate itself from other competitors so as to stay ahead in the market competition. In this context, participant C3P2 cites their recently developed tool, one of the breakthrough innovative products resulting from many years of intensive research works, *"In order to be not just one or two steps ahead but ten years ahead of our competitors"*. Participant C3P5, who works as a technical lead and senior verification engineer, also commented on the importance of this tool as an innovative and disruptive idea, *"I think innovation is very important, especially for the things that I am working on for [product name]. It is a new area that nobody has actually done before. So, innovation has to be there".*

8.3 The significance of engineers in driving the innovation process

The success of the firm with regard to innovation is related to having motivated engineers who love what they do and are willing to walk the extra mile to boost their business productivity. The number of employees has increased over the years, and today C3 has around 70 employees, most of whom are software engineers by qualification. Innovation is what engineers are expected to do in this firm and is key to perform their jobs successfully. Customer challenges are complex and can be solved only through innovative solutions by engineers. The founder C3P1 adds, *"I would say a hundred percent of engineers' time is to innovate. They do nothing else. The only thing an engineer does is to create innovative ideas that help our customers".* He further comments on the innovation-oriented roles of engineers in this firm, *"The technologies we use today are so different and more advanced than the technologies we used in the past. Ultimately, you still need very capable engineers to put those technologies into the right shape for somebody else to buy and appreciate… You still need bright and capable people to use those technologies and put them together in a very sophisticated way".* This is clear in the case of this company, where engineers are proud of their expertise and innovative capabilities. Participant C3P2, who works as a service delivery and account manager, explains the power of engineers and the confidence they show to handle different customer challenges and solve them through innovation, *"We said if any company in the world could solve this problem, it would be us. We have the right people. We have bright minds, and we should be able to do it… We have the best*

team in the world. If anyone in the world could do this, it should be (C3) because we have the best minds in the world".

The manpower behind the successful innovation journey that C3 has had so far is their engineers, who continuously bring new innovative ideas and suggest new features to keep their products advanced and competitive. Participant C3P5 acknowledges that the most important part of innovation is transforming raw ideas into real products where engineers are the main human resource who create, execute and deploy innovation. In this context, a major success factor contributing to innovation in C3 is that all employees are highly educated, with more than half of them holding a PhD degree. Participant C3P2, who is the account manager, feels proud of having so many highly-qualified engineers in this organization, *"This is very good because then new ideas come and float between their minds when they sit together".*

The mechanisms, according to the analysis of C3, are related to various cultural mechanisms driven by a friendly work environment, recruitment process and skills and competence development mechanisms, and leadership and management support mechanisms. The following sections will discuss these mechanisms and the intrapreneurial environment within C3, which represent the overall setup of the entire organization that facilitates intrapreneurship.

8.4 Intrapreneurship culture based on a friendly work environment

C3 is mainly attributed to creating a friendly environment with cutting-edge technologies. This friendly environment is characterized by effective and shared support, rich social interaction, and building strong relationships and networking among engineers and managers. A friendly environment that is reflected in every aspect within C3 supports an intrapreneurial culture and enables engineers to work as one unit and in a collective manner so as to align them to work in similar ways and standards. A friendly relationship between managers and engineers ensures more flexible and open interaction and values trust. Here managers believe in their engineers' capabilities to drive innovation and being key to the success of this firm. This friendly environment is further supported by a no-blame culture where engineers are encouraged to work on their ideas, conduct experiments and make mistakes without any fear of failure.

There is almost a very close-knit community feel inside C3, and this friendly working atmosphere pervades the whole workforce and influences the overall innovation culture. Participant C3P2, one of the head managers, explains, *"So when we meet with our engineers, it is like being set with your friends… and this energy in the company is fantastic".*

In this friendly environment, there is a genuine emphasis on employees being happy and engaged at work. Participants interviewed affirmed that most employees are willing to offer help and support

within and across different departments. Everyone is friendly, incredibly kind, and will go out of their way to help others. As a result, most participants refer to the company as their 'family', which indicates a high level of loyalty and satisfaction in this firm. Here are some of the key aspects that promote intrapreneurship and stem mainly from this friendly work environment in C3:

8.4.1 Emphasis on social wellbeing

A friendly environment can play a crucial role in building great team spirit, cooperation between employees, and increasing motivation and overall performance, as evidenced in C3. In this context, Participant C3P2, a service delivery and account manager, emphasizes how friendly interaction with others in a non-formal setup can drive innovative ideas. In C3, while some employees are based outside the UK, participant C3P2 explained that there are no restrictions as the setup they have allows engineers to talk to anyone in the firm. For instance, one can start a discussion with anyone without prior arrangement, thus facilitating new ideas or concepts. Participant C3P3, who is the head of product development, highlights the positive working relationship among engineers *"We are very close, and we had a great relationship between employees".* Participant C3P6, who is an engineer located in a foreign office outside the UK, adds, *"I enjoy communicating and dealing with people and interacting with different employees… So, this role allows me actually to travel and communicate with others, and exchange ideas and helps me grow from a social sense, which is for me, in particular, is important".* He mentioned that there is a lot of communication with people in the headquarter on a daily basis. This close-knit environment fosters social connection and well-being where all employees have a sense of bonding like a family, which is the most important motivation for participant C3P6. He reflects on this, *"Recently, the development team created something called the 'Company Forums', which is just a forum for us used within the company. It is just to talk about pretty much whatever you want, whether it is technical, whether it is social, whatever you want to talk about. So, during Christmas, people posted about their vacations. During quarantine, people posted about setting up like games together… So that sense of the levity between coworkers… creates a sense of family, which is the thing that I appreciate the most about the company".*

There is a great level of social interaction that takes place outside the office. The firm organizes different social events throughout the year, such as half-day of sports, Christmas dinners, summer BBQs, pub lunches, and evenings out for meals. Moreover, the firm runs a cinema and a cycling club. These social activities mean that everyone gets to know others which eventually facilitates their familiarity and interaction during working hours. Such emphasis on social well-being promotes good mental health, job satisfaction, and a sense of belonging toward the organization.

8.4.2 Open communication and weekly seminars

Open communication is another key factor that drives intrapreneurship in C3. Here open communication is represented by formal events, regular meetings, and non-formal aspects, all of which are bolstered by the firm's friendly culture.

Participant C3P1 notes how open communication allows engineers to easily and quickly reach or contact any employee in the firm, *"People talk to each other all the time; that is fundamental".* Participant C3P3, who is the head of product development, confirms that when someone has an idea, they are encouraged to communicate and share it with other teams. As discussed by participant C3P6, this is facilitated by management support, *"... Managers promote interaction because they promote communication. It promotes the initiative. We are more likely to speak out and explain our ideas and things like that. I feel like, just trying to increase communication as a part of that".* Communication is also well-established across -departments, between sales and marketing and engineers, as explained by the software engineer, participant C3P4.

One of the main events to promote and maintain continuous interaction among all employees, including management and employees, is the weekly meeting. They call it the 'Friday weekly seminar', considered a connection point across the firm. Everyone meets with everyone in the firm and is given the opportunity to interact with other teams, discuss their progress, identify any bottlenecks, and share their idea. Participant C3P1, who is one of the founders, comments, *"We do a weekly seminar for the entire company where one person is the volunteer to stand up in front of the entire company and explain the work that they have been doing to the whole company, which helps to share ideas, help to get people to innovate, help to get people to know what is going on elsewhere".* Participant C3P2 comments on the benefits of Friday seminar to voice ideas to the public and get management and other teams' support, *"The weekly seminar is an excellent venue of sharing new ideas… We just listen to different ideas at the same time. If any of the management, for example, the CEO sees, that is a good idea. We quickly tell that engineer, look, make a slide, make a quick demo of it…".* Participants consider this event as a weekly touchpoint that keeps communication going and allows engineers to understand what other teams are working on, their progress, and the challenges they are facing, so as to be involved with what is happening within the entire firm. As a result of this weekly interaction, in the view of participant C3P2, it keeps the whole company united and promotes working as one team toward defined clients' challenges*, "Everybody knows, what are the general problems that we have and how can we address them, and come up with better solutions, and help our customers and get more business as well".*

Participant C3P3 discusses the impact of remote work during the peak of COVID-19. As there were no face-to-face interactions during this period, he noted how he lost the advantage of having useful conversations in the office space with others. In a similar view, participant C1P7 explains, *"COVID-19*

has affected the interaction within the team and with other teams. The company is trying its best to be fair… you do not see people as much inside the teams. You do not have that thing where you walk around the office and see somebody. This is a bit harder now". The founder, participant C3P1, commented on the challenges of working from home and how communication was managed to minimize these impacts, *"It is very easy when you are all in the same room to gather around the whiteboard and have an informal discussion, but during COVID-19 time, it is much harder to work from home. So, we are encouraging everyone to use video calls all the time. You know, if people need to talk to someone, just have a video call, do not mess around with audio, do not mess around with email, just pick up video straight away. That is a real key; innovative face-to-face communication is fundamental. We also have a number of different tools available for that as well. We have an active internal software forum that people can use".* So, due to social restrictions, C3 has faced some challenges in maintaining that close-knit community business model during the pandemic.

8.4.3 Regular management interaction with engineers

Engineers have regular interaction with their managers on a non-formal basis. There is a weekly meeting held between each manager and their engineers on an individual basis, which keeps communication continuously flowing. This allows engineers to discuss any difficulties that they are facing or express any concerns they might have and also suggest improvements or ideas freely to their managers. Participant C3P1 comments, *"So every manager and the employee must meet once a week, to discuss these sorts of things... So, these things help to foster relationships and share the culture".* These regular interactions between managers and engineers were found to effectively increase positive feelings, improve work satisfaction, and sustain a productive relationship based on trust and friendship. Participant C3P2 adds that managers keep an eye on their engineers to upgrade their skills and understand their challenges, *"So we have a one-to-one weekly meeting with the manager and their employees. But on an individual basis, we have a Key Performance Indicator (KPI) check, and we have SWOT analysis. My job as a manager to the people working with me is to make sure that we address their weaknesses and we also encourage them to stay motivated".*

In this friendly environment, engineers can contact and interact with the executive team directly without referring to their direct manager, which indicates the openness and flexibility of management as discussed by participant C3P3. Also, participant C3P5 notes, *"A lot of engineers from the bottom level can talk to the CEO in the kitchen, having coffee breaks together or just smoking together… communication is very easy to any management level".*

8.4.4 An open office physical environment

The open office physical environment is a major factor cited by most participants interviewed, which facilitates a friendly environment, social interaction, and open communication. Having an open office

environment makes it easier to contact and reach any employee. Participant C3P2 explains how this speedup communication and facilitates reaching for information quickly, *"If a customer asks me about a feature of a unit testing… I just go quickly to the guy I know who is working on it, and I will ask him directly, very open"*. Participant C3P7, who is a senior quality engineer, comments on how the physical environment and the office open plan structure influence communication and employee interaction, *"The office is fairly open plan, and it is loosely organized by teams… You can walk and just see people in the kitchen. There are some joint areas where people are encouraged to meet. People tend to take lunch at the same time. People tend to take their tea break time together. So, there are places where you can just go in and sit around and chat. And there is an expectation that you can go and talk to somebody. So, if I want to talk to any team, I would probably just walk over and talk to them or see whether they are available at that time, just for a quick chat"*. Managers ensure that teams in different physical locations are working together and meet on a regular basis. They reduce the impact of no physical interaction due to the far distance between various offices by the high level of communication. Participant C3P6 explains, *"Management across both sides of the Atlantic (in the USA and the UK) try to facilitate constant communication between the teams. So, we have a weekly meeting for all the field engineers across the offices… Even with all those different time zones, we find a time every week where we can meet and talk and communicate"*.

8.4.5 A 'no blame' culture that tolerates failure

Along with remarkable innovation success in C3, failure is also seen as a significant part of the innovation process that can eventually lead to business success. Obviously, not every project or innovation succeeds in a firm, and as is the case for this particular organization, they have an attitude of accepting failures which reflects its strategy for supporting an intrapreneurial culture. Having a blame-free culture, according to participant C3P2, is one of the main principles that contribute to the development of intrapreneurial culture, *"We have a no-blame or a blame-free culture. If something goes wrong, we do not spend time on who did it. We spend time on how we can solve it. Because we are human at the end of the day, and anybody could make a mistake"*. Participant C3P1 also confirms the importance of accepting the mistakes of engineers while persuading for innovation as it encourages them to experiment and test their ideas without the fear of failure. If engineers are criticized for their mistakes, this may hinder innovation and prevent them from going out of their comfort zone to explore new ideas and opportunities. This no-blame philosophy encourages transparency and focuses on moving forward at all times. Participant C3P6, as an engineer, also demonstrates a similar positive attitude when someone makes a mistake, *"You do not have to blame someone to teach them a lesson. If somebody does something that is not right, you tell them that it was not the best, because of reasons A, B, and C, how about we did that instead, or, how can we make sure that situation will not happen in the future?"*.

Participant C3P3, the head of product development, notes how over the years, many ideas have failed to make it into a final product, but managers in these situations have been very supportive and work with other teams to investigate why some ideas failed. Participant C3P1 explains how the management focuses on solving the problem and takes it as a lesson learned for the future, *"The first thing we do when we have a failure is what can we do now to solve that problem. And then the next thing we do is how we can prevent that from happening? We never bother about who did this mistake because anybody could make a mistake, from the CEO all the way to any engineer".*

As C3 operates in a safety-critical industry, they cannot risk any errors and faults with their final products and solutions for their clients. So, it is essential to deliver high-quality end products and solutions. This implies following guided processes and ways of working when embarking on innovation projects that result in high-quality solutions and products. Nevertheless, the results show that managers from different functions have different reactions/attitudes in the event of a mistake or failure, especially those that can cause a delay in delivering projects on time. Direct managers have more sense of the technical complexity of the firm's innovation; they are much more understanding about the unpredictable nature of some projects and what solutions can be provided in the event of a failure or problem. On the other side, non-technical parties such as managers in marketing and sales sometimes underestimate the complexity of the problem and the time required to solve it. This calls for a better level of multidisciplinary cooperation and communication between these two parties, according to participant C3P4, to close this gap of different perspectives on mistakes. The analysis shows that when engineers receive similar support from all parties, who accept mistakes and tolerate failure as part of the essence of innovation, this will be an advantage for encouraging engineers to innovate without any fear of failure and take risks.

8.4.6 Job Flexibility

In this organizational culture, engineers are given freedom, which is linked to their proactive innovation initiatives. This freedom, such as decision making, is provided in the context of the firm strategy and goals as explained by the founder C3P1 *"… So, there is a lot of autonomy. I would not say free autonomy, but people are certainly empowered to make their decisions based on the strategy, make their decisions from tiny things, whether it is some trivial way of writing a piece of code up to decisions about product features. People are empowered to make those decisions with good reason and justification".* This freedom is supported by management practices as described by participant C3P2, *"So no manager in the company does micromanagement… My manager does not follow me on every single thing I do… During the weekly one-to-one meeting with my manager. He makes sure that I am happy and motivated more than to make sure that I am doing the right things".*

The flexibility of the culture even is extended to the job role, where engineers are encouraged to take on multiple tasks. This is related to the dynamic job design, which was found to affect the level of innovation to a large extent in this firm. Some of the engineers were also allowed to explore and try new roles by joining other teams and departments within the firm for a certain period. The findings show that job rotation is in its initial phase in this company. Recently, managers have started to pay more attention to the process of engaging engineers with other team jobs to expand their skills and build new competencies in new areas of their choice. Participant C3P5, a technical lead engineer, explains, *"… They do kind of rotation to work with different teams for maybe one day or week a month. It is not a formal thing, but we are trying to start doing that a bit more often… It is quite valuable in giving people a nice perspective outside of their own usual level".* Participant C3P2 adds, *"for the past year, we started getting one from each department to work with another department for a week or so just to see how their work is affecting the new teamwork. Basically, it has been interesting".* Job rotation that allows engineers to join other teams in different functions can be seen as a motivational factor for upskilling and information exchange in C3. With such benefits, C3 is now actively exploring the potential of job rotations with their employees.

Furthermore, engineers have more dynamic responsibilities and are encouraged to understand the multiple skills around the entire cycle of a product and not just specific to their job role, as explained by the general manager, participant C3P1. In this way, engineers gain more knowledge and skills in different areas beyond their particular roles. Participant C3P6, who is a field application engineer, states that working in C3, which is an SME, engineers can perform multiple tasks and get involved in various projects, *"Being in a small team where you have to constantly jump through multiple hoops is exhausting and keeps you very busy. But it is also interesting because no day is the same or no project is the same".* In a similar context, participant C3P5 links innovation in engineering roles to job satisfaction by giving engineers more freedom to do things that they are excited and happy about, *"You want to allocate engineers to do the kind of work they enjoy doing and that they are willing to do. If they do that, then they would be innovating in that specific area. Sometimes you end up doing too much stuff at the time, and lots of these things engineers do not typically like doing, and this is when innovation cannot start, taking a back seat because there is not much inspiration there, and innovation needs inspiration".*

This flexibility around dynamic roles is seen as an advantage in increasing the transfer of knowledge and experience among engineers and encourages team spirit. However, the nature of roles and projects is susceptible to frequent and dramatic changes in response to changes in customer requirements, which is a challenge for many engineers who are unable to adapt. In this context, participant C3P2 noted that too much context switching in the same role is the nature of working in this firm. Tasks' priorities frequently change, requiring engineers to adapt and respond quickly, which may frustrate many of them.

Participant C3P2 commented further on this result, *"So the challenge is we do a lot of context switching, and that is everyone in the company does this. And because of that, we lost some people because they could not cope with this. And that is why in our new interview, we tell people, are you okay with context switching?... but it has been working with us for the past 15 years".* Such a fast switch between different tasks and extra dynamic roles may limit engineers from focusing their attention on specific tasks, leaving them with minimum time and effort to dedicate to other innovative activities. In this perspective, C3 should find a proper balance between maintaining a good level of innovation and avoiding limiting the scope for their engineers and frustrating them with their roles. Also, engineers should have an open mind and be a bit more receptive toward flexibility in their roles.

Part of the freedom and flexibility provided to engineers is being flexible with working hours, and most roles can be done with a hybrid approach of home and office work. Such a process has been followed for many years that motivates engineers to work in the way that suits them. Engineers can decide to work online from home if they are not physically needed in the company. The process involves informing their manager by email without any prior request, as noted by participant C3P2.

8.4.7 Reward, recognition, and appreciation

Unlike C1 and C2, this organization has no monetary rewards system. C3 seems to place more emphasis on other forms of rewards like recognition of good work, showing appreciation, and celebrating team achievements. For example, *"Engineers would probably receive praise from their managers",* as per participant C3P1. In this regard, He adds that the management focuses on appreciating the innovative contribution on the team level by celebrating the achievement of major milestones in projects or having completed a software release, *"... There is usually some kind of celebration in the office. It would be something like pizzas or a party or a night out… When reaching a major milestone of a project, the manager would take the team out for a meal or a celebration".* Participant C3P6, who works as a field application engineer, explains this further, *"Managers give credit for the good work, if someone came up with a good idea and that ended up benefiting the company, they would send a company-wide email, or they do some sort of communication to thank them and show gratitude publicly, which shows appreciation for all of the team, and for each employee".* Participant C3P6 adds that daily and continuous appreciation and thanks from managers would motivate him more, *"It is encouraging when you see your name on the company-wide email, just showing gratitude, showing thanks, it is like a sense of accomplishment, sense of appreciation that you get, which helps motivate you for the whole year. But I would say that the constant communication and the constant small 'thank you' and gratitude and appreciation on a day-to-day basis on solving small issues are more of what keeps me motivated".*

Many engineers interviewed in this study showed mixed views about the lack of monetary rewards such as bonuses. For instance, participant C3P5, who is a technical lead engineer, is satisfied more with the

management recognition and appreciation than with financial rewards. Also, participant C3P6 confirmed a similar view *"I think my opinion is for engineers, as long as you are actually paying the market rate, and you are not obviously trying to underpay people, money is not a large part of what motivates them. It is essentially a creative occupation, and if you let people create good things, that is what developers want to do, and the money is quite a secondary thing".* There are perks to this approach taken by C3 as not every engineer can be motivated with just praises or celebration; some engineers look for monetary incentives. Participants interviewed cited some other engineers who would prefer receiving financial incentives and bonuses, which would motivate them more. The absence of a monetary reward system in the organization for these kinds of engineers may add a certain degree of dissatisfaction and could potentially impact their intrapreneurial behavior. This might limit their tendency to be proactive and develop ideas. As a result, they may want to protect and keep their ideas to themselves and eventually may leave the organization to pursue their own entrepreneurial endeavors.

8.4.8 Effective peer and team support

The friendly working environment in C3 encapsulates effective peer and team support. As most participants explain, all employees in this firm are helpful, knowledgeable, and always willing to lend a helping hand if someone ever has any trouble with any task. The software engineer, participant C3P4, prefers to start by working closely with one of his colleagues to get support, suggestions, and advice when having a new idea. This is his first approach before talking to management and convincing them about his idea. He notes that although working with other teams does have some disadvantages, such as bringing competing ideas and having a disagreement in some cases, it is still healthy, valuable, and positive to work with other team members. Working in a small team and having the attitude of teamwork would help them in identifying their weaknesses as well as the competencies they need to develop. In this regard, participant C3P6 highlights that all team members have a sense of belief that they are working as one person, *"Since we were a small team, you are aware of if one person is lagging behind the whole team. So, it is easy to identify who needs more training and who needs more assistance. It is a sense of teamwork and a sense of unity within the company".* The importance of supportive colleagues seems to be beneficial, especially for engineers who are in the early stages of their roles. Participant C3P6 considers the support from his team as the main driver to gaining trust and confidence so as to voice his ideas and spread the initiative to other peers. He further explains how this team support motivates him to be more productive, *"Different team members will be willing to assist and help resolve your problems, even at the inconvenience of themselves. And that teamwork that unity within the company motivates me personally to kind of try harder to work out the problem or contemplate different ideas. Talking with different people allows different opinions, different thoughts, and different understandings. All of which kind of leads to growth, both for myself and for the people that I am working with. And to me, those are factors that are definitely beneficial in this company".*

In C3, collaboration and teamwork spirit are essential ways of working among engineers and are effective strategies for innovation to take place. For participant C3P3, the best innovation can emerge when collaboration takes place across multidisciplinary teams with shared inputs from different professional engineers.

Multifunctional collaboration is seen as being more efficient, innovative, and better for driving the idea forward. Participant C3P5 considers collaboration as a basic principle when working on complex and innovative systems, *"Collaboration is fundamental because the kinds of innovations I work on and that can make a difference in the company, is the kind of innovations that you cannot do by yourself. You have to collaborate with others. If you do not have good collaboration, then it is not going anywhere".* Participant C3P7, who is a senior quality engineer, believes that innovation is explicitly a team effort, and collaboration between teams is mandatory for the quality of innovation for two main reasons:

- Firstly, involving other teams is a significant step in criticizing, reviewing, and providing suggestions and improvements to the new innovative idea or the suggested feature or product. For instance, the review process undertaken by multiple teams may sometimes completely change the way in which features are to be introduced or developed. Also, their suggestions can reduce the time to get things ready.
- The second aspect is related to the firm's core business which is to provide standardized products, where other teams can interact and change the specification of the products so as to meet the set standards and qualities.

C3 has employed some engineers in permanent jobs and a few interns during the pandemic. A culture of teamwork and cooperation, knowledge sharing, and supporting others continue while employees work from home. Despite the challenges from the pandemic, coaching and mentoring new employees through some of their motivational approaches has continued to be effective in engaging newly employed engineers with the company culture. One of the engineers, not from the list of interviewed participants, who started a position at the beginning of the lockdown reflects on his experience and how the teamwork culture supported him in overcoming the challenges of starting a new job remotely, *"The challenges of starting a job remotely were made much smaller by the close cooperation and communication within the company, and the willingness of all colleagues to assist one another and to pass on their knowledge of the product and the fieldwork. Suppose I have a technical problem or come across something I do not yet understand. In that case, I send a message to my colleagues in the team and usually receive an explanation or help via a screen-share. When I need more help, it is easy to reach out to the developer responsible for a specific tool or feature, reaching the operations team for licensing and financial queries, or to IT for technical help".*

8.5 Recruitment process

The recruitment process is one of the significant aspects of driving intrapreneurship in a firm like C3. In an approach similar to C2, the firm focuses on hiring engineers who have graduated from well-ranked universities, preferring those with higher academic qualifications such as an MSc or PhD. According to the founder, participant C3P1, *"I am a great believer if you hire great people, give them a direction to point to, and they will do great things… Part of innovation is to have the best people. We are very selective with whom we hire, and we hire the top engineers… We have very careful recruiting policies in place to screen and attract the best people. We recruited a lot of top-tier universities…, and probably more than half of our software team have PhD level qualifications. And that is important to us because it shows an element of the ability to be creative rather than just do what you are told to do".* Engineers possessing high educational qualifications and knowledge are found suitable to lead applied research and work on research projects to successfully commercialize ideas into real products. Another significant recruitment strategy is to hire engineers who have a passion for technology, as they believe that they are the kind of engineers required to drive innovation while working on advanced complex products. Participant C3P2 further explains, *"We are not selling anything normal to anybody. We are selling very premium software products to very smart people. And in order to do that, you have to bring people who are not only qualified or even have a proper degree such as PhD, but you have to have a technical passion".* One important point to note here in C3 is that most participants felt that anyone who shows a passion for technology would also be passionate about delivering high-quality, top-notch technology, and they will respond to customers' needs in a very proactive manner.

The recruitment process is a collective work that involves all team members taking part in the final decision of the hiring process. Any member of the team is allowed to object to an applicant from joining the team. What is unique in the recruitment process is that potential engineers would have to spend one day in the firm, as demonstrated in the application process, step 3, Figure 8.1. So, they are exposed to its culture and get an opportunity to meet different teams so as to understand the internal norms and working style.

Figure 8.1 Screenshot showing the recruitment process in C3

Spending a full trial day in the office reflects the company's philosophy of selecting engineers that can be integrated into its culture so that both C3 and the potential engineer get to know each other. The interviewee is encouraged to meet as many people as possible to break the ice early on and give them a feel of what they can expect if they join the firm.

In the recruitment process, generally, there is no particular focus on whether the prior technical experience fully matches the new job specifications. Participant C3P3, the head of product development, emphasizes the characteristics the organization focuses on, *"We hire people who love dreams and learn new things… If they have got good grades, that helps, but that is not a pre-pass to the company. It is much more about their attitude, interest, and willingness to learn… We rarely employ people who have expertise in what we do. We are looking for people who are keen to learn more and want to keep pushing themselves"*. This view is clearly demonstrated in some of the job adverts published by C3. For instance, Figure 8.2 shows some snapshots of various anonymized job adverts for 'software engineers' published in 2020. It is obvious that C3 emphasizes the engineer's ability to participate in research and innovation, cooperate with other functions, and mentor and train other engineers. Possessing specific skills such as good communication and hard-working and independent work abilities are mandatory for potential engineers.

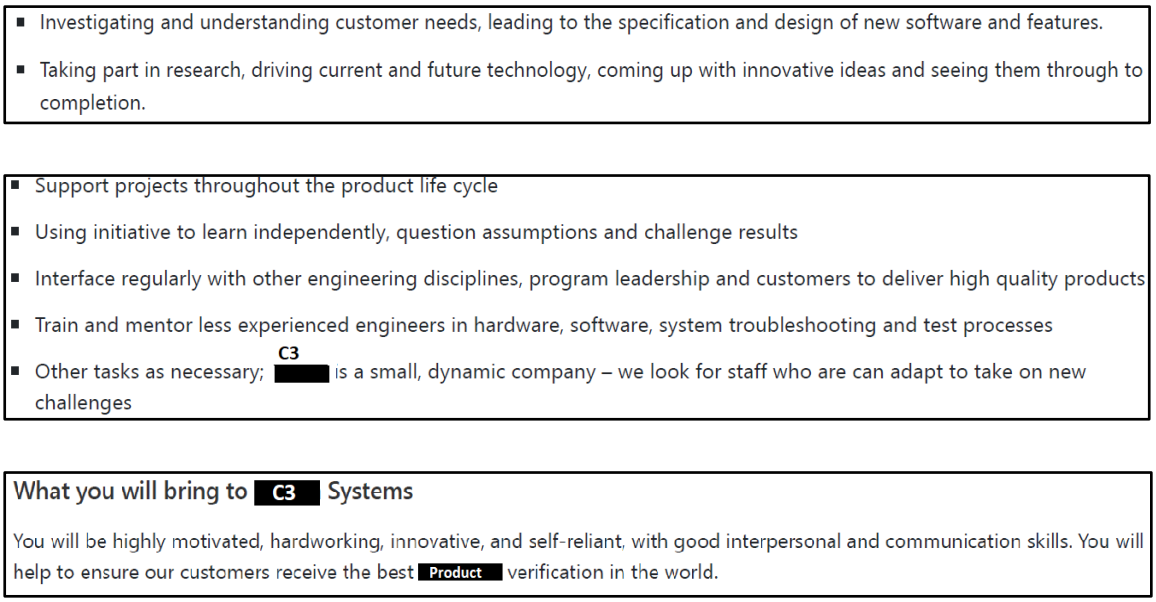


Figure 8.2 A sample of a job advert for software engineers in C3

8.6 Skills and competence development

C3 offers several in-house training opportunities for developing the skills of their employees. So, it is unsurprising that they have very clear platforms for training their engineers. As part of their training system, they offer various technical courses related to the software, tools, and systems they develop and non-technical courses. C3 recognizes the value of personal development and extends its training to upgrade soft skills that make employees motivated and feel very valued. From this perspective,

participant C3P2, the service delivery and account manager, explains, *"We attend many courses and training internally and externally… And we also encourage engineers to stay motivated. If they require extra training, we do it… So, the engineer who works with me does evening classes to become a better presenter and marketing manager. He started doing some management courses on how to manage a group of people. As an engineer who wants to learn something, of course, that is part of the CPD (Continuous Personal Development). We encourage people even to take, for example, distance learning masters degrees that they want to do, anything that would keep the employee motivated to do their job… At the end of the day, we are investing in these employees, and we are investing in making sure that they stay with us and do the job for us basically".* When there is a need to develop a specific competence in response to new customer project requirements, intensive courses will be provided to the employee. In this perspective, participant C3P1 adds, *"We will do whatever we can do to help them if it is something that they need to learn, like a new language, a new skill, a new programming technique that helps them make sure that they do their job better. Of course, that is out of the discussion and offered to them".* Participant C3P3, the head of product development, mentioned that he was granted a PhD opportunity and sponsored completely by the firm as part of the investment in software development. Such investments in engineers will pay off in the form of increased loyalty, motivation, and less turnover and can boost engineers' capabilities and productivity to do their job in an efficient and innovative manner.

8.7 Leadership and management support

The founders, representing the executive management, have stated a clear vision and strategy that makes it easy for every engineer to adopt and follow. Middle managers demonstrate this strategy and translate it down to their engineering teams into clear objectives to achieve. All managers, regardless of their level, are very receptive to any idea or suggestion. Their strong technical background equips them with the knowledge and experience to handle such ideas effectively, give constructive feedback, and drive them ahead in the right way. Engineers in C3 value many of their managers for being role models, which helps in facilitating their initiatives and being supported by friendly relationships and the lack of any communication barriers. The following sections will discuss these aspects, among others, in more detail.

8.7.1 Articulating and demonstrating clear vision and strategy

In C3, executive leaders adhere that the firm strategy is understood and accepted by all employees. Participant C3P1 confirmed that for engineers to be active in the area of innovation, a clear vision and strategies should be put in place and clearly demonstrated for them. He adds, *"… It is, therefore, important that everybody knows the strategy and what their role in executing it… So that every single person in the company has visibility of that strategy and understands where they fit into it"*. In the case

of C3, where multiple offices are located in different regions, this clarity seems to be critical in keeping all engineers from different locations aligned to work toward similar objectives. This thus helps in bringing consistency with their approaches and work ethics. According to participant C3P1, this clarity gives engineers abroad context and greater understanding to decide how they do their job and ensure that their daily decisions and behaviors support the firm's competitive intentions. He explains by citing an example, *"If an engineer finishes one job, what should they do next? They should be able to compare two jobs and say, it is more important to do this task or that task because it fits closest to the company strategy".*

Higher management holds quarterly meetings to update all employees about the business strategies, and engineers are involved in the process. They are encouraged to discuss, ask questions, and give their opinions to ensure they are part of the strategy for the best execution and delivery. Direct managers play a significant role in translating the strategy down to their engineering teams. They ensure that the strategy is well recognized at every level by opening a two-way conversation as per the head of product development, participant C3P3, *"The essential part about the firm strategy is that you engage employees at each level as it goes down… You have to keep flowing the communication and talking with them and going from 'we have got this idea' to 'how we could do it?' What would your role play in and guiding it? It is kind of ping pong down, and ping pong up to get it understood"*. Participant C3P6, who is a field application engineer, comments on his manager's role in facilitating clear strategy to his team, *"Our manager makes sure to relay what we are doing this month, what upcoming projects we have, what potential projects we might have come, he constantly updates as he strongly believes in being as transparent as possible".* Additionally, as discussed earlier, each manager holds a weekly meeting for their team of engineers and updates them frequently about the business, the market, and priorities to focus on.

Similar to C1 and C2, C3 has not adopted any specific strategy to drive innovation and hence keeps the opportunity to innovate available to any engineer. According to participant C3P1, *"We do not have a strategy to drive innovation… Everything we do revolves around innovation. There is no specific strategy to do it. Most of the strategies involved focusing on making sure we do not innovate too much. We will make sure we innovate in the right direction".* This allows the company freedom to explore new opportunities openly and encourages any engineers to bring new innovative initiatives.

In terms of innovation, the current business focus had to be adapted and revised based on the impacts of COVID-19. Participant C3P4 explains how COVID-19 has influenced innovation, *"At the moment, considering innovation, we are focusing slightly more on both fixings and polishing rather than actively developing new things. It does not mean that innovation has stopped. We still are doing some innovation there. It is just priorities have shifted in the last three months".*

8.7.2 Engineers' orientation toward customers and markets needs

As seen in C2, C3 too looks at customer interaction as an important aspect for driving innovation. By directly liaising engineers with customers, they can understand their challenges better and come up with innovative solutions. One of the motivations for engineers, regardless of their positions and role, is to allow them to interact and engage directly with customers. Participant C3P1 declares, *"This is a very important thing… So, we are doing a lot of interactions where engineers are going to be sitting with our customers. We try to have our customer-facing engineers and interact a lot with the people that actually developed the software".* As a result, participant C3P3 explains that engineers will understand customer requirements and propose new ideas and suggestions accordingly, *"So it is very useful for getting access to the customer. Engineers will bring new ideas and understand what problems they are really going to solve. And some of those ideas trigger new products. Some of the engineers already have a test project where new ways of generating tests or ways to interface with the system or new ways to perform analysis may arise, which are completely innovative activities".* Managers' practices in keeping their engineers updated about the customer and their requirements and market needs will give engineers some contexts and areas to develop, such as adding new features and improving the performance of the applications, as explained by most participants.

Engineers' orientation toward customer focus is seen by most interviewees as an advantageous extension to their engineering roles where they can act as sales employees when they work on customer premises. This allows them to understand customers' systems and technology and detect any area where the company can offer a solution or product to solve their issues or improve their systems. This is described further by participant C3P6, who is an engineer, *"You are also a face for the customer and doing some of the business and sales parts… It is an opportunity for the company to pursue some additional work… if you see a need that we can provide as a company, then you put on your sales hat, and you try to make them understand if they use this software in this sense, or in this way, it can resolve this issue that you are having. Or maybe your current process is deficient, and using our tool can help. It is a nice middle ground between software and sales".* Going beyond the engineering and technical roles by representing the firm and incorporating some sales and marketing aspects reflects the mutual trust level between engineers and their managers.

8.7.3 Managers act as sponsors for their engineers

As noted by the majority of participants, managers are not only receptive to new ideas but also encourage their engineers to share their thoughts and express their views and possible ideas regardless of their quality or potential value. Participant C3P6, a field engineer, further explains such managers' attitude toward engineers' initiatives, *"I have not heard any manager having a negative reaction to any ideas. It is always a positive reaction".* Participant C3P7, as an engineer, adds, *"… Managers are not criticizing engineers when reviewing their ideas and always want to make the idea better".* From the

point of view of managers, participant C3P3, who is the head of product development, indicates that managers welcome ideas and listen carefully and positively to their engineers. He commented, *"Engineers are always free to think outside the box, sometimes to come up with very crazy ideas, as engineers always do, as well as good ideas…, and there is no such thing as a bad idea, by the way".*

Participant C3P3 explains that managers encourage every employee to play a part in the firm by raising new ideas and suggestions and recognizing and valuing their efforts. Obviously, what differentiates the products and makes them more competitive is the development of unique and new features that are constantly introduced and become part of the software releases every three months, which in many cases results from engineers' initiatives. Without the full and continuous support of managers, these initiatives will not be explored and will remain on the engineers' side. This management support is demonstrated by direct interaction with engineers and taking their ideas seriously for further development or action. They benefit engineers by providing reviews, feedback, and recommendations to further strengthen the scope of their ideas. They give clear directions and practical suggestions on how to proceed with the raw ideas and push them forward. Participant C3P5 affirms that managers support their engineers by connecting them with upper management so that their ideas are looked into and recognized. This will then allow a fast decision to either adopt, delay or reject the idea. According to participant C3P2, *"We have had many examples where somebody comes up with an idea, whether it is great or not. The manager would early provide qualification of that idea and will discuss it internally… Then either they speak with the head of engineering or the product management committee and align this new idea, whether it fits there, or it does not".* Managers are also keen for their engineers to be linked with other business teams by facilitating their interaction and communication, thus, helping in convincing others about their ideas and driving their ideas forward. For instance, participant C3P4, a software engineer, explains that when he raises any opportunity, he receives immediate support from his manager, who connects him with sales and marketing teams.

8.7.4 Managers as role models

Many managers in this firm, according to many participants, are considered role models who inspire the engineers working for them to exhibit technical excellence. For participant C3P2, he considers the CEO as his role model from whom he learned many skills, *"I like to learn a lot from the CEO. He is a person whom I find a lot of common characteristics with him on the personal level, but on the work level, he is the one who showed me the tricks of the business and trade… So, I like to see how he handles the customer meetings. And I learned from him quite a lot by just watching him".* A similar sentiment was cited by the technical lead and senior verification engineer, participant C3P5, who considers his direct manager, who recently left the company, as a role model, *"He was really inspiring me. I very quickly realized while he was in the company how he knew something about every single tool in the company. Like if I had a problem with anything, we would be able to ask him, how does this thing work?*

And he would every single time and very quickly provide an answer… I would love to get to a point where I can talk with confidence about everything you might be dealing with like him".

Managers are not only acting as role models but also extend their responsibility to mentor their engineers and provide support on a personal and work level. Many participants highlighted the friendly mentorship and casual relationship between managers and their engineers as a key to maintaining a productive and efficient workplace. This relationship is built on a mutual level of trust and respect. Participant C3P6, who is a field application engineer, supports this view and says, *"My manager is very transparent with me..., so he always gives me advice about many things in the company and out of the company, personal and work-related things. So, it creates a very interesting relationship between us".*

8.7.5 Engineering and technical background of managers

One of the distinguishing features of C3 is that most managers here, including the founders, are engineers by qualification who have built technical expertise over years of work. This is again similar to C2, where managers with strong technical skills tend to earn more respect from their engineers as they fully understand their work. In this context, many participants view this as a benefit for engineers and an additional advantage in terms of facilitating the discussion and exchanging technical information. Participant C3P4, a software engineer, adds, *"All of my management chains are obviously engineers, which means they have a good view into the tools and products we are working on… Some managers are the leaders of the tools and project lead".* For participant C3P5, who works as a technical lead and senior verification engineer, *"All managers are quite open and professional, so they do take on board what you say, and they listen. They have all got a strong engineering background, so they understand engineering terms and technical talks as well".* Participant C3P7, a senior engineer, says, *"If you come from an engineering background, you have a more appreciation of where things can go right or wrong as well".*

On the other side, such strong technical backgrounds of the managers in C3 raise some concerns for the executive team founders for future plans. As the business is expanding and correspondingly the expected increase with their engineering staff, leaders in C3 wonder if they have to change this approach to strategically recruit managers without a technical background. Currently, engineering teams are managed by team leaders who were engineers and promoted to managerial positions through their career progression. Even the founders who represent the executive layer are engineers by profession. Participant C3P1 explains his own case as an executive manager, *"I am a software engineer… So, I had never done a management training course or a management MBA or whatever it is. So, I think over the years I have picked up certain skills, but my weakness is this. I am an engineer, not a manager. And we lack in the company people with Human Resource backgrounds and management backgrounds".* This

leaves a gap in the management practices concerning leadership and management skills which can be potentially developed through specialized training courses.

As for now, C3 is working toward supporting its position as a key provider of verification solutions for the global aerospace and automotive real-time embedded systems. They continue investing in core technologies and leading the development of cutting-edge technological solutions to meet the increasing complexity and computational power in the critical automotive and aerospace embedded domains. The company is looking at expanding their engineering staff by recruiting more talented and motivated engineers among its offices in the UK and the USA so as to lead their future success.

Summary of key points of C3

- C3 is a technology leader in the aerospace and automotive industries, with some of their production tools recognized as world-class. Engineers are credited as the ones behind this success of driving technological advancement in this firm.
- The intrapreneurial culture in C3 is attributed to its friendly environment based on strong relationships and interaction among engineers and with their managers, rich social life within the firm, effective informal communication, supportive peers and teams, and a no-blame culture.
- Managers at all levels contribute effectively to the establishment of this friendly intrapreneurial culture by demonstrating a high degree of trust and confidence in their engineers, fostering their growth and competence development, and acting as role models, mentors, and sponsors to their engineers. They demonstrate clear strategy and are committed to supporting their engineers toward customers and market-focused projects/roles.

CHAPTER 9: C4 – CASE STUDY OF A LEADING FIRM IN THE ENERGY INDUSTRY

9.1 Background and overview

C4 is one of the UK's leading technology firms operating in the energy industry, established in 1994. Compared to the previous case studies, C4 is not a manufacturing or product supply company. The company's core business focuses on delivering integrated and innovative end-to-end technology solutions to energy challenges, including early-stage feasibility studies, full design, build, and operation and maintenance of customers' sustainable energy assets. The solutions offered aim to support customers in taking advantage of the energy transition and decentralization, operating more sustainably, improving resilience, increasing asset productivity, and reducing pollution, costs, and energy bills. Through assured solutions, inspired thinking, long-term expertise, and integrated delivery, C4 delivers reliable, safe, and innovative end-to-end customized energy solutions that are aligned with clients' energy strategies and strategic operational objectives. These solutions are provided by integrating multiple advanced and complex technologies, such as electric vehicle infrastructure, battery storage, wireless charging, microgrids, renewable energy resources, Internet of Things (IoT), network automation, and active management and remote control systems.

C4 has a long record for successfully delivering innovative and integrated energy solutions for some of the UK's largest and most important companies, including those responsible for critical infrastructure and complex environments. Their clients include some of the high-profile public and private sector-related organizations across industries such as rail, defense, aviation, airports, seaports, water, manufacturing, logistics and fleet operation, and commercial buildings.

Although C4 functions in a highly regulated and less dynamic energy sector, innovation is part of their day-to-day business and is considered a strategic way to run their activities and services, signify themselves in the industry and maintain customer satisfaction. The energy systems are classified as stable systems, but recently, energy networks have started evolving and transforming, especially with green energy technology that needs to be integrated into the network. Therefore, the organization's vision emphasizes accelerating and leading this transformation and being at the forefront of influencing the energy industry's future. The business strategy focuses on exploring promising opportunities for leading zero-emissions technology and accelerating the transition to clean energy.

The firm has received well-recognized awards for some of their innovative outbreaking solutions. In 2018, C4 won 'Innovation of the Year' at the National Rail Awards for developing and implementing one of the world's first innovative solutions. The firm also received the 'Investors in People' platinum award in 2020 for recognizing employees and their achievements throughout the firm's journey.

9.2 The nature of innovation in C4

In C4, innovation is based on providing integrated and tailored energy solutions to solve complex customer energy challenges and responding to the high demand in the energy industry to reduce carbon emissions. Participant C4P1, who is the head of client relationships, considers this a significant challenge that started to impact the daily operation of customers and businesses and how they can succeed in their network modernization. The company is committed to enabling low-carbon technology solutions through innovation. Participant C4P1 explains, *"It is challenging for customers like, how do they solve their energy problems? Because there is battery storage, PV (Photovoltaics), wind turbines, and other technologies in place. Everybody comes to a customer and tells – 'try this solution to solve your problem'. This ends in solving the problem, but nobody is telling the customer that I will do this in a holistic way for you".* The innovation stems from the analysis of clients' networks and the use of a proper mix of technologies that are more sustainable and can be introduced as one solution to efficiently create electricity, store it for the best time, and then release it.

Innovation is very important to C4 to ensure business success, stay competitive in the market, and maintain long-term customer relations. In the view of participant C4P4, one of the technology and innovation engineers, *"Innovation is one of our unique selling points. So, we try to add more value to every solution that we offer to the client, and we would not just perform in the normal way. We try to come up with more innovative ways when delivering a solution. So, it would be more applicable to the client to go with us in the future. So, innovation is quite key… Whenever we deliver to our clients, we give them a bit more of what they were asking to get from us in order to build a better and longer relationship with them".*

C4 as a company is operating in a traditional, risk-averse, and highly regulated energy industry. To drive innovation from within the organization and adapt to the evolving customers' needs and the transformation toward renewable energy resources, the firm outlined a distinct strategy for innovation in 2015 and established the energy technology consulting team as the central team for innovation. These two approaches are unique in the business setup of this firm as compared to the three previous cases C1, C2, and C3. The following sections provide more details on these approaches.

9.2.1 In-house energy technology consulting team

What is notable in C4 is the creation of a specialized team to drive innovation called the 'energy technology consulting team', representing a dedicated in-house team that acts as a consultant unit to other teams to support and guide them in implementing innovative technology solutions. Participant C4P3, who is the technology and innovation team lead, explains, *"It is our role to spearhead innovation in the company and lead the innovation in the company. But it has to be within our strategy. So, it is not a very open-ended innovation. It has to be within targets".* The consulting team interacts directly

and works closely with clients, industry partners, and suppliers to develop and trial innovative energy solutions. They have deep expertise in different areas of energy technologies, so they can drive complex innovative projects and lead new opportunities to achieve competitive advantage. They facilitate intrapreneurship among other engineers by working closely with different teams, incorporating and involving them in the innovation process, and sharing knowledge and expertise with them, so as to push forward innovative projects as a collective and joint efforts with other engineering teams. They are involved in any new idea within the firm that emerges from any engineer from any function as they have the capacity and competence to provide support, recognize the idea and facilitate their implementation. When any engineer proposes an idea, managers assign one or two engineers from the consultant team to support and work directly with him/her, thus facilitating the innovation process.

Despite having this team accountable for leading innovation, innovation in this firm is an accumulative process resulting from different inputs and initiatives emerging from different teams to reach for optimal solutions. These teams include the team that generates the idea and other teams that are going to execute it. Other teams are also required to be innovative in doing their part. The technology and innovation team lead, participant C4P3, described this, *"In our company, we have the design team and delivery teams. All engineers in these teams are involved and become part of the concepts or ideas we come up with. So, if we want to develop charging infrastructure for an electric vehicle or electrical aircraft, we will develop specification architecture and high-level design, but our engineers are responsible for making that real on the ground. So even though they may not be involved in a lot of innovation in their day-to-day job, they are particularly part of our project team. Because they know some details in terms of, for example, our design engineers are experts in things that we do not know on how to design an electrical network. They will use that experience as much as they can, but sometimes they need to come up with new concepts and ideas, such as a different type of circuit. So that is where their contribution to innovation comes from… But as an engineer, I think it is natural for an engineer to be innovative in their role because not every system or solution is the same. And sometimes you have to develop a solution in a way that fits into special requirements".*

This technology consulting team comprises nine engineers who are highly skilled and have expertise across different energy technologies. Brainstorming sessions are well organized within this team as a fundamental technique to find new opportunities and ideas to achieve the business targets. This team is given greater freedom and flexibility than other teams with regards to their core mission for innovation and interfacing with other teams within the organization.

9.2.2 Articulating a clear innovation strategy

Innovation for C4, as per one of their innovation documents, has been defined as *"The development and implementation of any approach which enables us and our stakeholders to achieve our objectives*

faster, more affordably, safer, or to a higher standard, and which uses unconventional methods in the context of our business". This enables the firm to deliver the best value to customers and respond better, faster, or more cost-efficiently to their changing requirements. Innovation in this firm goes beyond having innovative projects or those delivered by the consulting team. It is something that is instituted as day-to-day activities throughout the business. Therefore, engineers are actively involved in the business strategy; they are expected to be innovative while working on their challenging roles and liaise closely with the innovation team to implement projects successfully. The company focuses on retaining, motivating, and empowering every engineer to act on their intrapreneurial potential.

Articulating this clear strategy seems more beneficial for the firm in accomplishing business objectives. It gives engineers more boundaries to innovate, improves alignment across different teams, and helps focus innovative efforts around achieving the firm business strategy. Participant C4P5, a technology and innovation engineer, expresses that when he thinks about a new idea or solution, the main emphasis is to think about how this idea can contribute toward the execution of the firm's vision or strategy. In his view, *"I think essentially every solution must be aligned with the company's vision and values"*.

9.3 The significance of engineers in driving the innovation process

The company is proud of having professional, experienced, and innovative engineers whether they are working in design, operation, or projects. Engineers are experienced in different aspects of technologies and work collectively to find the best innovative solutions to offer their customers. The business development manager, participant C4P2, explains, *"Innovation success is credited to engineers themselves where they thirst for innovation of the new technology… If there is an opportunity, they can do something really out of the box or out of the normal thing, and they will come up with some fantastic solutions"*.

The firm is engineering-intensive, with approximately 220 employees in total. The majority of their staff are engineers from different educational backgrounds, such as electrical and electronic engineering, power engineering, and electromechanical engineering.

From the research, it was evident that the main strength of C4 with regards to delivering innovative technology solutions is related to the capabilities and expertise of its engineers. They apply best practices from the industry and integrate the latest emerging technologies to identify how customers' power networks can be planned, optimized, and modernized. In one of the innovation documents, C4 stated that they are *"Employing world-class engineers and professionals. We pride ourselves on the expertise of our people"*. Engineers are central to the success of delivering innovative projects and services to clients and for the continued growth of the organization. Therefore, the firm attracts, recruits, and retains high-performing employees with the potential skills and experience.

Although C4's business has been dramatically affected by the pandemic, engineers were active in thinking of new solutions to emerging customer challenges and exploring new opportunities that can aid the post-COVID recovery journey for their clients. The company has launched an innovative project to use technology to help electrical engineers remotely control and monitor the electricity network rather than attending onsite using 'mixed reality' technologies. This adds an advantage to clients such as airports ensuring power supplies stay safe and reliable and keeping engineers safe during this challenging phase of the pandemic. The successful implementation of this innovation will enable their engineers to work on several projects remotely and have control on different electricity networks, thus minimizing the risks of COVID-19 transmission in the workplace as well as any further site access restrictions due to potential national lockdown. Providing a smarter remote operating system for the electricity networks will have additional benefits, such as reducing energy losses and costs, as sections of the network can be monitored and switched off remotely when required.

The mechanisms, according to the analysis of C4, are related to various cultural, strategic recruitment process and skills development mechanisms, and leadership and management support mechanisms. The following sections will discuss these mechanisms and the intrapreneurial environment within C4, which represent the overall setup of the entire organization that facilitates intrapreneurship.

9.4 The intrapreneurial culture in C4

Given the nature of the business sector that C4 is involved with, the intrapreneurial culture reflects some of the complexities in this highly regulated industry. The environmental work conditions, for instance, are risky for workers and are coupled with the risk-averse attitude of their clients. This is explained by participant C4P4, *"We work with certain types of businesses that we classified as risky, even though they might have high turnover and profits. The business as a whole is not risk-taking, and we try to keep the risk as low as possible".* Therefore, the intrapreneurial culture within C4 is designed to promote an outstanding culture of safety where engineers' health and wellbeing always come first, and measures are taken to avoid mistakes and minimize errors and failures. They evaluate risk-taking toward innovation with substantial attention to any of their business strategies. This culture is supported by management practices and a clear vision and strategies in place that facilitate the intrapreneurial work of engineers. The culture within C4 is seen as a key factor in supporting engineers to grow, learn and build the required skills. The target is to have a culture that empowers engineers to become world-class figures who are experts and competent in their subject matter fields. Some influencing factors of this culture are mentioned in the innovation strategy document, *"We pride ourselves on our culture, and the rewards, benefits, training and development opportunities we provide our people. When you join (C4), you will be part of a respected, award-winning team".* In an internal document, one of the client delivery managers who is not from the interviewed participants concludes, *"C4's safety culture, vision, and*

values ensure an inspiring working environment". The following sections illustrate C4's intrapreneurial culture in more detail.

9.4.1 How the firm drives innovation in a high-risk averse energy sector

The energy industry is a risk-averse business with high uncertainty for organizations to build and transform into new technologies. Businesses in this sector provide critical services to the public, and many of them run on traditional systems that have been stable over many decades. This approach in the energy industry is affecting manufacturers, vendors, and suppliers who tend to be risk-averse and deliver highly standardized end products and services. Accordingly, the general work approach in C4 is to calculate potential risks and decrease errors and failures to their minimum level. Given the complex nature of the energy sector, any potential error or failure could have a significant impact on the quality of energy solutions and, as a result, disrupt the reliability of clients' networks. Hence, they tend to take any steps very carefully. This is reflected in one of the managers' behaviors, participant C4P2, the business development manager who usually tends not to encourage engineers to take risks, *"We are linked to a regulated business related to power networks and distribution in the UK… So, managers are very low-risk appetite".* Participant C4P4, who works as a technology and innovation engineer, discusses a similar view of why C4 is high risk-averse. This is related to the nature of the industry C4 operates in and the client's business behavior, who usually show a low tendency to embrace new technologies and avoid taking any related risk. As a result, this impacts innovation within C4, especially for radical innovation or introducing new products. Participant C4P5, who works as a high voltage operation engineer, elaborates more on this, *"In terms of innovation, it is very little chance to do new innovation. I think in such a stable industry, it focuses on technologies that work for decades, that have years and years of research behind. So, it is hard to kind of bring in new technology, especially our clients are very risk-averse. So, for them to accept new technology into the electricity network, it has to go for a long process of research and testing".* Engineers interviewed complained about this limitation with taking risks within this company, which affects their proactiveness in exploring new opportunities or acting as innovators. Hence, it creates a style of restrictive culture that limits the ability of engineers to innovate in a flexible manner. Participant C4P6, who is a senior consultant technology and innovation engineer, evaluates the need for a risk-taking attitude and encouragement from their managers and highlights that this is an area that needs further development in C4. C4P4 cited examples where many opportunities on the innovation side that could potentially add more value to the clients, such as offering some energy supply, are considered red lines by managers where the firm is not willing to take any risk to invest in new areas. This is a limitation for C4, where their high risk-averse attitude/approaches tend to restrict opportunities to diversify innovation, thereby limiting engineers' ability to initiate new ideas to a certain extent. C4 still has managed to build an organizational setup that encourages intrapreneurship despite being tied to a risk-averse sector.

C4 has a precise, well-defined process for managing and mitigating risks and avoiding potential failure prior to starting any new project. They also have strategies in place on how to capitalize on any failure if a situation arises. The risks associated with innovation are managed carefully and reflected in the rigorous approach to the selection, governance, and delivery of innovation projects. Failures and errors are generally accepted, well documented, and managed for future consideration. Participant C4P5 comments on their management reaction in the unfortunate event of an engineer making a mistake, *"It is not you are like in trouble. It is not a case of demonizing the individual… So, we have an investigation about what happened and why has it gone wrong? Then we go through an audit and look through all the records and understand how it went wrong… The outcome is a lesson learned where other engineers can learn to avoid similar mistakes".*

When the organization estimates that innovation is likely to fail and not lead to any real business benefits, such as no longer delivering value for money invested in or not generating the expected results/learning, they tend to apply the 'fast fail' approach. They will pull the brakes of that project by halting all related activities. They will focus/prioritize other projects that might have more potential or impact in terms of providing value. However, for any failed projects, C4 focuses on capturing the learning; there is a clear approach to analyzing failures and incorporating the lessons learned in managing new projects in the near future. Participant C4P4 highlights some aspects of such a learning process, *"We have different gates on how we deliver the project, the last gate after we deliver to the client, we need to have some lessons learned. Within those lessons learned, you captured every new idea that we made or every mistake that we made. And then it changes the process of how we deliver new projects… So, once you start the new project, you have to read all of the stuff that was captured from the previous one".* Another strategy for reducing the possibility of failures is that engineers are encouraged to address any challenges and difficulties they face to their managers at early stages. This help engineers in getting the proper support at the right time and avoid the risk of failure at a later stage. According to participant C4P5, an operation engineer, *"I think one thing they (managers) can tolerate mistakes is when you speak up early enough, as I mentioned, you have a weekly one-to-one meeting with your manager. So, whenever you suspect something might go wrong, it is better to tell at that time…, So whenever you talk early enough, you are more likely to get the support that you need to avoid getting troubles or failures in a project… I have many projects that had some difficulties, but the manager did help a lot".*

On the other side, participant C4P2 mentioned that when the identified risk is not avoidable and needs to be taken, then they will take the risk. The organizations have confidence in the abilities of their engineers and managers to reduce any potential risk so as to have minimal impact and deliver any project to their set standards/expectations. This process is extended to innovative activities, as explained by participant C4P3, who is a team leader, *"We always identify risks as early as possible, always*

estimate risks according to an internal process…, but in terms of innovation, if the company thinks that there is a good potential for innovation or an idea or a concept or a promise solution, they do take risks".

9.4.2 Driving a culture of safety through a specially designed program

Working in severely dangerous working conditions like in C4, the organization places the health and safety of engineers as their top priority. It is mentioned in one of the safety documents, *"Safety is our number one priority. Our industry-leading safety performance is achieved only through focus and always putting safety first in everything we do".* C4 is committed through one of its core values to delivering an outstanding culture of safety that is a key in operation management and overall working processes. Hence, safety principles and guidelines are clearly defined. To ensure a culture of safety, special programs are designed to train engineers about best practices, develop a proactive approach to safety, and change the mindset of teams through the coaching of correct behaviors, beliefs, and attitudes. This program ensures the integration of safety principles to be an integral part of the culture and in everything engineers do. This program is described further in one of the safety documents *"In order for safety programs to be successful, managing health and wellbeing must also be addressed… An impactful program creates tools and techniques which are pragmatic and accessible and helps teams to improve energy levels through improving physical and mental fitness, diet, hydration, rest and recovery. Healthy teams are safer teams… A culture of continuous improvement has allowed us to embed safety as everyone's priority at (C4)… Continuous improvement is driven by analytics which informs proactive action. Safety pervades through design, implementing rigorous safety practices and learning from incidents, hazards, and near misses".* As further steps are taken in the firm, new engineers in their induction weeks are exposed to intensive health training. The firm recently developed safety training by incorporating interactive technologies such as augmented and virtual reality to increase their effectiveness and accessibility and present them in a more engaging way to their workforce.

The organization aims to have zero public safety incidents, and it has had an exceptional safety record in the last few years. One of the employees, who is not from the interviewed participants, explains this further in one of the internet websites, *"The firm has a strong focus on health and safety, mentally as well as physically".* When it comes to innovative opportunities, according to C4P3, safety overcomes taking any risk for any innovative activity, *"Definitely do not take a risk when it comes to safety".* The attitude toward safety is explained further by participant C4P3, *"I stay safe by following procedures. If I see anything around me that looks dangerous, I will challenge it to keep others safe too".*

For C4, part of their response to COVID-19-related restrictions is to keep their employees' effectiveness, safety, and well-being their top priority while still committed to fully serving their clients. As an action to comply with the pandemic circumstances, the organization has created the 'Continuity

Business Plan' that is reviewed and updated continuously, and a 'COVID-19 Risk Assessments' formulated for each sector, including operational and non-operational aspects. This is to ensure uninterrupted delivery of many essential projects for their clients and incorporate COVID-19 risk mitigations across their business, including travel arrangements and close monitoring of the health, safety, and well-being of their staff.

9.4.3 Specific job designs for specific roles

It is obvious that engineering roles within C4 are designed to be very specific, thus requiring engineers who are technical experts in very narrow disciplines. This approach focuses on having more depth of knowledge and narrow experiences, which is different from the one followed in the previous three case studies where engineers were allowed to develop more wide technical experience. It is hard for engineers in this firm to gain multidisciplinary technical experience as options such as job rotation or joining other technical teams or groups are not supported due to safety protocols. This is justified by participant C4P2, the business development manager, *"There is no job rotation because of the very strict disciplines for the number of different types of engineering functions in the energy sector… Within the electrical safety regulations at work, staff need to be deemed competent, work on live equipment, or work on high voltage equipment. And so, the competencies are very regimented and well-governed, so it is not that easy to just move someone from one discipline into another, even if it might look very similar".* Some of the engineers interviewed state that this is an area that could be improved. They cite a few engineers who have gained multidisciplinary experience over many years of working and how they are key to supporting others. Participant C4P6 explains, who works as a senior consultant technology and innovation engineer, *"… The best engineers are those who are multidisciplined. So, they can do two or three different roles, but then that is usually historically just a built-up and have experience over time. And then earn the competencies with the experiences going on".*

The freedom provided to engineers is demonstrated by the management practices, which include a no-micromanagement style. Managers give room for engineers to decide on the best way to accomplish their job but within the boundaries of their safety protocols. Participant C4P5, who works as a high voltage operation engineer, explains, *"I can do whatever I want with my time… There are no questions at the end of the day, like, what have you done? What did you do today? Or you have to explain what you did. None of that exists, and it is very flexible. There is a lot of freedom in this company and in my role especially".* It is worth noting that freedom and flexibility are not provided to all engineering teams across the company in the same way and level. Participant C4P3, who works as a technology and innovation team lead, explains that it depends on the job function, scope, and department. They have to be careful given the complex sector they are involved with. Participant C4P3 mentioned that the technology innovation consultant team has more freedom than other teams in operation or design. He justified this further, *"Because we are the innovation team, we have some flexibility to do some design*

work, we have some flexibility to attend on-site and interact with the delivery team. We also work on some financing aspects as well… This is the nature of our role because we are trying to develop a solution from scratch. So, we support other teams because we will have more knowledge about the solution and we support and guide them around how to do it in a certain way. If you were in the other teams where your role is to design and deliver, they tend to have less flexibility to do their work".

Despite the firm focusing on developing subject-specific engineers, they are encouraged by all management to go out of their technical comfort zone and incorporate business and management skills in their roles. According to participant C4P1, who is the head of client relationships, some engineers are involved in the business discussion for new deals with customers. He mentions that business and client managers always engage engineers in conversations with customers and involve them in the initial meetings. Furthermore, engineers who work on projects are engaged and involved in some parts of project management and control. Participant C4P3 explains, *"I do not just do technical work on the projects. I also do project management and take care of the contract agreements".*

9.4.4 An effective rewards, recognition, and incentive system

In C4, one of the engineers' main motivational factors to build commitment toward intrapreneurship is to have a robust rewarding and recognition system. This system includes monetary and non-monetary rewards and managers' recognitions. The firm signifies itself by giving employees more rewards and benefits than any other company in the energy industry. According to participant C4P2, who is the business development manager, *"I think some of the things we do internally help the engineers recognize what the company is doing as a whole, and indeed for them is to receive rewards for jobs well done. We have got internal rewards as the 'delivery values scheme', in which you can nominate members of any other teams within the organization for praise for any particular job well done. They will get a certificate, sometimes gift vouchers and things like that. They got recommendations that are reflected in their annual bonus review as well".* Participant C4P6 also explains the 'innovator of the year' scheme, where the company announces the most innovative employee of the firm, which encourages everyone to compete so as to win this award.

The reward system is also tied to engineers' productivity and performance by achieving their yearly objectives. Engineers' evaluation at the end of the year is mapped to four levels of performance (outstanding, meet expectations, below expectations, and need improvement). Participant C4P3, who works as a technology and innovation team lead, mentions that the promotion scheme applied in the firm follows specific criteria related to engineers achieving particular targets and meeting certain goals. Participant C4P5 provides more detail about this, *"It all ties into the IPR (Individual Performance Review) where if you are above expectations, then this ties into your bonus for the year, which has a certain percentage. That is essentially how they reward you. Also, you get personal recognition and*

satisfaction as well, which is sometimes worth more than monetary rewards". This rewarding structure system influences everyone to perform to their best so as to reach the next level of performance.

Other forms of non-monetary rewards are designed carefully to acknowledge engineers' achievements. This is clear in the case of working in projects where the celebration takes place at the end of each project or at the accomplishment of a major milestone in the project lifecycle. For each project completed, engineers are valued, acknowledged, and recognized publicly for their efforts; as explained by participant C4P4, who is an engineer, *"The senior manager will send an email congratulating the team. In that email, they would be mentioned by the name, or like this person did this, and this person went an extra mile".* In the view of participant C4P3, despite monetary rewards being very important, he is motivated more by appreciation and acknowledgment*, "I think for me personally, having a bigger bonus is maybe not as motivating as I want to see all other engineers or the management say - he was the cause of this solution. I want people to talk positively about me, and that is for me a big motivation to work hard and to come up with innovative solutions".*

9.4.5 Effective collaboration and teamwork

Collaboration and teamwork are the cornerstones of innovation success in C4, which encourages new ideas and moves them along the innovation process much faster. Participant C4P2, who is the business development manager, considers innovation a joint effort across teams to deliver the most effective solutions in the most cost-efficient way possible. As per participant C4P3, when he has a new idea, his first approach is to share it with his team members, discuss it, and get instant feedback to develop it further. Participant C4P2 mentions how teamwork is fundamental when having a new idea, *"In my team, if we are putting an idea or a proposal together, it will be very collaborative. We will work together and usually bounce ideas around each other with a storyboard".* Participant C4P4, who works as a technology and innovation engineer, highlights that his team members are very receptive to ideas and are always willing to provide support to discuss them.

The in-house innovation team is a hub for incorporating different teams with the required competencies to work collectively to deliver the projects. They facilitate collaboration and ensure effective communication among different members of different teams. Collaboration across different teams is a strategic route for the company to ensure successful innovation. Participant C4P5 values collaboration with commercial and business disciplines, especially for duties that are out of engineering contexts, which enabled him to develop other non-technical skills and be a successful engineer. This is also extended to collaboration with clients as per participant C4P2, *"Collaboration is a very key thing within the company… I think the structure is fundamental to having a work environment that facilitates cross-work between all functions of the company. And I think that helps drive everyone's buy-in… We also try and do that collaboration with our clients as well".*

Participants interviewed extended the value of teamwork not only for getting benefits for the innovation activities but to interact with experts and technical figures in other teams, where many of them act as role models. Participant C4P6, who works as a senior consultant technology and innovation engineer, explains that interacting and collaborating with these kinds of engineers is an effective way to get inspired and motivated and learn from them in terms of how they think and perform their tasks. Participant C4P3 describes the benefits in this perspective to provide consultations and advice based on their valuable knowledge, *"In the modern world, you can not do everything by yourself. You need to work with different people who have different expertise and knowledge. You do not need to know everything to be an expert, but you just need to know how to access the information around basically"*. Special to this firm is the governance process for any project, which is also designed based on teamwork so as to have backup resources at any time of the project. Participant C4P4 explains this further, *"We work as one team. Most likely, you would not find a project that is solely owned by one person. In each project, we need to have two or three people involved in it fully. So, if someone was absent or had any issues, other people would know exactly where the project is stopping, and they come to continue"*.

9.4.6 Open communication

Despite having a restrictive environment for innovation, C4 has still succeeded in promoting intrapreneurship through effective and open communication. Such open communication strategy influences how employees perceive the culture and exchange knowledge within and across various teams.

On the engineering team level, meetings are well organized within and across teams on a weekly and monthly basis to maintain continuous interaction between team members. What is distinctive about these meetings is allocating a specific time for general discussion for team development and improvement. Participant C4P4 reflects on this, *"We have a weekly team meeting, and part of that meeting is just 15 minutes; we can show how we can improve the team in terms of processes, in terms of innovative ideas. 15 minutes for discussion on what we can do more to change the way that people work"*. Most teams and group meetings are also designed with an open agenda slot where engineers can add any topics of their interests that may be beneficial to the team.

Open communication is also well established with clients, and management is aware of promoting this external interaction. Obviously, managers tend to pay more attention to engineers who might face some difficulties or limitations, such as a lack of communication skills. Account and delivery managers who are always in frequent contact with customers particularly support these engineers to interact with their counterparts on the customer side. According to participant C4P2, who is the business development manager, *"It is a difficult one because some of the engineers are very fantastic engineers, but from a communicative level maybe not so good. People like myself will quite often operate as an intermediary"*.

One of the engineers, participant C4P5, adds, *"The thing I enjoy most about working with clients is coming up with solutions together that benefit them from a network resilience and carbon footprint point of view and to make sure they are happy and satisfied with the work we are doing".*

All participants share similar opinions regarding having a physical environment with supportive facilities in place that increases workplace collaboration, influences interaction, and contributes to a rich communication culture. Participant C4P5 provided more information on this, *"We were lucky in a sense that we all work in the same office, so everyone is easily accessible… It is an open desk where our managers might be just sitting opposite you or just over there. They are visible to everyone".*

The organizational culture used to be reinforced by face-to-face interaction, which is no longer the usual way of working due to COVID-19 restrictions and impacts. A constant communication approach has become key to minimizing the impacts of this fundamental shift to working from home and losing the natural communication setup seen in an office environment. Managers maintain frequent contact with employees through calls and remote meetings to share the company messages and check staff well-being. Team brief sessions are being held frequently where engineers could show their progress and highlight any challenges so as to get the proper support. Participant C4P5 values their CEO's daily contact with all employees who communicated with them openly and honestly throughout the pandemic. He describes it as a more interactive connection to keep engineers aligned with the current business situation and ongoing plan changes. Participant C4P5 explains that the CEO had a daily video call with all employees for the first three months of the pandemic, then two videos a week. In these video calls, engineers could ask questions and raise concerns, in which leaders value the inputs from all employees. In addition, managers hosted online Q&A sessions to keep teams informed and give them the opportunity to ask questions.

This open and high-quality communication system maintains a continuous interaction that bonds employees and managers in a friendly environment despite all the challenges from the pandemic.

9.4.7 Positive relationships across all levels of management and engineers

In C4's intrapreneurial culture, managers are keen to build solid and positive relationships with their engineers. This is reflected in their positive attitude when contacting, communicating, and interacting with engineers. According to participant C4P2, who is the business development manager, open communication makes the environment a good place to work, where employees can talk and interact informally with management at any level. He adds, *"I think some of the key elements making the workplace a fun and enjoyable place to be, whilst keeping away processes and what can make it formal, but relaxed enough to be enjoyable is good interaction between all levels. I think that is absolutely a key… So, everyone in the company knows each other and has good relations, especially managers and engineers".* In this open environment, the CEO and higher managers interact with engineers directly,

not through middle managers, and frequently so that everyone feels important and valued within the firm. This is tied to the firm governance process where managers work closely with engineers and make real efforts to know everyone's names and what they do. Participant C4P4, a technology and innovation engineer, illustrates this further with an example of how managers behave during daily work. He highlights that in all meetings and discussions, he never felt that his manager was acting or functioning as a manager. He feels that he behaves like any other team member and takes any kind of discussion with an open mind. This participant also confirmed that managers always trust their engineers' capabilities, respect their views while discussing, and consider their suggestions when making decisions.

The organization emphasizes developing managers by focusing on their attitudes and encouraging interaction with their engineers. Participant C4P2 explains, *"One of the key messages when we bring in a new manager or promote anyone into a management role, is that we have a five-day management training course that the company runs. And that is very much about the personal touches and the personal involvement"*. He adds that managers learn how to engage with employees by gathering more information about them, such as *"know the people's names, to know whether they are married or have children, it makes a massive difference. In my opinion, the fact that someone that you have not seen for six months and having to walk into your office and says, how is your daughter doing? Or how is your son at university?... Like, take the time to know and learn these things or to keep at least the engagement going"*. Furthermore, in C4, managers at any hierarchical level interact with engineers and share their personal news and socialize together. Managers are always in frequent touch with their engineers throughout the day, communicate with an open mind, and are happy to discuss non-work-related matters. According to participant C4P3, "*We are a small team as well, and there is not this huge gap between senior manager and engineer"*.

9.5 Strategic recruitment process

The firm follows clear steps in the selection process for hiring potential engineers. The recruitment process is an accumulative learning process based on the experience developed over the years in recruiting suitable employees that can fulfill certain job requirements. Mainly this organization focuses on developing, improving, and training hired engineers to obtain deep knowledge and skills. According to participant C4P2, a business development manager, *"I think we have a very structured recruitment process, and it seems to work. But we will take people that we will develop further into the role... If you can see that potential in someone, and I know it is difficult to do in an interview process, but we have had some major successes. We have had some horrible failures, but it is the way to do it, and we have developed fantastic engineers from potential"*.

One of the main strategies for recruiting technical experts for some of the job vacancies is to attract engineers who are well known for achieving innovative success in other companies and are experts in their field. So, they do look for engineers with experience. Participant C4P6, a senior consultant technology and innovation engineer, explains, *"For my team, innovation consultant team, they pulled from other consultancy companies with similar expertise. So, like my boss comes from the company (X)... A lot of them were like actually giving consultancy services"*. They attract competent engineers with potential innovation and creativity capabilities, then provide them the opportunity to grow and develop within C4. Participant C4P2 empathizes, *"I think we are lucky. We have got some absolute nerd engineers that absolutely focus on engineering solutions… I think it is a testament to the internal recruitment and development of the engineers themselves. We have managed to prove that sort of mentality within the teams and at all levels"*.

Besides recruiting competent and experienced engineers, the firm provided comprehensive graduate programs that give opportunities to young talents to kick start their careers and develop them into future leaders of the energy industry. Graduate programs are organized and structured where after a year, potential engineers may be offered a position and go for another year of developing further experience. These engineers have to show high marks at university as a prerequisite to joining the firm, following a transparent selection process illustrated in Figure 9.1. The firm invests time and money and allocates a professional mentor to support graduate engineer development to ensure success.

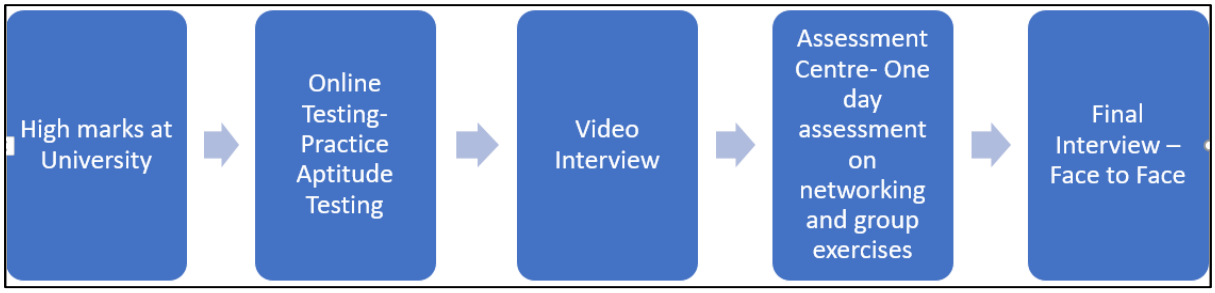
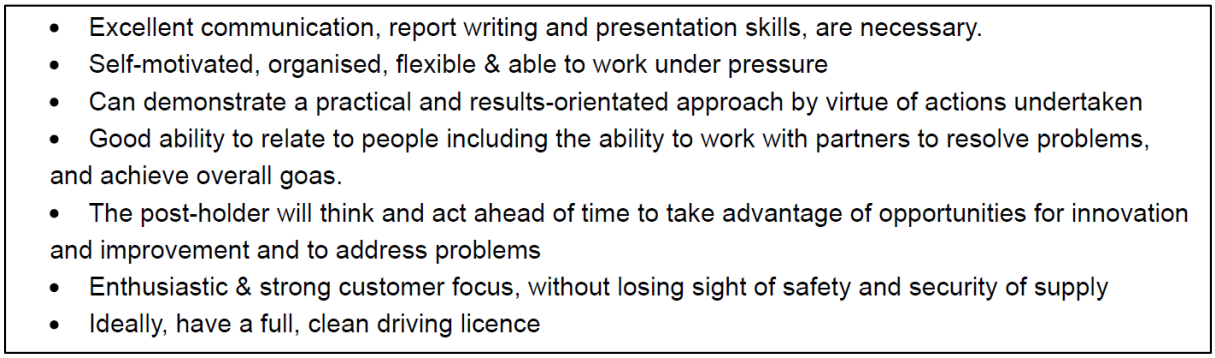


Figure 9.1 Graduate scheme selection process in C4

Participant C4P4, who started his role as a graduate student and currently works as a technology and innovation engineer, reflects on his own experience when joining the firm, *"Initially, I joined the company on the graduate scheme. So, for the first year, I have been doing placements with different departments in the business, and it gave me more insight and more like networking with other departments of the business. It gave me more insight into the holistic view of the company. And it is kind of useful when I need to do some work and get in touch with other teams and know whom you could ask"*. After exploring and joining different teams and business departments in the first year, the engineer can decide which team they would want to join initially and then progress to their first supporting role. Engineers in this process develop work experience under the guidance and support of a special mentor. At the end of the first two years, the engineer can either work in their base location or apply to other

suitable opportunities across the business. This program gives engineers wide knowledge before being attached to a permanent role, where they can build their expertise. This program is accredited by the Institute of Engineering and Technology (IET), which gives engineers all the teaching and experience needed to become Chartered Engineers.

The firm focuses on hiring engineers with specific characteristics that can enrich the innovation process with creative ideas. The firm is usually keen to recruit engineers who are motivated, social, and can add value to innovation. Figure 9.2 illustrates one of the job advertisements from the year 2021 for network planning engineers, highlighting the essential skills needed from engineers in addition to technical abilities.



- Excellent communication, report writing and presentation skills, are necessary.
- Self-motivated, organised, flexible & able to work under pressure
- Can demonstrate a practical and results-orientated approach by virtue of actions undertaken
- Good ability to relate to people including the ability to work with partners to resolve problems, and achieve overall goas.
- The post-holder will think and act ahead of time to take advantage of opportunities for innovation and improvement and to address problems
- Enthusiastic & strong customer focus, without losing sight of safety and security of supply
- Ideally, have a full, clean driving licence

Figure 9.2 Network planning engineer sample job advert in C4

9.6 Skills development opportunities

The firm is keen to nurture and grow its employees by developing their capabilities and providing a platform to ensure the learning curve is always going up. The firm focuses on having engineers who become experts in their work domain and lead the future of the firm. It invests heavily in developing and upskilling their engineers. Hence, C4 offers a comprehensive range of online and e-learning training modules, specific in-house courses, on-the-job training and external courses, and ongoing coaching and mentoring schemes. All are designed to build their engineers' technical expertise, management aspects, and soft skills. It is mentioned in one of the career documents, *"But what really sets us apart is our excellent training and development, which is why many of our employees go on to become highly respected figures in the industry"*.

The company makes a significant investment in training their engineers and has established their own training center that design, manage, and develops customized training reflecting specific engineers' needs and technology development. Being in specialized sectors, this setup helps tailor and customize training based on project conditions, requiring engineers to develop specific knowledge and competencies to handle. Participant C4P2, who is the business development manager, explains, *"We have quite a strict competency setup within services for every level of engineers from the top down to apprentice… We have got an internal system with all the competencies in there… There are regular*

internal and external courses to keep people relevant. So, it is an ongoing thing. We have got a dedicated training center within a footprint". Participant C4P4 cites an example reflecting the proactive work of the local training center; they have added technical training about installing solar panels in response to one of their project requirements, which enables their engineers to do the job instead of using a subcontractor. Participant C4P6 mentions the flexibility in training through self-training and learning using platforms such as online learning and LinkedIn. This facilitates learning while engineers manage their time effectively. According to participant C4P2, engineers are encouraged to proceed for further long-term qualifications and studies, *"You can apply for funded studies with the company funds that go through, whether it is a degree or diplomas to further them into whatever role they would like to go".* Most participants indicate that engineers can request their managers for any training they need that could help them to develop their skills. Managers are very supportive in finding the proper training for them.

C4 is a learning organization, as explained by most participants. In order to retain and further nurture the talented people they recruit, they offer opportunities and tools to help everyone learn and develop in the way that works for them. This is combined with having a clear growth path for every engineer so they can understand, plan, and execute meaningful career growth. Participant C4P3 confirms, *"It is not just paying someone fairly. It is also about improving that person as an employee, improving the expertise and knowledge".* Participant C4P5 is always seeking to get new knowledge by consulting with other expert engineers and sharing ideas with other teams, which is facilitated by teamwork spirit and effective communication. Participant C4P6 confirms the importance of mentoring programs, *"So we get a lot of mentoring, so, you know, which is also cross-functional so I can get and go out to other people who are always quite accessible as well".*

9.7 Leadership and management support

The analysis shows that leadership and management support are essential for promoting intrapreneurial culture. Managers in this firm value the abilities of their engineers and are willing to support them to grow, develop, and stay motivated and efficient. They welcome new ideas and initiatives, discuss them with their engineers for applicability, sponsor their engineers, secure resources, and support progressing these ideas with their higher management and business teams. The following sections discuss some of the emerging themes on management support.

9.7.1 Clear vision and strategy

C4 has clear visions that flow through everything the firm does and in every project and activity. These visions are related to becoming an employer of choice where people are motivated and engaged, having respected corporate citizens who value a safe culture, and being sustainably cost-efficient. The executive team is keen to convey the firm visions and related strategies at every level of the

organization, which according to participant C4P2, supports engineers to reflect on them through their work, *"There are lots of communication centrally... So, spread the clear vision throughout the company, as to what we do, what we can do, and what we want to do".*

In this firm, to ensure that every engineer is working toward the vision and strategy and is committed to them, their yearly targets and objectives are tied to one of the company's three visions related to being an employer of choice, providing cost-efficient solutions, and being respected and trusted corporate citizen. Participant C4P4 explains this, *"The visions are quite fixed, and the strategy is built around these visions. Even on my yearly objectives, all of the objectives need to fit within three criteria within the three visions. So whatever objective you add to yourself, it needs to classify like which vision will it meet? Even if it is self-development or a new project, even if it is more responsibility that you want to take, it needs to meet an objective. For example, anything that is related to professional development should meet the first vision, which is to 'become an employer of choice'... Everything that will add to your own professional development is classified within that vision... So, whatever your objective is, it will need to be assessed based on the company visions".*

Communicating the strategies is vital to convincing employees of the importance and relevance of their company's strategic goals so as to inspire and engage them. Managers have a critical role in demonstrating and translating the vision and strategy to their engineers. Participant C4P3, who is the technology and innovation team lead, explains his role as a manager from this perspective, *"We all understand what our objectives are as a company and what we are trying to achieve. We will identify how doing a specific project contributes toward our strategic level objectives… So, we identified these objectives, and it is about trying to understand how to work with my team of engineers and how we contribute to our strategic objectives. So, they know they are part of the team, not just for the project but as a whole company. They do contribute and have an impact on its success by how they can achieve the objectives".* Other participants have similar views and emphasize the importance of managers acting as good examples for their engineers. Participant C4P5, who works as a high voltage operation engineer, illustrates, *"Definitely, the management does demonstrate the vision and the values of the company in their day-to-day work. But if the management were not demonstrating them, it would be very difficult for us to demonstrate them because we are essentially following the management in that way".* However, it seems that different teams are engaged with the strategy in different ways based on their management actions. Engineers have different perspectives about the clarity of their team objectives. It is evident that the innovation team sometimes struggles to achieve their team objectives as projects are on continuous change. According to participant C4P4, a technology and innovation engineer, *"I am talking from my own experience. So, my manager does not have clear objectives and clear targets that are affecting people to achieve… but in other teams where it is more or less fixed work, like nothing change, for example, the electrical design team, it gets a bit clear. But my team where they are still*

consultants, and there is a very changing project-dependent work. The objective needs to be very clear on what is expected to do". Similarly, participant C4P6, who is an engineer from the technology and innovation team, clearly mentions that to a certain extent, this uncertainty in their team projects affects how their managers demonstrate the strategy, which adds some conflict to their roles. This area could be improved in this team to avoid a lack of direction among employees or to demotivate them in their roles.

All participants affirm the importance of the 'annual business forum', which is a full-day strategic organization event held by the management to share the firm information in terms of future strategies and financial and marketing aspects. This forum is held every six months, involves all employees, and goes through open and effective two-way communication where engineers can express their views and ask questions to the executive team. Participant C4P2, who is the business development manager, explains, *"We do two annual business forums, which effectively take everybody in the entire company into a conference. It is split over three or four conferences to keep the numbers manageable, where the senior managers will effectively spend a day presenting the company performance, current solutions, and wins, etc... Everybody from the engineers to the apprentices is able to ask and engage directly with the senior managers, and it is really a very open forum, so there is a lot of opportunity for feedback".*

9.7.2 Encouraging new ideas and securing resources

Although the firm is very risk-averse and careful due to the nature of the energy business sector, this does not prohibit engineers from coming up with new initiatives. Managers are usually keen to listen to new ideas and suggestions. Participant C4P2, who is the business development manager, confirms the support of higher managers in this context, *"What is good in my organization is definitely, the buy-in from the very top about being innovative, and it is one of the key drivers of innovation through technology… If you can justify it from a financial point of view, then you will get support… The senior managers are pretty open-minded for engineers".* Direct managers also are very receptive to any idea. They sponsor and support their engineers in the initial preparation phase. In this perspective, participant C4P4, who works as a technology and innovation engineer, explains that when having an idea, he would first discuss it with his manager and get initial feedback and approval to work on the idea to a level that can then be presented to their senior managers. His manager provides the time to explore the idea, and once it is developed, he will involve the business and senior management in an official meeting and let the engineer present the case directly to them. Direct managers in this firm support their engineers in backing up the idea by showing financial figures such as how much it might be cost-effective for the company or add value to their clients so as to convince the executive team. This part of innovation is considered the main challenge for some engineers like participant C4P2, who struggles to represent their idea in business language.

Managers are very supportive in securing and getting the right people who could help new ideas go to the next level in the innovation process. According to participant C4P4, *"If the idea is good, you are more likely to get someone else to work with you just to speed up… you will be assigned one or two more analysts to assist in working on this".* Managers facilitate engineers' networking with other teams and getting them involved as per participant C4P4, *"So whenever you collaborate with other teams of engineers, it might not be easier for you to speak directly to that manager. So, it becomes a bit of a challenge when you are trying to convince some other team to do something in a certain way. You will need your manager's support to talk to other managers… It is not everyone will agree to take a new idea from you. Like your manager will happily take that idea and present it on your behalf, and it will be accepted".*

9.7.3 Managers' technical support

Engineers in C4 confirm the ability of their managers to discuss, develop, shape, and strengthen their ideas. Managers can ask technical questions to engineers to understand if their ideas are really innovative or promising. Participant C4P3 comments on his manager's support for developing his idea and making it ready for execution, *"We always encouraged to submit and discuss ideas, first to see if there is an opportunity because managers are trying to see the solution or your innovation objectives. Because sometimes, when you develop something or when you come up with the idea, you may not see it in the first place and end up your objective, but they will ask guiding questions around certain areas, so to think about the concepts and understand if the solution is really innovative or promising".* From a similar perspective, participant C4P4 also mentions the support he received from his manager to take his ideas forward and shape their direction, especially ideas that can pop up during the project phases, *"Innovative ideas are more or less stuff that will make you deliver the project in a more productive or easier way… You just need to think outside the box sometimes on how you can better do something and most likely start with just like a chat with my manager. Like I have just some random thoughts that I would discuss with him. He could add more to the idea or pitch in with some other way of doing my idea. And he could tell me like, okay, it is not for this project. Maybe we can discuss it after this project to add something else".*

Engineers highlight the capability of their managers to evaluate their ideas, give feedback and provide technical advice. Similar to what was observed in the three previous case studies, most managers in C4 too come from a technical background or have an engineering qualification that enables them to understand their engineers' initiatives and help them in making technical decisions. Managers will have the confidence to communicate in a highly technical language and give mentoring support. Engineers such as participant C4P5 find it very hard to speak or express the technical problem in engineering terms to other managers who do not possess any technical experience, such as the commercial team.

Many managers in this firm are considered role models for engineers who aspire to act more proactively, work hard, and effectively. Participant C4P4 believes the CEO is the role model that inspired him, *"It is our director. He is a bit young for the role that he is carrying, and he is quite knowledgeable... It is quite interesting to observe him on what he does and follow how he works. The experience he has is also interesting"*.

C4 is now focusing on being ready for the transitions in the energy sector and meeting the evolving needs of their customers. They aim to be efficient and effective in delivering the best possible value to their customers through innovation and best practices. Their plan for the future also looks for the readiness of Net Zero energy by connecting and integrating low-carbon technologies. In addition, as part of the firm social corporate responsibility, they aim to reduce their carbon footprint in operational activities.

Summary of key points of C4

- Despite working in the high-risk energy industry, the company has succeeded in developing a culture of intrapreneurship that empowers everyone to innovate.
- A clear and standalone strategy for innovation is articulated in this firm compared to previous case studies. The strategy includes a set of principles, processes, and governance that lead the innovation process. A separate consultancy and innovation team leads innovative activities within C4 and facilitates innovation across other teams in a collaborative manner.
- The firm values their engineers to contribute effectively to innovation. A culture of innovation focuses on their safety in the first place. This culture is influenced by positive relationships among employees and management, open communications and effective teamwork, and recognition of good efforts.
- The company provides a clear competence development plan for engineers to constantly grow, learn and build the required technical skills through the mechanism of customized training and development programs and mentoring.

CHAPTER 10: GENERAL DISCUSSION AND CROSS-CASE ANALYSIS

The previous chapters discussed how intrapreneurship is being facilitated in the four specific cases chosen for this study. Each case has some distinct setup and perspectives on facilitating intrapreneurship within the organization's boundaries and hence different mechanisms emerged in each organization context. These cases present different stories and indicate that intrapreneurship is a contextual phenomenon based on certain circumstances related to the organizational structure, culture, processes and policies, and the characteristics of the industry the firm operates in. For instance, in one of the cases (C1), the organization emphasized the application of Kaizen principles to drive intrapreneurship. In another case (C2), the focus was on applying the principle of having 'well-rounded' engineers to drive their intrapreneurial initiatives. C3 has a unique friendly and flexible culture that facilitates the intrapreneurial initiatives of their engineers. In contrast to the previous three cases, C4 works in a very regulated and risk-averse energy sector. Intrapreneurship was driven by articulating a clear innovation strategy and forming the in-house consultancy and innovation team dedicated to supporting engineers' intrapreneurial initiatives. Despite these differences in the main drivers of intrapreneurship and the unique setup for each case, there were some common strategies they all have in place to engage their engineers with intrapreneurship which seems to benefit the overall organization.

Among the different combinations of factors found across cases, the results show that some factors were relevant to all cases, while others were limited to a few cases. Some factors were deemed necessary in some cases and found less important in others or managed differently. Through cross-case analysis, this chapter will discuss the similarities and differences of these factors.

10.1 Comparing the influence of specific organizational structures for the cases

The four companies operate in dynamic, highly competitive, and rapidly evolving markets. Hence, in these firms, the organizational structure is designed to boost the capability of the company for innovation and maintain organizational competitiveness. Table 10.1 illustrates the details of the emergent sub-categories of organizational and team structures.

Hierarchy within an organization structure can be a potential hazard toward promoting intrapreneurship engagement. But as seen here, the four companies followed a horizontal organization structure with few vertical hierarchy layers. In C2 and C3, most of the engineers on the operation level have one layer between them and the executive team, while for C1 and C4, there are two layers (see criterion 1).

Criteria content	C1	C2	C3	C4
1. Hierarchy levels (between engineers and executive management)	• A few hierarchical levels (two levels)	• A few hierarchical levels (the majority is one level; a few teams have two levels)	• A few hierarchical levels (the majority is one level; a few teams have two levels)	• A few hierarchical levels (two levels)
2. Flat/vertical structure	• Flat organization	• Flat organization	• Flat organization	• Flat organization
3. Organic structure	• Decentralized decision-making • Low degree of formalization • Horizontal integration	• Decentralized decision-making • Low degree of formalization • Horizontal integration	• Decentralized decision-making • Low degree of formalization • Horizontal integration	• Decentralized decision-making • Intermediate level of formalization • Horizontal integration
4. Organization/team structure	• Cross-functional teams-based structure (Spotify agile scale model) • Mostly team division is based on product	• 5 Mechanical groups and 2 supporting groups • Project team base-structures	• Product and project team-based structure	• Market and client division team-based structure
5. Executive management layer	• Executive managers are responsible for special functions, consisting of: - The founder, CEO - Chief Financial Officer CFO - Chief Marketing Officer - Chief Technology Officer CTO - VP of product - VP of people - VP of Technology - VP of operation	• Four executive managers with a wide range of management functions, consisting of: - The Managing director (CEO and founder) - Engineering Director (founder) - Technical Director - Business development director	• Three executive managers with a wide range of management functions, consisting of: - Head of sales and marketing (CEO and founder) - General manager (head of operations and founder) - Head of engineering, product, and service development	• Many executive managers with various functions and responsibilities, consisting of: - The CEO - Safety and health manager - Head of client delivery (2 managers) - Head of markets - Head of Strategic Advisory Services (leading on strategy and regulation, product development, client solutions, and innovation)
6. Number of employees /managers	• + 200 employees • 50 Managers	• + 80 employees • 12 Managers	• + 70 employees • 10 Managers	• + 220 employees • 37 managers

Table 10.1 Comparing the organization structure among the four case studies

The executive layer in C2 and C3 is very simple, consisting of the founders and a few top managers having many associated functional responsibilities, whereas, in C1 and C4, they have almost triple the number of employees resulting in more functional departments and more executive members, and subordinate managers (criteria 5 and 6). The results show that a few vertical hierarchal levels represent a flatter organization that facilitates flexible interaction and enriches the communication between engineers and higher management in both directions. In this structure, communication between the teams and decision-making take place on a horizontal level rather than a vertical level, giving ground for fast decision-making and increasing autonomy and empowerment; therefore, innovation can happen more quickly.

10.1.1 Team structure

Given their diverse organizational background, the study found no common team based-structure among these firms (See criterion 4 in Table 10.1). They follow different team structures based on a specific division, such as the product line and solution, market and industry areas, project base, and the knowledge and expertise of engineers, or a combination of these. The different team structures have been developed based on the specific background and business growth that suit and work for each firm to ensure running the business in the best and most efficient way possible. In more detail, C1, which develops and offers new products and solutions at high speed, has adopted the 'Spotify agile model' that is normally more suited for very large-scale and fast-growing environments. This model gives more autonomy with a less formal process for these teams (squads and tribes) to set their own goals and ensure more self-management in a decentralized approach. Therefore, this gives the setup in C1 greater flexibility to improve domain expertise in each area of the product portfolio and, at the same time, provide a team dynamic to form squads and assign engineers to different squads, which allows knowledge to be shared among team members who are not working together, resulting in empowering innovation and creativity. This is summarized by the views of participant C1P3, who indicates that the knowledge gained while the engineer works in a squad in a specific part of the product can be applied to other parts of the product and shared with other teams when joining different squads.

C2 has a flat and simple structure consisting of 4 executive members and 12 managers (criteria 2 and 5). The organization is structured around projects where engineers are divided into groups enabling it to respond to the various requirements of customer needs (criterion 4). Each group has a leader who reports directly to the executive level. Within the group, engineers work on a variety of different projects. Accordingly, engineers have a wide scope of tasks and responsibilities and work on various project scopes related to different customer requirements and industries. Participant C2P2 highlights how this setup structure enables intrapreneurship, *"Project groups are all doing very different things, and they could be behaving very differently depending on the customer requirements… So, I think being able to respond appropriately and rapidly to a very different set of requirements is really important. And it is kind of being innovative through organizational structure and through the way we organize ourselves".* Moreover, this team structure enables effective collaboration and promotes sharing knowledge and ensuring continuous support from other peers, as explained by participant C2P7 "*I think it is good to have that sort of flat structure because then you can sort of collaborating more easily, such that when you design something you can check it through the way with someone else down the road".*

The three founders in C3 represent the higher management layers and manage all functional areas with broad management and technical responsibilities in a simple hierarchy and flat structure (see criteria 1 and 5). Below them, there is a department head and then team leads. The strategy in this firm is that no more than five engineers are managed by one person. This structure, as explained by participant C3P3,

speed-up new initiatives to take their place in the innovation process, *"The other key part being in this small company, we do not have too many layers, so it is easier for messaging, and communication and the idea do not get too lost for people to track along the way".* The team structure is based on product and project divisions, including different teams of engineers who work on various product lines and software development, field application team, and testing and quality assurance team. The scope of work for these teams is dynamically changing according to the product they develop and their customer requirements. This gives engineers dynamic roles and the ability to work on different tasks and responsibilities. Participant C3P2 comments on this team dynamics, *"This gives more flexibility by allowing engineers who desire to try other roles and give them the ability to work in different departments (wherever the engineer skills can be of use), which adds to the enjoyment of working in this firm, making it incredibly accommodating and fostering innovation".*

C4 has a more complex environment with a larger number of employees (around 220) and a wide range of expertise and core business (see criteria 5 and 6). The CEO and six executive members have various roles based on function and client delivery. The engineering teams are divided according to the industry and client's projects based on a flat setup, so they work in different teams such as design, technology consultant, asset stewardship, and operation and maintenance. This team structure facilitates teamwork and fast delivery of solutions and services to various clients. Collaboration across different teams is a strategic route for the company to drive innovation. In this structure, there are no rigid processes or boundaries between teams, and they interact on a continuous basis.

Although the four case studies offer several examples of organizational configurations and team structure, they have adopted an organic structure characterized by a horizontal layout with few hierarchy levels and decentralized decision-making (see criterion 3). This organic structure appears to be an effective way for encouraging innovation and entrepreneurial activities (Ireland et al. (2009), Martínez-Román et al. (2011), Delić et al. (2016)). It is beneficial for engineers with multiple skillsets and who need to make decisions on multiple subjects. According to Fernandez and Pitts (2011), an organic structure provides employees with the freedom to operate creatively and innovatively and allows them to express and spread their views and ideas, participate in decisions affecting their work groups, and even delegate to them the authority to make significant decisions. This structure gives more flexibility to engineers with dynamic and changing roles to work on different projects and tasks or join other groups which expand their expertise into new areas. On the other side, *"Static organizational frameworks with rigid division and specialization of labor cannot provide the flexibility and agility"* (De Mello et al., 2012, p.1). The results indicate common findings across the cases that engineering teams are given the freedom to execute their work with no strict processes in place or rigidly defined division areas. Cross-team collaboration is fundamental for solving complex problems, getting other teams' support, and improving knowledge sharing and competence development.

10.2 Factors that influence an intrapreneurial culture

Each firm has its own culture that has developed over time and is under the influence of their key owners. Over the years, with the development of the business, expanding products and markets, and the increased number of employees, these firms have oriented their culture to support intrapreneurship and considered it to be a strategic route to enrich innovation. It is the culture in these firms that defines how employees work and establishes the common norms, values, and assumptions that express their organizations' strategies. The culture is centered around employees to nurture and empower them to be active contributors to the success of the business. Engineers, in particular, are essential and at the core of this success as they tend to be the main contributors to innovation, providing ideas and translating them into real products in the market.

The culture in these firms reflects some common factors that can potentially harness the intrapreneurial capabilities of their engineers. This culture is influenced by everything from physical and social work to engineers' activities, management practices, and leadership approaches.

10.2.1 Rewards, recognition, and appreciation

Research studies have proposed a wide range of incentives, bonuses, and career promotions to motivate employees. The findings of this study showed that engineers seem to have different opinions on rewards/recognition offered by their organizations. Therefore, a well-designed reward system should include a wide range of incentives and recognitions that satisfy and accommodate the different and distinct preferences of engineers. The four cases demonstrated different approaches to rewarding their engineers, as illustrated in Table 10.2. Various forms of monetary and non-monetary rewards systems were in place in these firms (see criteria 1 and 3).

Monetary reward is common across all cases except for C3. For C3, they do not offer their employees any monetary rewards or bonuses compared to the other cases (see criterion 1). This is justified by one of the founders, participant C3P1. *"There are certainly no monetary rewards, nothing like that. I take money off the table. There are no bonuses for any sort of innovation because otherwise, you innovate for other ways that change your behavior to chase the money instead of chasing the right thing. So absolutely no bonuses for innovation"*. However, this may be a potential problem in the bigger picture. Some of the engineers interviewed in C3 express that bonuses are an important kind of reward and could be an advantage to be included in the firm's reward system.

Criteria content	C1	C2	C3	C4
1. Monetary rewards	• Annual bonuses • Employee share Scheme • Vouchers	• Annual bonuses • Employee share Scheme	• No monetary rewards	• Annual bonus • Work anniversaries and special money rewards for employees completing 5, 10, 15 years • Gift vouchers
2. Salary increase mechanism	• Paying fairly compared to the market • Salary review connected more to innovative efforts	• Paying fairly compared to the market • Salary increases related to innovation and engineer's performance but related more to their general performance	• Paying fairly compared to the market • Annual pay reviews (based on performance, not innovation)	• Paying fairly compared to the market • Salary increases related to innovation and engineer's performance but related more to their general performance
3. Non-monetary rewards	• Management recognition and appreciation • Paper certificate of achievement • A good job is announced at large events to all employees and in the company newsletter	• Management recognition and appreciation • Promotion- career progression to project management • Having an engineer's name associated with a solution • Sending out an email to the company	• Receive praise from managers and other peers, and constant small thank you and gratitude and appreciation on a day-to-day basis • Career progression and development • Team celebration for achievement- such as organizing dinner or spending one day out • Good job released out and is published to all employees • Send a company-wide email • Announce good feedback from customer	• Management recognition and appreciation • Promotion and career development • Written certificate • Celebrating major team achievements and project success • Any team nominates a person who supports them for appreciation • Congratulation emails by the CEO • Innovator of the year scheme
4. Reward focus (individual or team)	• Both of individual and team	• Both, more focus on the team	• Both, more focus on the team	• Both of individual and team

Table 10.2 Rewards and recognition systems among the different case studies

Considering the justification of the CEO, Oden (1997) highlights that money cannot drive employees to be innovative or creative if applied alone and may, in this case, create more difficulties than it solves. All incentives should fit together to support innovation. In this aspect, Oden (1997) suggests that money should follow, not lead, innovation. A company should start with the challenge and pay employees who rise to the challenge. Therefore, based on the perspectives of some of the engineers in C3 and the evidence from the other cases, C3 might want to restructure its reward system so as to include monetary rewards and integrate them with other components of the existing rewarding system.

The results show that monetary rewards are found to be short-term, and it is not the most significant motivator of intrapreneurship. This is clearly indicated by most of the interviewees among the four cases. The recognition and non-monetary rewards motivate engineers more, which have been structured

among the different cases using some common and different techniques, illustrated in criterion 3. Such a result is consistent with the view of Ellis and Pennington (2004), who explain that direct financial rewards have a crucial role in the process of attracting talented employees, but these kinds of rewards have temporary and short-term effects on their motivation. Nacinovic et al. (2009) agree with this concept and suggest that social incentives such as recognition and appreciation motivate employees more than financial rewards.

It is clear that having a fair payment system is crucial for engineers to stay motivated in their roles. In all cases, engineers are being paid competitive salaries, which are not below the market rate (criterion 2). Such fair payments make sure that salaries are consistent and complement other compensations and benefits that provide an overall system that motivates engineers.

In these firms, salary increases and bonuses have a different focus on rewarding innovative activities of engineers. These are linked to either innovation activities by engineers or their general performance, or both (see criterion 2). Bonuses and salary reviews are related more to the general performance of engineers and how they meet their objectives throughout the year. This is evident in the case of C2, C3, and C4. In C1, however, it is related more to the innovation efforts of the engineer and how they contribute to the success of their team and the organization as a whole. It is suggested that engineers' innovative activities should be included as a major factor in the overall performance assessment of engineers, which motivates them to incorporate innovation and intrapreneurial thinking in their roles. Also, some other parts of rewards, such as the non-financial ones, can be extended and directed toward innovation and creativity aspects. Getting acknowledged and appreciated by their managers continuously is regarded as very important and meaningful to many engineers in this study. For instance, using simple phrases like 'thank you' or tapping on engineers' shoulders could be considered a great form of appreciation to them. This needs to be an inherited practice among supervisors and managers to keep the spirit of recognition and acknowledgment in one's job. Organization can direct their rewarding system to focus more on innovative and creative activities of engineers besides their general performance. Thus, to be successful in promoting intrapreneurship, the rewards system must be designed and structured appropriately to entice and motivate engineers to engage with intrapreneurship (Ahmad et al., 2012).

Another interesting point that arises from the analysis is whether the rewards should be based on individual or team activities. C2 and C3 focus more on team rewards rather than the individual. The rest of the firms have a balanced mechanism to reward both individuals and teams. Participant C1P1 explains that there should be a balance when rewarding individuals and teams, *"... When you are doing innovation within an existing organization. So, it just does not make any sense to have an individual form of reward. I think you get success as a team. You can then absolutely recognize the contribution of individuals to that team, but the success comes as a team".* Rewarding the entire team for their work

seems to be a great way to boost team spirit and promote collaboration and cooperation among team members and across the whole business. Reward and appreciation can be applied along the innovation process as a solution suggested by participant C1P3, which rewards individuals once the idea is generated, and the team when implemented.

C1 and C2 both have a special rewarding strategy by providing a share to their employees. Therefore, it seems this gives employees a strong sense of ownership and commitment to the business, leading to minimal turnover, long-term benefits, and meaningful effects. Employees who hold a stake in the firm are owners and will have a strong desire to understand the company's vision and long-term goals, what role they will play in those plans, and what opportunities lie ahead.

The secret to some effective incentives is to act quickly and acknowledge their accomplishments right away. This may be achieved by sending him/her an email, announcing their name on display screens, or having a coffee break with them. This is clear in the rewarding policy of C2, which encourages other employees to follow such innovative behavior.

Organizations have to review their rewarding process that works better for everyone. It is one of the things that the organization can change and adjust to fulfill the different preferences of engineers by including a range of recognition and rewards that are well embedded in the company's culture.

10.2.2 Maintaining a balance between risk-taking and innovation

The four organizations operate in highly volatile markets susceptible to changes, and hence they are very risk-aware. This is reflected in the decision-making process, strategies, and working procedures. This is clear from the information analyzed, where controlling, managing, and mitigating the risk to its lowest possible probability with clearly defined processes in place are the major strategies and approaches in these firms. They calculate any risk and choose the least risky approach to do the work (see illustrative quotes in Table 10.3). Furthermore, they are high-risk averse in certain situations, such as when they are close to delivering a product or solution to a client or when working directly on a customer product. These companies are working for some of the critical industries where there is very minimum tolerance for providing products or solutions with errors or mistakes.

Based on the explanation provided by the participants on the general trend among these firms in managing risks, it appears that organizations with highly managed and controlled risk strategies may potentially erect hurdles for intrapreneurship. Many scholars consider risk-taking a significant pillar of the intrapreneurial organization to embark on innovation (Lumpkin and Dess, 2001). Kang et al. (2016) stated that a risk-averse climate would conflict with an innovation climate. However, this is not the case as these organizations are very aware of the quality and standardization when working on critical products within risk-averse industries.

Case	Risk-averse approach
C1	Participant C1P4 confirms, *"We do calculate the risks. That is the first thing, so if it fails, then our product will collapse… I suppose we like the risk tolerance to the level that definitely nothing in production should break".*
C2	In C2, risks are well controlled in all project phases through the risk management process. All designs are reviewed by different employees before starting implementation. Participant C2P3 highlights, *"Some people are risk-averse, and it depends on the size of the risk, so if the risk affects a customer or the solution that we deliver to a customer, we are all risks averse, we do not want to deliver something that does not work. Because it gets a bad reputation".*
C3	Participant C3P7 demonstrates, *"We are not in a risk-taking business in our particular software. We are supplying to aviation companies. So, we want to make sure everything is absolutely nailed down and solid… you might try a new way of writing some Sofware, and it is all going to get reviewed and looked at by somebody else and checked. And if suppose you work in SQA (Software Quality Assurance), then you tend not to be a particularly risk-taking".*
C4	Participant C4P4 discusses the firm's risk-averse attitude, which is related to the nature of the industry it operates in and the clients' business behavior who almost avoids taking any risks, *"As an organization, we are not a very risk-taking organization. We have very specific businesses…, but the business as a whole is not risk-taking. We try to keep the risk as low as possible…".*

Table 10.3 Organizational risk-averse approach in C1, C2, C3, and C4

Part of innovation success is providing high-quality products and solutions and satisfying customers with deliveries according to their requirements; therefore, managing the risk is considered part of the innovation success. These firms appear to have found a proper balance between innovation success, where mistakes are part of its nature, and taking calculated risks. Supporting quotes from the four cases are illustrated in Table 10.4.

Case	Balance risk-taking and innovation activities
C1	Participant C1P7 says, *"In innovation, you have to take risks, right? Innovation is uncharted territory. So, you have to take risks. You have to build solutions which might not be right. This is the way forward. So, during innovation, you should have a higher risk appetite. Otherwise, there is no point, and you just go for the traditional ways of solving problems".*
C2	Taking risks is essential in innovative activities. It goes hand in hand with managing the risk in C2. Participant C2P1 points out, *"People have to take risks, and in order to do something, you have to work out the best way to do it. It could be 10 different ways. We will never know until we have done it whether it was the right way or not. So, it is fundamental to what we do".*
C3	Participant C3P1 explains, *"If there is a bug in our software, it could crush a plane. So, we take it very seriously. So, we have multiple layers of quality control before something gets that far. However, that clashes very seriously with innovation. Cause, you know, if you want innovation to succeed, you must be free to experiment and make mistakes. So, there is a balance between them, and you need to have a space for innovating and a space for real high quality".*
C4	Managing risk is seen as an associated process with innovation in C4. The relation between risk-taking and innovation is further explained by participant C4P3, *"We are also not afraid to do new things as long as we manage the risks... We are not scared of doing innovative things because we understand how to manage the risk, which I think means things actually do happen".*

Table 10.4 Supporting quotes for balancing risk-taking and innovation activities

It is clear from the analysis that the risk aversion on the organizational level is translated into the risk-aversion attitude of engineers, particularly in C4. To a large extent, engineers in C4 are not encouraged to take risks, as evident in the views of participant C4P6, *"I think the biggest risk is not taking risks, but trying to push that message out… I think the risk-taking ability is the first, and I always complain about it… it is less than what we would like to be".* This, in the case of C4, seems to limit the proactivity of their engineers to pursue potentially innovative approaches. This is evident in the study of Kang et al. (2016, p.632), who noted that *"Employees who are passionate about inventing yet are working in risk-aversive environments may feel prohibited from suggesting creative ideas and implementing new ideas, and hence they may tend to reduce their innovative efforts".* This implies that an organization with high risk-averse nature of the business needs to prevent such attitudes from being exhibited by their employees in favor of innovation to start. In this perspective, managers are recommended to encourage their engineers to take calculated risks and allow adequate experimentation and tests on their new initiatives to minimize possible risks. Also, engineers are strongly recommended to develop the right skills in risk assessment and how to justify any risk involved with their initiatives.

To give more room for engineers to take risks and innovate, C2 has planned to expand its business to new markets that are classified as less risky industries. According to participant C2P4, they enter the food industry, which offers the freedom for engineers to take more risks and embark on innovation, *"That is why we liked some of the food projects. It is just a bit more fun from an engineering perspective".*

The organizational culture in these firms is conducive to intrapreneurship despite the risk-aware approaches. The culture in these firms, in most scenarios, encourages taking a responsible risk and doing experimentation and testing before the delivery of the product. They facilitate a culture that tolerates failure, accepts mistakes, and encourages innovation while taking a controlled risk approach.

10.2.3 Physical environment

The majority of interviewees in the four firms described the physical environment as a comfortable place to work. Table 10.5 illustrates the commonality of the supportive physical environment among the four firms.

	Content	Case study
Open-plan office layout	• Open plan office structure where all employees work on the same floor and in the same open space with their managers	All
Physical environment facilities	• Availability of ideal physical space, meeting rooms, and other building facilities such as coffee room and restrooms	All

Table 10.5 Physical environment supporting intrapreneurship of the four selected cases

All necessary facilities that support them to do their work are available such as suitable desks, furnishing, meeting rooms of different sizes, and coffee and restroom areas. Open-plan layout offices are the main design in all these firms where all employees and their managers are set in a flat area and open desks. According to Ashkanasy et al. (2014), workplace setup significantly impacts employee performance that influences employees' behaviors, productivity, and well-being. The findings from this research show that an open-plan office where all staff is located in the same physical location will increase the level of communication and teamwork, stimulate various aspects of cooperation, and enrich social life. As there is no physical separation between desks, this seems to remove the barriers between engineers and their managers and top management as well. Moreover, the structure and design of the physical work environment have a significant influence on employees and teams and their engagement in creativity and innovation processes (Haner, 2005). This complies with the results of this research, where many participants acknowledge how they can easily reach their managers and other teams to voice their ideas and quickly get their support for any problem they face.

10.2.4 Organization's strategic response to failures

The findings indicate that the fear of failure is one factor that prevents engineers from acting on or initiating innovative activities, hence potentially impeding innovation from starting. Many interviewed managers have explained that any employee, by nature, has an anti-failure bias, and many engineers, especially newly employed, consider avoiding failure as one of their primary objectives. The four organizations have retained a culture where they embrace failure as a necessary component of the innovation process.

There is no punishment or blame for engineers who make mistakes. In C3, for example, one of their key cultural concepts is having a 'no blame culture'. Authors such as Menzel et al. (2007) emphasized the necessity for a strategy regarding tolerance for failure, which instills employees' confidence that if they take risks and fail, such cases will be handled fairly, and they will receive support and be backed by top management. Managers in these firms believe to a large extent in giving room for engineers to experiment. In the event of a failure, their mistakes are accepted as part of the learning process. This drives engineers to seek out and explore areas of uncertainty where many potential innovative opportunities may reside.

Failure in these organizations is considered a major step in the success of innovation and a key concept in the learning process. These failures are taken as a lesson learned for the future and to improve or seek alternative ways for innovation. Companies such as C1 and C2 focus on failing very fast when trying new things so as to learn very quickly and move to the next steps. Participant C1P3 explains the concept of 'successful failure' that leads to new knowledge and encourages engineers to accept failure and learn and try again to reach for a result and eventually succeed, *"The process of innovation includes trying*

many things, failing, and pulling back in front of something else, only happens when there is a clear definition of what successful failure is". Most of the innovation in these firms is a result of prior learning from failures and turning them into success. These results are in line with Ferreira et al. (2020), who emphasize the link between failure, innovative performance, and organizational learning. In their view, the acquired knowledge and skills from failures strengthen ongoing innovative activities by providing opportunities and new approaches to success and reducing the probability of new failure through improving efficiency and resilience. Ferreira et al. (2020) also highlighted that tolerance for failure alone does not promote innovation if not followed by knowledge gain.

10.2.5 Job design and work context and their relation to intrapreneurship

The job design, characteristics, and specification of the engineering roles have been found to have a great influence on their willingness to develop intrapreneurial skills. Table 10.6 summarizes the flexibility of the job design among the cases.

Criteria	Content	Case study
1. Freedom	• Give employees the freedom to design their work • Provide decision-making latitude and how engineers execute their work	• C1, C2, and C3 • In C4, it is given more to the consulting team
2. Job role design	• A flexible and dynamic role • Engineers can go beyond their job specification • Job variety: working on multiple tasks and taking on new responsibilities	• C1, C2, and C3 • In C4, these features are more structured for the consulting team
3. Job rotation	• Engineers move and shift to other jobs and join other teams temporarily	• C1, C2 • In C3, still in the initial test • In C4, generally, engineers are not allowed to join other technical teams
4. Flexible working style	• Flexible working hours provided for engineers	• C1, C2, and C3
5. Flexible remote/home working	• Engineers can choose to work remotely and onsite	• C1, C3 • In C2 and C4, it is recently introduced after COVID-19

Table 10.6 Job design context and flexibility among the four cases

Common findings among all firms imply that a great level of freedom is granted to their engineers so as to do their job and decide how to execute certain tasks, and in the process, they are given more authority to make their own decisions (criterion 1). This is reinforced by the management practices and transformational leadership style that do not follow micromanagement or high-control management styles.

Despite having a written job description with certain specifications, engineering roles are more flexible and dynamic, as seen in C1, C2, and C3 (criterion 2). These organizations focus on building a breadth of knowledge across different expertise from different functions within the firm, whereas, in C4, the

focus is on developing more specialized expertise. It was found that when engineers are allowed to go beyond their job specifications by joining other teams, working on different projects and responsibilities, or expanding to new roles, then they are more engaged in innovative activities. This gives a positive and continuous learning curve so as to upskill quickly without rigid boundaries of their job.

In many cases, engineers noted that their roles are always changing, corresponding to the nature of the evolving industry that they are working in and the continuous change in customer and business requirements. This dramatic change in roles is emphasized as a major challenge for some of the engineers in C3 who were unable to cope with the frequent and fast change in their roles, prompting some of them to leave the company. This is still a challenge for C3 that they are trying to resolve, which calls for a good balance in engineering roles being dynamic but not to the point where they are overwhelmed by dramatic changes.

The results also show the role of managers in understanding and supporting the engineers' desire to take on additional tasks, explore their interests in other job domains, and learn new skills outside of their job role. This enables managers to understand better where their engineers can work best and explore their untapped talent. For example, in C1 and C2, many engineers are allowed to move permanently to other teams or departments after working several years in one position to take new jobs that they would enjoy. This would not happen if their managers did not allow them to do new tasks or move around in the firm. In this context, allowing job rotation (criterion 3) is a great means for challenging engineers, giving them new opportunities to take new adventures and gain new knowledge. They can break their work routine and explore new challenges in other areas within the firm. Pinchot (1985) asserts that job rotation will boost employees' intrapreneurial behavior. A further study by De Jong et al. (2011) found that job design that allows job variety by taking extra tasks has a significant influence on employees' intrapreneurial behavior that increases innovative capabilities, personal initiatives, and problem-solving skills. Participant C1P6 reflects on his own experience *"The kind of rotation is that you can get more knowledge here and there, and that can affect your brainstorming when you bring some ideas".*

The flexible job design is related to encouraging teamwork and horizontal interaction that is enabled by the team and organizational structure. With flexible and broadly defined jobs associated with no rigid boundaries, engineers can easily engage and consult with other teams and get their support. This is consistent with the findings of Mustafa et al. (2018), who confirmed that job designs that promote horizontal exchanges and interaction among employees facilitate the exploration of new knowledge and opportunities, thereby positively affecting their intrapreneurial behavior.

10.2.6 The different approaches for structuring and utilizing brainstorming sessions

The four organizations use brainstorming in different ways to encourage creativity, but some have more defined structures and designs to the utilization of these sessions. For C2, brainstorming is a core concept and is used as a structured process to generate new ideas and find creative solutions for complex issues. The design process for any automation project begins with a brainstorming session to outline the best design that can fulfill customer requirements. These sessions are well designed and include multiple teams of engineers and a mixture of experienced engineers. Managers are part of these sessions as well. Brainstorming sessions are also followed along the project lifecycle to make the best technical decision in critical situations of the project and solve the complex challenges along with the project execution. Due to the complexity of the automation process, multiple cascaded and follow-up brainstorming sessions are held to find creative ideas and solutions. Also, in C2, frequent brainstorming sessions are designed at the company level, where all engineers work on pre-defined problem statements and clear expectations. Moreover, brainstorming hackathon events are usually held in joint with the customer to find innovative solutions to develop some of the products.

C1 follows a less systematic way of designing brainstorming sessions. These are mostly done on the squad level to run their tasks effectively and find the best possible solutions to technical issues. They are part of the reading seminars or paper reviews to find ideas on how to solve problems. According to participant C1P8, *"I guess most of the brainstorming happened are like for problem-solving. They are not fixed sessions… when we do our sprint planning sessions, there will be quite a bit of like, what should we work on? What do we need to do this? What do we need to accomplish this? What is the best way around solving this issue? Brainstorming is a quite key part of our planning sessions, let us say, more ideas coming up on how to accomplish things".*

There is no specific brainstorming structure in C3. They are integrated with some of the scheduled meetings to brainstorm some ideas that facilitate solving technical issues. In C4, brainstorming sessions are more structured within the in-house technology team, but they are not a common approach among the rest of the teams.

The evidence from C1 and C2 shows that brainstorming can provide many advantages and hence should be integrated into current processes and work procedures to trigger new ideas continuously. It should not be followed as a secondary technique for just solving technical problems. It should be structured and managed to get the best results out of it on the organization and team level.

10.2.7 Open and flexible communications

Flexible communication methods in all four cases are well developed throughout the entire organization. Communication openness and quality of communication as characteristics of the

organization are positively related to intrapreneurship (Antoncic, 2007). The four firms have established open links and connections that move in all directions, vertically between engineers and the different management layers and horizontally with other teams. This open communication gives the ground for an open culture that encourages sharing ideas and opinions and fosters a more relaxed and comfortable work atmosphere. Engineers can feel confident enough to be more open and seek help and support when needed. As a result, cooperation inside and between teams is enhanced. This open communication facilitates exchanging ideas and information and ensures a more efficient transfer of new knowledge among employees (Bhatia and Khan, 2013). This can take place in formal and informal ways supported by the intrapreneurial culture of the firm. Table 10.7 summarizes the different main setups and ways of communication among the four case studies.

Criteria content	C1	C2	C3	C4
Formal meetings	• All staff meeting/ quarterly • Technical team meetings/ monthly • Open agenda meeting/ Weekly (engineering team) • Morning standup and stand-down meetings/ squad level (10-15 min) • Squad meeting/ 3 times a week • Sprint meeting (planning session) every two weeks on the tribe level • Study group meeting/ weekly (team level) • Monthly research plan (team level)	• All staff meeting/ quarterly • Monthly meetings on the group level • NPD meetings • Design reviews meetings • Frequent project meetings (Project team) • Weekly and formal meetings with clients • Weekly meeting with the line manager • Frequently scheduled meetings for project updates and progress	• Every quarter company-wide meeting • Open agenda meeting for all staff (Friday weekly seminar) • Weekly meeting (team level) • A weekly one-to-one meeting between the manager and engineer • Daily meetings on the team level	• All staff meetings/ quarterly • Annual business forum/ every six months • One-to-one meeting with the manager/ every week • Weekly meetings on the team level
Using technology to improve communication in the Workplace	• Emails • Intranet website • Online social network applications • Slack (massaging, chatting, and sharing files) • Online Magazine	• Emails • Intranet website • Online social network applications	• Emails • Intranet website • Online social network applications • Company forum (internal software developed tool)	• Emails • Intranet website • Online social network applications
Non-formal meetings	• Face-to-face interaction while in the office facilitated by open communication • Chatting in corridor and rest areas or after meeting	• Face-to-face interaction while in the office facilitated by open communication • Chatting in corridor and rest areas or after meetings	• Face-to-face interaction while in the office facilitated by open communication • Chatting in corridor and rest areas or after meetings	• Face-to-face interaction while in the office facilitated by open communication • Chatting in corridor and rest areas or after meetings

Table 10.7 Different means of communication among the four firms

Managers in these firms tend to promote informal communication with their engineers. They are open to communicating verbally and face-to-face with engineers around the offices or during short breaks with no formal boundaries. These firms have no defined formal communication standards, systems, or guidelines when engineers need to communicate with their managers or peers. Hence, engineers can express themselves freely and share their personal interests and needs. This close relationship between employees and management will enhance the level of trust and communication (Hughes and Mustafa, 2017). This does not contradict the use of some formal communication, which according to Zahra (1991), can drive intrapreneurship. Both formal and informal communications are important to the success of intrapreneurship (Pinchot, 1985). Formal communication is established through scheduled meetings on the team, division, and organization levels, using email, internal website, and other means of communication. Companies in this study have established various forms of meetings that follow their distinct organizational structure and business management. It seems that technical teamwork is organized and structured by different and frequent meetings at different levels in these firms, which keeps all engineers updated and aligned toward the overall company objectives. A unique setup followed by C1 and C3 is the open agenda session that is integrated into most of the meetings, which gives engineers the freedom to share their opinions and voice their ideas and suggestions while supporting others in solving the challenges they face. Despite the existence of formal communication, the discussion is done in a friendly way.

What is important about communication is how they are effective and useful for engineers to stimulate their creativity. According to Zahra (1993), high-quality communication is a key in the relationship between managers and their employees that promote the development of the intrapreneurial spirit within the organization. The results of this study match this perspective where engineers in these firms attest to excellent two-way communication and freedom to speak and raise their concerns. Managers are always listening to them and providing feedback. It is crucial to accommodate both types of formal and informal communication in a balanced way to enable a high level of coordination mechanisms between all employees and be flexible enough to allow transparency and continuous social interaction between all levels.

10.2.8 Engineers' performance review

Engineers acknowledge the importance and effectiveness of the employee performance measurements, which positively impact their engagement and empower them to work more productively and drive peak performance. As seen in Table 10.8, these assessments follow formal and non-formal processes in these organizations, with numerous checks and reviews occurring weekly, monthly, or quarterly throughout the year.

These reviews are considered by engineers as a way to identify growth opportunities and potential areas of improvement so as to give them a better view of how they progress their work and achieve their individual and team goals, which is, in the end, aligned to the direction and strategy of the firm. Engineers value these performance reviews and consider the meetings with their managers as a good point of connection and interaction to get support from them. The most important things from these reviews are the effective feedback, guidance, and advice they receive from their manager and their understanding of how their work is perceived in the organization. Engineers can address their challenges openly and plan for potential solutions.

Criterion	C1	C2	C3	C4
1. Well-defined performance metrics	• Clear metrics and measures assigned	• No specific metrics or measures defined	• No specific metrics or measures defined • more subjective review	• Specific measures are defined, and each goal is linked to one of the company's three visions
2. Team/ individual performance measure	• Both, more focus on the team performance measurement with clearly defined KPIs	• Individual	• Individual	• Both, more focus on the team performance measurement with clearly defined KPIs
3. Peer review	• Part of the process	• Part of the process	• Not included	• Not included
4. Innovation performance	• Part of the measurements	• Focus on general performance	• Focus on general performance	• Focus on general performance
5. Performance review	• Formal quarterly individual performance review • Monthly review and feedback • Colleagues are part of the assessment (two peers send their feedback about the engineer) • Self-assessment and evaluation are included	• Annual individual performance review • More checks on the progress of the GDP • Monthly feedback by direct managers	• Annual individual performance review • Weekly assigned one-to-one meeting with the manager • New employees are supported by 1 and 3 months of review	• Formal quarterly individual performance review • Monthly review meeting and feedback

Table 10.8 Engineers' performance review among the four selected firms

These firms follow no common assessment portfolio. In comparison to C2 and C3, in C1 and C4, besides individual assessments, teams are also assessed based on their KPIs and meeting their team goals (criterion 2). What is unique in C1 and C2 is that peer engineers are involved in evaluating their colleagues in the final year review (criterion 3).

Compared to C1 and C4, which have clear measurements and KPIs (criterion 1), C2 has no specific metrics defined in their assessment processes, and C3 follows more subjective reviews with no objective measure of performance even in the final year assessment. There are no formal measurements assigned, as explained by participant C3P1. It is more of an open conversation with managers to discuss the

development of engineers, their future plans, and their objectives. On the other side, C4 follows a more formal individual performance review similar to C1. A standard metric is assigned at the beginning of the year where each engineer proposes their own objectives that are mutually agreed with their managers. They are measured and reviewed at a monthly review meeting. This is facilitated by using an online tool where the records and feedback are continuously updated. Engineers can add their comments, progress, and their thoughts about the feedback. In C1 and C4, the focus is on measuring team performance rather than individual ones (criterion 2). A general observation in these firms is that the freedom is given to engineers to express their own objectives. These can be updated, adjusted, and changed based on their manager's approval during review meetings.

Individual performance in these firms is not done one time a year. More frequent talks at shorter periods seem to yield better results in terms of giving real-time feedback and maintaining continuous discussions and positive relationships between managers and their employees. Specifically in C1, they include innovation and creativity as measurement metrics with their assessment of engineers compared to other firms. This indicates the importance of innovation as a critical activity in engineering roles (criterion 4).

10.3 Vision and strategic orientation to influence intrapreneurship

The results show that these four cases in this study have formed a clear vision and strategic plan for their future, including how to grow the business, expand in the market, and which emerging technologies they may have the potential to invest in. Engineers are considered the primary workforce to transform this strategy into commercial products, solutions, and services. Hence, the clarity of these strategies and objectives at the engineering level significantly impacts the emergence of their intrapreneurial activities and promotes innovation as a way to deploy the strategies. Participant C1P2, who is a product director, emphasizes this and says, *"One of the single biggest things I think is having clarity on the company's growth strategy. Because that is where innovation will start".* This clarity seems to enable engineers to direct their efforts and creative thinking to execute this strategy and align the different engineers' capabilities toward a common path. The results show that the better engineers understand the overall strategy and business focus, the better they can align their team objectives, reflect them in their day-to-day duties, and work harmoniously to achieve them. To do so, and as explained by most managers in these firms, it is essential to keep engineers aligned and committed to the strategy. This requires more steps to be taken by managers to engage them as partners of the strategy, give them more freedom to set their own objectives, and open many discussions and conversations on this.

Convincing engineers about the strategy is seen as an essential step to guaranteeing its implementation success by aligning their innovative activities and creative ideas. Participant C4P2 as a manager complements this view and says, *"So, when the engineers are connected with us on the same vision,*

then when they go back to their computer, they come up with very fantastic ideas aligned with the strategy". Convincing engineers about the strategy also entails sharing it at every level and encouraging everyone to contribute to the organizational vision and objectives. Managers in these firms give the space for engineers to express their perspectives and provide feedback about the strategy as an inclusive process. As mentioned by many engineers interviewed among the four firms, they are encouraged to ask questions, raise their concerns and discuss their views with the organizational leaders about it. Engineers are given the freedom to make good local decisions that will help them to achieve the main goals and the vision that the company shares. Participant C1P3, in this perspective, said, *"The vision and our mission keep us all guided and aligned, but in terms of their own team and, ways of working, everybody should be very flexible to have different goals".*

What distinguishes C4 from other firms is that all engineers' individual objectives should be linked to one of the three visions of the company, which keeps them aware of the vision and how their individual work and objectives contribute toward these visions. It was evident that engineers who work on a project basis, such as in C2 and C3, sometimes find it challenging to adhere to the strategy as projects and customer requirements are constantly changing. Managers in this scenario should balance allocating dynamic roles to their engineers without too many changes, which will satisfy them feeling fulfilled as well as challenged with their roles.

Most of the engineers interviewed as part of this research see the firm's vision as an influential factor for them. The vision of these firms is centered on something that goes beyond achieving business profit. They serve the public and humanity with the products and solutions developed that inspire engineers to continue being proactive and actively contribute to innovation for the sake of benefiting people around the world. For example, participant C1P8 mentions that what he does is help fight financial crime around the world through technology that keeps him working hard and thinking about finding new solutions. This agrees with the view of Oden (1997, p.57) about articulating an inspirational vision of the firm, *"A vision that can energize people by legitimizing the organization's existence and satisfying a basic human need: the need to be important, to make a difference, to feel useful, and to be part of a worthwhile enterprise".*

C1, C2, and C3 have an overall business strategy, but there is no particular innovation strategy compared to C4. In these firms, innovation tends to happen informally and in a more flexible way. There is no specific team responsible for R&D or innovation. Therefore, innovation and creativity can be generated by any engineer regardless of their role or position. These companies seek to connect the innovation work to the core strategy rather than treat it as separate. This gives engineers a broader sense and the freedom to explore interesting ideas, do experiments, and try new things. C4, in particular, has a formal and written innovation strategy that is led by the consultation team. In this sense, innovation is a more controlled process led by their management. This has been seen as impactful for the flexibility of

innovation that affects engineers to engage with intrapreneurship by exploring new areas. This limitation in innovation flexibilities implies that their initiatives should be aligned to and within the scope of the innovation strategy, which in a way may limit their ability to explore more opportunities in different areas openly.

Some of the strategic processes in these firms are related to the recruitment processes and the development of competencies and knowledge of engineers, which are described in the following sections.

10.3.1 Recruitment Process

The recruitment process is one of the new factors that emerged from this research which is rarely highlighted or discussed in the relevant literature on intrapreneurship. The four companies are very selective with their recruitment process and take great care in hiring capable candidates to join their company. The different aspects concerning the recruitment process are illustrated in Table 10.9. Their recruitment strategies are directed toward attracting talented and intelligent engineers. It is clear that all companies have a direct recruitment process (criterion 1), so they do not depend on third parties or external agencies, ensuring that the company can implement and control the process and its outcomes appropriately.

The findings reveal that these SMEs have different perspectives about the experience of newly employed engineers (criterion 2). C1, C3, and C4, in their general approach, focus more on recruiting experienced engineers or mid-career engineers to fill the position of junior and senior vacancies. On the other side, C2 is more reliant on recently graduated engineers with superior academic records who are in later stages integrated and supported to develop within the firm. This is related to the philosophy of the owners that emerged through their experiences. C2 and C4 have a special scheme to attract new engineers every year using internship and placement programs (criterion 3) who, in some cases, would prefer to stay and continue their careers in the firm after completion of the program. By this, the organization can make a good judgment about these engineers who spent a year or more in the company based on their performance and engagement with the culture.

Aside from the technical skills, all firms tend to look for engineers who can integrate into the firm's culture and can engage with its norms and ways of working. C1 and C3 conduct a culture interview for the shortlisted engineers where they are given the opportunity to learn about the internal culture of the firm by meeting different teams and engineers and spending a day in the company (criterion 4). C1 and C3 show more focus on advanced academic qualifications such as PhD as this gives more capabilities to engineers to handle the job effectively as it includes research aspects. For instance, half of the engineers in C3 own a PhD degree.

Criterion	C1	C2	C3	C4
1. Recruitment method direct/ through an agency	Direct application • Online applications	Direct application • Online applications • University Job fairs • Talented engineers from apprentice and graduate programs	Direct application • Online applications	Direct application • Online applications • Talented Engineers from graduate (two-year) and apprentice (three-years) programs
2. The focus on experienced or new graduated engineers	• The majority of newly employed engineers are experienced / Junior and senior engineers or mid-career who are qualified and subject matter experts in their field • A few cases for employing new graduate engineers • Focus on diversity and inclusion • There are no minimum years of experience shown in the job adverts	• The majority of newly employed engineers are recently graduated with little experience • Not hiring managers as they are promoted from engineering teams	• The main focus is on Mid-career engineers who are qualified with an advanced degree in the appropriate discipline (preferred with PhD) • There is no specific focus on whether the prior technical experience fully matches the new job specifications • Some job adverts required engineers to have 7-10 years of experience	• The main focus is on highly experienced employees who are well known for their success in other companies and are experts in their subject matter • A few cases for employing new graduate engineers
3. Providing internship or graduating programs	• Very limited cases	• Special programs for internship (12 months program) intake every year • Undergraduate placement, around 10 vacancies are provided yearly	• Very limited cases	• Special programs for graduate (two-year) and apprentice (three-year) programs
4. Main steps in the interview process	• CV screening process • Technical and personal interview • Culture interview (meet different engineers)	• CV screening process targeting high academic engineers from well-ranked universities with candidates showing engineering interest • Face-to-face interview process	• CV screening process • Spend one culture day as a full trial day in the office • All team members and top managers are involved in the decision	• CV screening process • Technical assessment and a face-to-face interview
5. Common characteristics and non-technical skills required from engineers as per job adverts	• Multiple drivers and talented engineers • Help and coach others, share knowledge and experience • Focus on team delivery, not individual • Collaborating with other team members and shaping the future of the team • Take the initiative, be pride in their work, and contribute to a positive working environment • Spread the knowledge around the team • Hire people that are curious and proactive that kind of pulled the company values	• Creative, talented, and motivated graduate engineers • Eager to learn about multiple technologies • Can think laterally and enjoy working in a technically challenging environment • Show interest in engineering	• High-qualified engineers preferred with a PhD degree • Have a technical passion • Focus on the attitude of the person, so the company is trying to hire bright people who want to find a good role • Looking for people that keen to learn more and want to keep pushing themselves • Talented and highly motivated engineers and able to adapt to take on new challenges • Taking part in research, having the ability to drive current and future technology, suggesting new approaches, and coming up with innovative ideas and working toward their implementation	• High performing employees with the potential skills and experience • Being social, proactive, and looking for innovation and continuous improvement opportunities • Willingness to learn and adjust in a complex and fast-moving environment • Good team working skills • Self-motivation and the ability to work under own initiative. • Ability to work independently with a flexible and adaptable problem-solving approach

Table 10.9 Recruitment processes across the four cases

The analysis shows the importance of the intrapreneurial capabilities of potential engineers (summarized in criterion 5). All firms emphasize that new hires possess certain qualities and show potential for intrapreneurship. These skills and capabilities are common and observed in most engineering job adverts. Great attention is paid to talented, visionary engineers who are proactive, dynamic, and willing to take a challenging role and handle complex tasks, play a major part in teamwork, share their knowledge and experience with others, and can see the big picture of the company, and push its success forward. Such emphasis on skills is in line with the literature. *"Organizations seeking engineers suited for intrapreneurial roles should try to recruit and select individuals who are more extraverted, teamwork-oriented, open to new learning, and optimistic, customer-oriented, and visionary than those who have traditionally been filling engineering positions"* (Williamson et al., 2013, p.164).

It is evident that some of the interview questions with potential recruited engineers are designed with a particular focus on assessing and exploring these intrapreneurial aspects of engineers. For instance, C3 would ask engineers about the success they brought to their previous company, whether they have ever launched new initiatives or explored new opportunities, and how they are passionate about its mission. C2 explores any engineering interests, pursuits, or hobbies the engineers can show, even in areas unrelated to the job, which indicates their passion and talent for engineering.

There is no single/common recruitment process that fits all companies. Hence, these firms developed their own mechanisms for the hiring process, which have evolved over the years based on their best practices and experience and what mistakes they have made. In this perspective, organizations need to develop the mechanism to know how to recruit employees with potential intrapreneurial skills that should be key criteria in the hiring process (Filion, 1999). This process is adjusted and tailored for many of these case studies to achieve the best results.

While the results show that the four cases have a certain focus on hiring engineers who are talented and with high innovation potential, Williamson et al. (2013) say that it may not be enough to recruit intrapreneurs to influence innovation within an organization. Such steps will not generate sustainable innovation if they are not followed by giving trust, freedom, resources, and full support to the employees so as to empower them and unleash their creative potential (Bhatia and Khan, 2013). The support should be in place from the moment an engineer is hired, and their development of skills and knowledge should be looked after while they work for the firm.

10.3.2 Competence development, building new knowledge and skills

These technological firms that are leaders in their industries distinguish themselves through their exceptional technological expertise, acquired by developing their engineers' competencies and skills. The results revealed that competence development is a continuous process that all firms use to build

their engineers' skills and capabilities, gain new knowledge, and broaden their expertise. This is seen as crucial while working on cutting-edge technologies and keeping up with the latest knowledge where skills and technology requirements change frequently. Table 10.10 summarizes the main techniques followed by these firms to upskill their engineers. This is also supported by the flexible and dynamic job role design (explained in section 10.2.5) that allows engineers to work on new tasks and join other teams to gain a wide range of skills from different domains.

Criterion	C1	C2	C3	C4
1. Specially designed internal training programs	• Not provided	• GDP and business development programs designed for developing well-rounded engineers	• Not provided	• Graduate Training Programs
2. Support for training courses	• Internal and external training • Fixed budget to every engineer for learning • Weekly study group and paper review	• Internal and external training	• Internal and external training	• Internal and external training • Online training • Having own training center that customizes training according to the needs of engineers
3. Attending related seminars and conferences	• Provided for all engineers	• Provided for all engineers	• Provided for all engineers	• Limited cases
4. Gain knowledge from higher education	• Continue for higher education (educational grants) • Allow for a sabbatical year	• Not provided	• Funding higher education programs	• Funds available but for very limited cases
5. Provide mentoring/ coaching and buddy programs	• Mentoring, coaching, and buddy schemes	• Mentoring and coaching schemes	• Mentoring and coaching schemes	• Mentoring and coaching schemes
6. Engineers interface with customer	• Not all engineers, only those whose jobs required interacting with customers	• All engineers from any level	• All engineers from any level	• Not all engineers, only those whose jobs required interacting with customers
7. Job rotation	• Provided for engineers	• Provided for engineers	• Recently added and under exploration	• Very limited cases

Table 10.10 Competence development, knowledge build, and upskills

Training and development programs are a common way to achieve competence development. Over the years, C2 and C4 have developed specific internal training and competence development programs (criterion 1). Other firms provide training programs internally and externally in specific areas related to the expertise of their engineers (criterion 2). Engineers are encouraged to attend conferences and related events in core areas so as to interact with experts and share knowledge with them (criterion 3). Engineers who interact with customers will be able to identify clients' pain points and influence them to find solutions for them (criterion 6). In C2 and C3, all engineers have the ability to contact and meet with customers regardless of whether they work in the frontline or back office. While in other firms, it is restricted to only engineers whose nature of work requires communication with customers, such as

project managers and operation and field engineering teams. This could be an area to improve in these firms.

These firms have different focuses on what type of skills engineers are required to develop, which affects the design of such developed programs and the strategies to facilitate the skills of engineers (see criteria 2, 3, and 4). In C1 and C3, non-technical skills such as commercial and management skills are developed according to the role of engineers and if it is needed. They have less priority compared to technical and subject matter skills. In C4, engineers are more tied to their technical roles but are encouraged to join the business department, not other technical teams. C2 focuses on developing the technical, as well as business, commercial, and management skills of their engineers.

Another factor that is found among engineers is related to their higher education level (criterion 4). In order to keep their engineers up-to-date with changes in future technologies, C1 and C3 allow their engineers to continue higher education in particular fields and keep up with recent knowledge in technology. It is clear that in these firms with an applied research focus, the quicker they build and gain the knowledge, the faster they can use it, apply it to new products, and lead the market. C3 is currently adapting new promising technology for the next ten years, and they usually build new technology skills by integrating and reconfiguring their engineers' skills. Having a PhD degree has been seen as an advantage to pursuing intrapreneurial initiatives, as explained by participant C3P2. Urbano and Turró (2013) confirmed this relationship between the high level of education and the ability of the employee to act as an intrapreneur.

All firms have built an organization that keeps teaching and learning in every aspect and level based on knowledge sharing, exchanging experience, applying effective coaching and mentoring schemes, and transparent ways of communication and teamwork. In these firms, it is found that engineers are always eager to learn and develop themselves both personally and professionally. They strive to improve their skills and are willing to share knowledge with others in a friendly and supportive environment. It seems that engineers who are continuously learning and developing their skills are more able to generate new ideas and increase their ability to detect and identify potential intrapreneurial opportunities and develop skills for problem-solving. These results are in line with authors such as Oden (1997), who explain that organizations should foster a learning culture where learning becomes an integral part of the work experience and a continuous process integrated into daily operations, resulting in knowledge skills necessary to maintain a competitive edge. Haase et al. (2015) emphasize the link between organizational learning and intrapreneurship, explaining that organizational learning allows the development and exploitation of new knowledge that enhances employee creativity, intrapreneurial activities, and innovation, thereby encouraging individuals to engage as intrapreneurs.

10.4 The role of management and leadership in supporting and facilitating intrapreneurship

Managers have a significant contribution in promoting and facilitating intrapreneurship in these firms. Their decisions, actions, and management practices empowered by their position and roles greatly influence the intrapreneurial activities of engineers. They are fundamental toward sustaining intrapreneurial culture and supporting engineers in their innovative activities. One of the engineers in C2, participant C2P5, states *"I thoroughly like our managers because they listen. They are very understanding… They will push innovation, but then they will help you when you need it. They give you a lot of control over the projects and responsibility as well".*

The results indicate that managers in all these firms are usually positive and open to receiving ideas from their engineers regardless of the potential value. There is no blame for engineers when they suggest ideas that may not have much potential or may be impractical, and managers here value any new suggestions that arise with an open mind. They show respect and a positive attitude, value engineers, and appreciate them for coming up with new ideas. Thus, engineers are more likely to express and share their ideas quickly, find ways to improve things and raise suggestions for new concepts, which could be something to develop and build on top of it.

Managers show a strong belief in their firms' vision and strategy, and top managers emphasize innovation as a strategic success for the future. They demonstrate the strategy and convince engineers to implement and reflect in their practice. They always open a discussion with their engineers about team objectives and the firm's overall strategy and get their feedback to feed upper management. Engineers seem to be part of the strategy, and understanding it will lead to successful implementations.

Managers in selected cases seem to pay particular attention in keeping their engineers informed about the overall business updates in terms of strategic direction, customer and competitors' news, and market challenges. These are seen as very important for engineers so as to stay up-to-date with the overall picture of the business and where they sit within the surrounding environment, which is reflected by their ability to understand market challenges.

Managers provide great support to engineers to discuss their idea from a business perspective, show the potential value of their initiatives and convince top management about it. They play a major role in both the engineering and business processes related to idea generation and adoption. Engineers seem to lack such business and commercial skills in C1 and C3. While in C2 and C4, they work closely with the business and commercial team after joining the company. Participant C1P5 explains the importance of management support by linking engineers with the rest of the organization, including non-technical

teams such as the sales and marketing, and involving other business people to better understand new initiatives.

Building on the above discussion, managers are considered enablers of their engineers' intrapreneurial activities. This, according to Gerards et al. (2021), is a transformational leadership style in which leaders inspire and encourage employees to strive to contribute to the success of the business and give them a clear direction for achieving common goals. Moriano et al. (2014) highlight the positive impact of transformational leadership on the intrapreneurial capabilities of employees, where leaders inspire their employees to adopt the vision of the organization and build their confidence and skills to implement innovative responses to current organization and business challenges.

The findings show that the relationship between managers and engineers is based on mutual trust and respect. This is influenced by open communication and a friendly social environment. Managers tend to show a great level of trust in the capabilities and skills of their engineers and provide them with a certain degree of freedom to do their work independently. At the same time, they keep a high level of observation to see where engineers are stuck in their work to provide the proper and immediate support.

One of the interesting topics that emerged regarding management support is about keeping engineers involved in innovation. Some of the engineers in these firms highlighted that they sometimes do routine jobs that are not interesting or challenging and may last for a few months. This, for some, can become monotonous. They suggested that managers should pay more attention when engineers do too much routine work or are overloaded with daily tasks. Managers should find a way to keep a good balance by motivating engineers in their roles and ensuring that along with the routine work, they are also given tasks that challenge and excite them.

The results show that engineers have different capabilities and attitudes toward innovation. Some are good at idea creation, and some are better on the implementation side. Managers have to cope with this and explore their engineers' capacity and what they are good at. This could be facilitated by job rotation, allowing engineers to join other teams, and assigning them a variety of tasks and responsibilities. Then managers can understand the full potential and capabilities of their engineers so as to utilize them efficiently and better match them with the particular intrapreneurial needs of the organization.

In all of these firms, it appears that managers have received adequate training and are knowledgeable on how to deal with their engineers in their daily activities so as to keep them motivated and perform at their best. They are equipped with additional management and business training when promoted to a managerial position. One of the most effective approaches for investing in the learning and development of employees in these firms is to ensure they have managers and leaders with appropriate skills. To meet this, C1, C2, C3, and C4 are keen to develop the leadership skills of their top managers as they

progress throughout their careers. This is done either by training courses or a specific leadership development program. This is extended in C4 to develop managers' personal attitudes toward better practices that encourage interaction and socialization with engineers.

10.4.1 Is technical background among managers an advantage?

Continuous management support is critical during the innovation process, starting from idea generation and then extending to the development and implementation phases. As discussed earlier, managers act as sponsors and facilitators for their engineers. Most of the direct managers and supervisors of engineers, as seen in the four cases, have an engineering and technical background, and most of the executive and higher managers in technology and engineering functions come from technical backgrounds. This gives them a better understanding of how engineers work and how they can best support them to succeed. It gives them the capability to understand technical discussions and the ability to judge, evaluate and prioritize ideas at their early stages and see the potential of which can be transformed into a business opportunity.

In many cases, engineers do bring raw ideas that may not be well defined, but with the support of their managers, they shape these ideas, mold them into better quality, and push them forward. This background enables managers to provide engineers with feedback and suggestions that help them strengthen their ideas and develop them further. Many of them act as coaches and represent inspirational role models for engineers. This is consistent with Oden's (1997) view that managers in an innovative organization should act as teachers and facilitators who provide coaching and mentoring services for employees to create an environment for personal growth. This technical background is not seen as an advantage to be acquired by only engineering managers or direct managers of engineers. All higher and executive managers in C2 and C3 have technical engineering backgrounds. They are inspired by engineering and involved in the technical details of their engineering teams. They tend to speak the same language as their engineers and provide direct support to them in an open atmosphere.

10.5 Engineers pursuing an intrapreneurial route

The study findings revealed that not every engineer has the intention or capability to be an intrapreneur. Participants from the four cases highlighted that some engineers are satisfied with doing their normal job tasks and would be happy to retain the status quo. It is clear that not everyone is cut out to be an intrapreneur. Orchard et al. (2018, p.13) explain such a view, *"Whilst it is highly unlikely that every employee can be directly involved in the development and progression of substantive innovative advancements, they can contribute to intrapreneurship in the sense of heightened awareness, incremental change or improvement in whatever role they have been employed to undertake".* This is supported by the view of participant C3P2, who considers that every employee in some way can contribute to or be part of innovation, *"Innovation is spread among all the resources, and it is embedded*

in every role inside the company". However, with the right supportive environment, organizations can harness their engineers' skills better and motivate them more to engage with intrapreneurship. As described by Pinchot and Soltanifar (2021, p.249), *"Building such culture is not about creating intrapreneurs, since they already exist, often concealed, within established organizations. It is, however, about discovering them, showing them that manifesting intrapreneurial behavior is safe, and supporting and empowering them".*

Organizations today need more intrapreneurs than ever before, according to Pinchot and Soltanifar (2021, p.234), who highlighted that *"Intrapreneurs are as essential to corporate innovation as entrepreneurs are to start-ups, so most companies need many more intrapreneurs than they used to in the more stable times of the past".* This is also evident from the results of this research; engineers in the four companies are being actively encouraged to embrace intrapreneurship in their roles. But organizations cannot impose intrapreneurial thinking on their employees. Organizations can encourage intrapreneurship and help their employees to develop intrapreneurial skills and provide them the necessary opportunities to engage with innovation. Participant C1P1 explains that engineers have the capacity to innovate if they are directed to do so, *"You cannot teach people how to have the ideas, but how to harness the ideas and recognize which ideas are the good ones or which are the bad ones. I think if you had somebody that just never had an original thought, you could not teach them to do that. But frankly, I like to believe that everybody has original thoughts. It is just a case of teaching here, how to recognize them, act on them, categorize them and capture them".*

These four organizations have structured their culture and entire management practices to encourage intrapreneurship across all levels and functions, which are available and offered to any engineer. They are not directed to a certain group or function or team. Hence, they are open to being utilized by any engineer, and they can take advantage of such an opportunity. So, these firms are looking for more innovation from within and are willing for more engineers to take on the role of intrapreneur to strengthen their innovative capability as an organization. The results show that engineers with intrapreneurial capabilities show more productivity and efficiency and perform better in their roles regardless of their position and job level. This adds more value and benefits to the business they work for as engineers. When acting as intrapreneurs, they will be more proactive in searching for new ways to do their work, will not be afraid to think out of the box, and do things better, faster, and with less time and cost. Mustafa et al. (2018, p.290) note, *"Firms will only be innovative to the extent that its human resources are innovative".* Therefore, organizations should go beyond empowering employees and look at ways to get the best out of their engineers, utilize their skills effectively, and strive to transform every employee into an intrapreneur, thereby increasing the organization's effectiveness (Oden, 1997).

10.6 Is experience important for shaping engineers' intrapreneurial skills?

It is clear that engineers from different levels are coming up with new ideas and initiatives. The analysis shows that the more experienced engineers tend to bring more initiatives. This is evident in all four cases, indicating a positive correlation between the number of years of experience and the quantity of innovation. According to Participant C2P1, *"Most of the ideas tend to come from the senior engineering staff… It is just natural because they have got more years under their belt"*. Participant C2P3 explains that more experienced engineers gain more confidence to speak out their thoughts and provide crazy ideas without any fear of being judged, which is not the case for less experienced engineers, *"The more experience you have, the more you can use them when you see a problem… So, I think once they go and they start to feel like a more integral part of the team, then they can put crazy ideas on the table without fear of being judged. So, I think it is about confidence. So, as they get a bit more confidence, then they start to forget about the confidence, and they start to think about the work"*. Participant C3P3 also confirms this view and explains, *"… They (ideas) may normally come from the senior engineers a bit more. They have a bit more freedom on what they are doing, they got more experience on what they are working on as well. Some of the junior engineers come up with excellent ideas, but they would not have the confidence… there are very good ideas emerging. I think it is just the most senior maybe because they can drive an idea forward quicker".*

This implies the importance of building the experience of engineers by having a flexible and dynamic job design and a culture of learning and developing. This is supported by Urbano and Turró (2013), who found that employees with past intrapreneurial experience are more likely to engage in intrapreneurial activities and improve innovation levels. In a similar view, Neessen et al. (2019, p.556) add that *"Past experience and personal knowledge are related to intrapreneurship".* Through their experience, they gain more knowledge and skills that can be reflected in their willingness to act more intrapreneurial. This is the case for C1, C3, and C4, where they generally prioritize the recruitment of engineers with prior work experience and a record of success in their previous jobs over those who have just graduated. They test this during job interviews. In C2, the focus is on recruiting newly graduated engineers and building their skills quickly through training and the GDP program.

It is also clear that exciting outcomes can emerge when different experiences of engineers come together. For instance, in the view of participants C2P5 and C4P2, problem-solving and brainstorming sessions have excellent results when new graduates and experienced engineers collaborate. Participant C1P1 agrees with this and adds, *"Sometimes it is great to have a recent computer engineering grad because they come out with all the, you know, the stuff that is recent in their mind about computer science theory".*

10.7 How roles of engineers have evolved in today's business environment

Today, technology is evolving dramatically and moving faster than ever. Engineers are at the heart of this transformation as they are the main assets in technology firms. While the traditional role and technical expertise are still necessary, engineers' role is evolving to keep up with the pace of technology, the rising market demands, and the need to find new innovative solutions that can improve people's lives. The CEO of C4, participant C4P7, explains how the role of engineers has developed in the energy industry, *"The role of the engineer has evolved radically, particularly over recent years. The energy transition and the journey to Net Zero pose new challenges for society, and the impacts on electrical and other engineering professions are profound… Creativity and problem-solving have always been a part of the engineering skill set. However, the Net Zero challenge means engineers will need to evolve their roles again to meet these challenges".* He explains further what could be an engineer intrapreneur to lead the technology evolution, *"To make effective decisions, successful engineers will need to combine their creative, problem-solving skills with new commercial skills to understand the financial impacts for Net Zero... The 'intrapreneurial engineer' describes a commercial engineer who understands and can explain the financial benefits, costs, and risks associated with engineering solutions to support and make better decisions and then has the motivation and perseverance to make it happen and see it through".* This indicates that engineers must actively embrace change and industry evolution, be open to learning new skills, and move with time.

In C2, participant C2P1 explains that engineers need to expand their knowledge outside of their engineering contexts. They are expected to understand the market, competitors, and where the technology stands in their area of expertise. He adds that the engineering role is expanding to other functions, and building skills and competencies outside the engineering profession is mandatory. A well-rounded engineer in C2 represents someone with a wide knowledge of business, management, and financial skills. Participant C4P6 describes the intrapreneurial engineer as someone who has a vision and is very focused on their innovation, *"Someone should address the market's need. Number one, number two, it should be a solution for a problem that exists, not for a problem that does not exist. And thirdly, it should have commercial justification".*

Engineering is an ever-evolving profession, and engineers will play a key role in reshaping and reinventing the future of this sector. They will always be confronted with the problems of dealing with complex systems and technologies that address the challenges of ever-expanding markets, customer demands, and interconnected worlds that emphasize innovation. This necessitates a continuous renewal of the engineering profession capable of nurturing professionals who lead, identify, and solve market challenges as they shape the future.

10.8 Facilitating intrapreneurship during COVID-19

COVID-19 has led to dramatic changes in the economy and industries where many organizations struggled to respond quickly or adapt their businesses to survive. While the business of some of the selected cases, like C2, flourished during COVID-19 due to the significant growth in the health sector, C1, C3, and C4 have witnessed different challenges in managing their businesses as they were operating in some of the most affected sectors, including a drop in the sales volume and cash flows. Some of their ongoing projects had to be put on hold, and the number of new customer requests declined during this period. Despite the contrast in how these companies were affected positively or negatively by the pandemic, they were facing similar challenges:

- Adapt quickly to fast changes in the economy by adjusting their business strategies, goals, priorities, and internal working processes to maintain business continuity and resilience
- Adapt to some of the new issues that evolved as a result of COVID-19, such as new working concepts and processes imposed by governmental regulations
- Minimize the impact on their cultures while their staff worked remotely. They had to ensure that the level of collaboration, team spirit, and interaction within teams and across departments and with managers were consistent/similar to the physical working environment they had prior to COVID-19 so as to keep their engineers motivated, productive, and effective with their contribution to innovation despite the changes
- Maintain employees' well-being, mental health, and safety

For instance, the main focus of C1 during the pandemic of minimizing the impact of COVID-19 on their engineers was to keep the advantage of the Kaizen culture alive while they worked remotely. The organization acknowledges that old office-centric ways of reinforcing the internal culture must be developed to match the home-working style. The focus was on establishing more touchpoints, fostering inclusive ways of communicating, promoting collaboration and team spirit beyond location, and reimagining the employee experience. This keeps C1 a great environment to work in where engineers feel fully supported during the pandemic. Employee well-being was one of the organization's main focuses throughout the pandemic. The firm provided an unlimited time off policy to help employees relax, refresh and recharge. Also, they offered regional health insurance options for employees and their families and provided a global employee assistance program to support employees and their families 24/7, 365 days a year. The firm grants a fixed budget to each employee to spend on office furniture and enhance network connectivity for video conferencing. One of C1's main challenges at the beginning of the pandemic is to keep ideation and brainstorming sessions running effectively while remote working. They have looked for and secured suitable technology tools to facilitate this and enable whiteboard features. The remote work experience during the pandemic shows successful results in terms of increasing engineers' productivity and motivation. To maintain such benefits, the organization is in the

phase of designing a hybrid working model to be applied in the short future as a post-COVID new workplace rule. This model aims to establish a flexible work arrangement where employees work effectively and cooperate efficiently remotely and at the same time have the choice to work from the office to build relationships and meet others face-to-face. A similar result was recognized according to the experiences of C2 while remote working. One of the main processes that will take place in C2 is to adopt hybrid and remote work policies after the pandemic, where engineers can enjoy more flexibility in their work location. In C1, many creative ideas and innovative initiatives were originated by engineers while being stuck at home, such as developing internal processes and tools related to their jobs that could facilitate their daily work. Participant C1P3 comments, *"This is probably the majority of the innovation at the moment. Thinking about new ways of working, especially in this remote world work…, but really because we are in a different stage of our development, then they put the time to really think back and think actually this tool would be great if we went back and really set it up for sustainable success. And ultimately, they know that if they can improve the way of working, it is going to make their role much easier on a day-to-day basis".*

In C2, engineers were part of the fight against COVID-19 as part of a wide range of social responsibilities. The firm allows their engineers to support local communities by manufacturing and supplying medical products that save lives for others. Engineers have produced around 30,000 Visor and masks that were donated to their local community, neighbors, and care-workers community. Each engineer was provided with a 3D printer at home that could operate 24x7 to produce visors and masks. Participant C2P5 comments on this proactive approach, *"I think that was a great idea. Obviously, it was out of their own pocket. They did not profit from it. It was completely free to provide back to the community of face masks. So, they do go the extra step to help everyone around them, rather than thinking solely about company finance. Because they will obviously if had to buy these machines and with no benefits, so they go above and beyond to try the best they can do".* One of the main advantages brought by intrapreneurship in this firm is having a structure of well-rounded engineers. This has helped the firm to handle the increasing number of projects and customer requirements as they can utilize the wide experiences of their engineers by moving them to work in different teams and projects with high priorities. Such advantages of wide skills and experiences of engineers were also beneficial for C1. The Spotify model allowed the firm to structure and restructure squads to optimize different teams according to the business needs. This would not be possible without exhibiting certain strategies to equip engineers with skills from all around the different functions within the firm. In C1 and C2, it was easy for the management to move engineers and allocate them to work in different roles and projects that have high business priorities. Teams were formed and re-formed quickly to suit customer and market needs.

C3 has faced tremendous business impacts as it operates in one of the most affected industries, aviation. Travel was restricted, and airports were closed for a long time during COVID-19. The firm reacted

quickly by adapting its business focus to short-term business so as to maintain its cash flow and business survival. This has been made clear for engineers and reflected in their team objectives. Participant C3P2 explains, *"We are a very agile company. Because of the COVID-19 situation, we have decided the strategy is to sell what we have and focus on short-term sales because we need to sell in order to survive. Once you are okay with the prospective business and cash flow, then you have to think outside the box. Because of this COVID-19 situation, we were lucky enough to quickly adapt to what we do now, so let us focus on X, Y and Z… So, we know that. For the future or the long term, for the next 10 or 15 years, it is all going to be about [hidden name] architectures. And there will be a lot of business that comes with it".* Accordingly, engineers have adapted their innovation focus to new strategies. Participant C3P5 explains, *"In this situation with coronavirus, the innovation is trying to prioritize things that will help quickly the potential return on investment. Other than that, we are getting loads of many challenging problems that are requested from our customers. So, we were innovating to try and solve these problems".* Engineers show high commitment to serving customers, providing continuous support, and developing existing tools.

C4 has been dramatically affected by the pandemic where many of their engineers are required to physically work at customer premises to ensure no disruption on the service delivered to clients. Safety and well-being of staff were a top priority during the pandemic, where work policies and processes were updated. Remote working was a major challenge for the executive and direct management to manage the business and maintain good interaction with engineers. The firm ensured using the technology tools to facilitate working from home and created virtual 'toolkits' to help employees work effectively and efficiently from home, ranging from how to run video calls, looking after their well-being, and how managers can help their teams while working remotely. The online 'Yammer' platform continues to be used by employees to chat and keep in touch, not just about work topics.

The pandemic has opened new opportunities to move toward remote control for the operation of customer power networks. C4 sees that innovative technology solutions can be the solution to enable engineers to work remotely rather than onsite. According to the head of client relations, participant C4P1, *"COVID-19 has taught us that the world is highly dynamic and our lives will continue to be reshaped and industries need to evolve to survive and innovate to stay relevant and be strategic in future-proofing in order to thrive".* Such investment in applying new solutions will take place in the post-COVID phase when businesses have recovered to some extent.

The findings of this empirical research about the strategic actions of the four technology-based SMEs during the recent economic crisis initiated by the COVID-19 pandemic are summarized below:

- Prioritize the employees' health, well-being, and safety as they are the main assets to drive business success.

- Adapt quickly by changing business strategies, work priorities, processes, and ways of working, and adjust short and long-term goals to meet the frequent changes in customer behavior, market changes, and health regulations. Such plans are reviewed and updated frequently to reflect the best practices in response to rapid and frequent changes.
- Effective communication is a strategic approach that maintains the culture and its value to survive while working remotely. Frequent meetings within and across teams and management check-in are key to keeping engineers connected and updated about the business direction, current challenges, and market updates
- Facilitate communication by introducing the technological tools and computer-mediated communication channels that support engineers to interact, share knowledge, and socialize to enrich the work experience from home
- Engage and involve engineers through the journey of success during the pandemic by providing continuous support and getting frequent feedback and suggestions from them
- Adjust and restructure teams to meet new business priorities and ensure teamwork and collaboration remain as main pillars to drive the productivity of engineers while working from home
- Drive engineers to keep an eye on current and future innovative opportunities that nurture the business in the post-COVID phase

10.9 Recommendation for organizations to facilitate intrapreneurship

From the analysis of the four organizations, the various facilitating factors for intrapreneurship within an organization are categorized under three main areas: cultivating an intrapreneurial culture, ensuring effective leadership and management support, and articulating a clear vision and strategic orientation. The details of practical steps and recommendations for an intrapreneurial organization and how these could be adapted and implemented to harness the intrapreneurial capabilities of engineers are illustrated in Table 10.11. These represent a framework for technology-based SME organizations that would implement or enhance the development of intrapreneurship.

Designing an intrapreneurial culture		
Activities toward an intrapreneurial organization		**Implementation recommendation to harness engineers' intrapreneurial capabilities**
Communication	Design events and develop processes for brainstorming sessions and idea generation	• Sessions based on multi-function teams that include a diverse background of engineers, a mix of expertise, engineers from different levels of experience, and involve managers from different functions • Brainstorming sessions are flexible to be called by individual engineers or teams to solve their problems and any challenges they face at any stage of the innovation process • Design idea generation events, such as hackathons where engineers can generate ideas for specific challenges

	Frequent formal and informal meetings on the team, department, and organizational levels	• Engineers are involved in frequent meetings at different levels of the organization and feel free to express their ideas, thoughts, and suggestions
	Culture is based on friendly relationships and social interaction	• Build a strong organizational community and encourage non-formal relationships among engineering teams and with the entire organization through designing frequent social events and activities • Managers spend casual time with engineers around the office, taking breaks or drinking coffee together • Engineers-management relationships are based on respect, mutual trust, and friendly relationship
	Using technology and online tools that facilitate employees' interaction and sharing of knowledge	• Engineers can use interactive tools designed for technical and non-technical interactions where they can share any concerns or technical challenges and get their peers' support and guidance
	Flexible and open communication with the CEO and higher management	• Engineers can reach and communicate directly with higher management to share their ideas and express their thoughts without the existence of rigid boundaries or referring to their direct managers
	Enable frequent feedback from employees	• Engineers can provide positive and negative feedback about everything that matters to them and have the option to anonymize their names
	Free-flowing of market and customer information	• Engineers are involved and updated frequently about the business, customers, market, technology, and competitor news via their direct managers, upper management, and other relevant media of communications such as emails and internal websites
Rewards and recognition	A system of a wide range of monetary and non-momentary rewards	• Satisfy the different preferences of engineers by including a wide range of monetary rewards and recognition forms • Continuous recognition and appreciation by managers • More focus on long-term rewards such as recognition and acknowledgment, career promotion, and providing company shares • Allocate a specific slot of meetings to acknowledge and recognize the excellent work of individuals and teams
	A fair and transparent system of rewards	• Engineers are paid fairly for their work compared to the market • Have a good balance between rewarding the teams and individuals, avoid rewarding only the manager or the leader • Rewarding engineers very quickly • The reward system considers the innovative efforts and creative ideas of engineers in addition to their general performance
Teamwork	Facilitate teamwork and collaboration with other teams across the organizations	• Support engineers to work in a multidisciplinary collaboration with other teams throughout the innovation process • Support engineers to build a network with non-technical teams and facilitate their interaction and collaboration with business, marketing, and commercial parties • Remove all boundaries and rigid processes among teams and departments that eliminate cross-functional teamwork • Support cross-functional teams by assigning team members from non-technical departments of the firm
Organization structure	Design a flat organization with few hierarchal levels	• Engineers work in a flat structure with a few layers between them and higher management, enabling flexibility, enriching communication, and for faster and more effective decision making
	Design an organic structure based on decentralized decision-making, a low degree of formalization, and horizontal integration	• The structure enables engineers to choose the best way to implement and complete their work • Engineers have the authority to make decisions at their level • A structure promotes a horizontal mode of communication between all levels of the company where engineers can share their responsibilities in groups and teams

Job design context	Provide freedom and flexibility in job roles	• Engineers are allowed to work independently, do things differently and make their own decision and act on them • Allow engineers to go beyond their job specifications and build a diverse skill set in areas of their choice • Flexible working hours and a hybrid working style that provide a better life-work balance and flexibility to work from home or office
	Design flexible, dynamic, and interesting roles	• Choose projects that are interesting for engineers to work on • Let engineers work on challenging tasks where they can prove their capabilities in finding solutions • Allow job rotation mechanism and let engineers join temporarily and work with other teams and groups. Engineers have an influence on the selection of projects and teams they want to join • Design exciting roles where engineers are given the opportunity to do what they aspired about • Avoid routine work for a long time by allowing job variety to engage engineers frequently with new tasks and responsibilities • Support engineers' market orientation, customer focus, and direct interaction with customers
	Encourage risk-taking and acceptance of failures	• Encourage risk-taking among engineers that is preceded by calculating and mitigating the risk • Creating a no-blame culture where the failures and mistakes of engineers are accepted without any kind of punishment/consequence • Encourage engineers to experiment and make failures in test environments and offline systems • Failure is part of the learning process and taken as a lesson learned that is adapted and integrated into existing processes
	A supporting physical environment	• An open-plan layout office that supports engineers for direct communication and interaction with management and other teams • A workplace with supportive facilities for meeting, gathering, interacting and socializing

Organization vision and strategic orientation	
Activities toward an intrapreneurial organization	**Implementation recommendation to harness engineers' intrapreneurial capabilities**
Clarity on the vision and strategies and overall direction of the business	• Articulate a clear and specific vision and strategy at all engineering levels that inspire engineers to innovate • Vision and strategy can give clarity to engineers about setting their team objectives and priorities and how their work fits into and/or contributes to them
Improve the engagement of employees with strategic alignment	• Active involvement of engineers as they are key partners of the firm strategy, through open discussion with management, providing feedback and suggestions about it • Managers demonstrate, share, and convince engineers to execute the company strategy and explain what it means for engineers in their function • Update engineers about any changes in the business objectives or the strategy and the future of the firm so they can reflect this in their roles • Engineers are part of assigning and discussing their teams' objectives
An effective recruitment process that focuses on talented employees	• Focus on direct recruitment of engineers that is manageable by the firm, not through a recruitment agency • Recruit engineers who are talented and show inspiration about technology and engineering • High academic results show the intellectual capabilities of engineers • A balance of recruiting new graduates and experienced engineers based on the position requirements • Well-designed apprenticeships, internships, and graduate programs are a great source for recruiting tested engineers

	• Having a culture day as part of the recruitment process where engineers have a taste of what the work environment looks like • Involve the engineering team in the recruitment decision
Frequent performance checks and review	• Engineers need frequent and continuous reviews and feedback on their performance • Engineers' performance measurements are based on creativity and innovation besides general performance metrics
Design training and education programs	• Design learning programs and training courses for engineers, including technical, soft skills, management, and commercial aspects • Tailor and adjust training resources to the needs of engineers • Support and fund engineers to acquire knowledge in new technology areas through professional and higher education
Facilitate knowledge sharing among teams	• Design mentoring, coaching, and buddy schemes for engineers • Find and encourage role models engineers who inspire other engineers and act as a technical reference for them • Job rotation toward technical and business teams
Leadership and management continuous support	
Activities toward an intrapreneurial organization	**Implementation recommendation to harness engineers' intrapreneurial capabilities**
Promoting a transformational leadership style	• Managers exhibit a transformational leadership style to encourage, inspire and motivate engineers to innovate without micromanaging them • Managers act as role models and technical references for their engineers. Managers with engineering and technical background are more likely to encourage innovation from engineers • Engage engineers with business, market, and competitors news
Leadership and management's continuous support throughout the innovation process, starting from idea generation to final implementation	• Being receptive and open to divergent ideas and encouraging new ideas regardless of their potential value • Challenge engineers' ideas, ask critical questions, and give direction on how to push ideas forward • Act as sponsor for engineers, voicing their ideas and bridging them with higher management and business teams • Secure resources for engineers, such as time, budget, experimentation, and testing of their ideas, and facilitate engineers networking inside and outside the firm

Table 10.11 Recommendation for organizations toward being more intrapreneurial

10.10 Developing a theoretical model

The findings from this research are developed and demonstrated in a theoretical model, depicted in Figure 10.1. Comparing this model to other models reviewed from the literature (see section 3.3), it is a detailed model which comprises a wide range of factors that emerged given the nature of this research as an exploratory study. Following the critical realism philosophy employed in this study, the generative mechanisms are not only related to the culture of the organization but also various mechanisms related to the vision and strategic orientation, and management support. These represent the main factors to nurture intrapreneurship within technology-based SMEs. The classification of these various mechanisms and factors under three main categories of cultural, management, and strategic aspects is compatible with the literature (see Chapter 3) and the practical recommendations (provided in section 10.9).

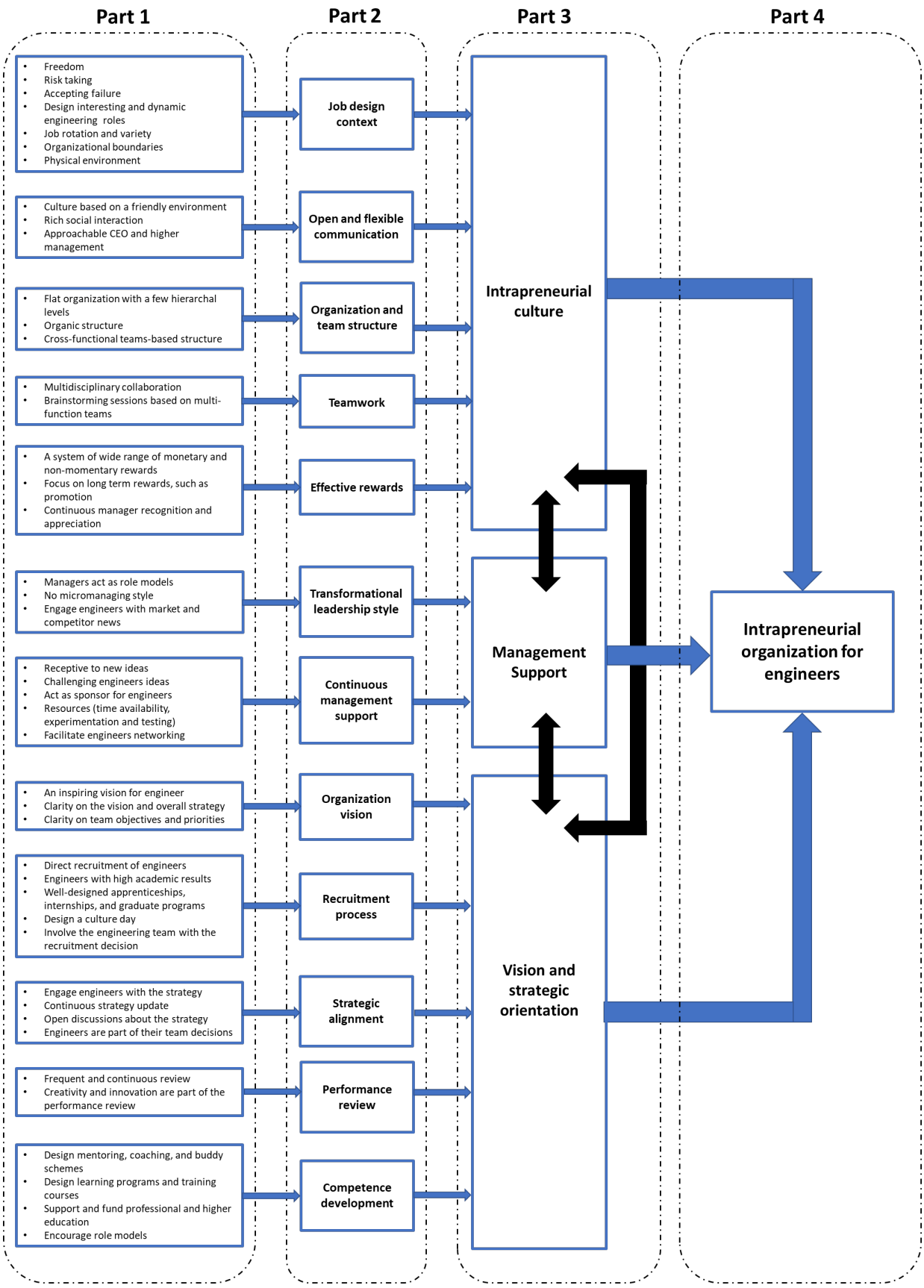


Figure 10.1 Theoretical model of factors relevant to facilitating intrapreneurship within technology-based SMEs

The underlying mechanisms are presented in more detail in this model and are structured in different parts. The model mainly consists of four main parts:

- Part 1 includes the detailed factors that are designed and configured to encourage and facilitate the engagement of engineers with intrapreneurship; these are drawn from the results of this research and represent the underlying mechanisms of part 2.
- Part 2 compiles the multiple factors from part 1 (the underlying mechanisms) in a specific group and presents them as the main organizational factors that promote intrapreneurship within technology-based organizations.
- The grouped factors from part 2 are related to three main categories presented in (part 3). These work collectively, and hence the integration and complementary of these and their subcategories (represented by the black arrows in the two directions) will lead and result in an organization that is conducted for intrapreneurship and that can facilitate the engagement of engineers with intrapreneurship (part 4).

In more detail, the main five factors (organizational boundaries, work discretion/autonomy, rewards/reinforcement, time availability, and management support) presented in the various intrapreneurship models (such as models by Hornsby et al. (1990), Kuratko et al. (1990), Hornsby et al. (1993), and Hornsby et al. (2002)) are part of this developed model. However, some of them were presented differently to suit the nature of the research considering engineers and the structure of the detailed information in the model. For example, 'time availability' is part of the 'resources' (provided in part 1) and is categorized under 'continuous management support' (provided in part 2). 'Autonomy/ work discretion', which is renamed to 'freedom', and 'organizational boundaries' are presented in part 1 as underlying mechanisms of 'job design context'. The factor management support is presented as 'continuous management support' in part 2 to reflect the various supports required along the innovation process, starting from idea to the final stages of the product/service. 'rewards/reinforcement' is a major factor that is represented in part 2 but with different ways to be applied for engineers.

More than the main five factors, 'communication' which is provided in models such as by Christensen (2005) and Antoncic and Hisrich (2001) is a major factor in this study. This has been renamed in this model, presented in part 2, to 'open and flexible communication'. It compromises new elements, provided in part 1, such as 'rich social interaction' and 'approachable CEO and higher management'.

Considering the specialties of engineering professionals and the design of tasks and responsibilities they carry, many related factors were included in the 'job design context'. Therefore, the model includes new factors such as 'interesting and dynamic engineering roles' and 'job rotation and variety'. Organizational structure (having a flat and organic structure), which is included in many models in the literature such as Christensen (2005), Covin and Slevin (1991), and Ireland et al. (2009), is also part of

this model. What is unique in the case of engineers is having a team structure based on cross-functional teams that enable collaboration, facilitate knowledge sharing, and develop their competencies. This is reflected in the new name 'organization and team structure'. Rewards need a special design to be effective and motivating for engineers, a focus on 'long term rewards' such as promotion and including a 'wide range of monetary and non-monetary rewards' are some key factors to reward engineers. Furthermore, engineers are more motivated by non-monetary rewards so as to have 'continuous management recognition and appreciation'. 'Teamwork' is one of the key factors in this model which does not explicitly appear in the previous models. In the case of engineers, 'multidisciplinary collaboration' and 'brainstorming sessions based on multi-function teams' are key for them to thrive in their engineering roles. This factor, while it has been mentioned in the literature (see Frederick et al. (2016), Sun et al.(2012), and Weber et al. (2014)), was not considered one of the major or effective factors in intrapreneurship models.

The wide aspects of management support within organizations are demonstrated under 'management support' in part 3 which is represented by two main underlying factors in part 2; 'transformational leadership style' which is explicitly added to the model and 'continuous management support'. 'Transformational leadership style' could be achieved by managers through acting as 'role models', avoiding any micromanagement style, and 'engaging engineers with market and competitor news' (presented in part 1). 'Continuous management support' includes new elements that are specific for engineers such as resources related to 'experimentation and testing' and the ability of managers to 'challenge engineers' idea' and 'act as sponsors' for them.

One of the new factors in this model is the 'recruitment process', presented in part 2. There is a lack of research in the intrapreneurship literature about it, and it was not mentioned in any of the explored models. This is found to be a key factor in technology organizations to recruit talented and motivated engineers. Special steps (provided in part 1) are found to work effectively by managing the recruitment process directly and not through recruitment agencies. Furthermore, recruiting 'engineers with high academic results' shows more ability to embrace intrapreneurship. 'Well-designed programs of apprenticeship, internship, and graduate programs' are effective ways for recruiting potential talented engineers. 'Design a culture day' and 'involve the engineering team with the recruitment decision' will give better choices for the final decision of recruitment.

Once engineers are recruited, 'competence development', in part 2, is crucial for them to succeed in their roles. This could be achieved through multiple underlying mechanisms, provided in part 1, such as designing mentoring, coaching, and buddy schemes, designing learning programs and training courses, supporting engineers to continue for higher education, and encouraging role models. Another new factor is related to the 'performance review' of engineers, provided in part 2, which should include creativity and innovation activities and be based on frequent and continuous reviews.

Some factors related to the organization's vision and strategy were mentioned in some of the models in the literature, for instance, the 'intrapreneurial strategic vision' factor was part of the 'ABC model' by Frederick et al. (2016) and 'entrepreneurial strategy' was presented as a main factor in the 'initial model for corporate entrepreneurial strategy' by Russell and Russell (1992). In this model, two main factors were added under part 2; 'organizational vision' which should be inspiring to engineers and provide clarity to the team objectives, and 'strategic alignment' where engineers are engaged with the strategy and are involved in their team's decisions.

CHAPTER 11: CONCLUSION

As evident from the discussion in this thesis, intrapreneurship is a concept highly recognized in the field of organization management. Over the years, both scholars and practitioners have paid growing attention to this concept as an extremely important research domain. However, as noted in the literature review, limited attention has been paid to the implications of intrapreneurship in SMEs compared to large organizations. SMEs usually run on limited resources and capabilities. Therefore, it is critical for them to invest in their employees and utilize their potential capabilities to actively engage with intrapreneurship. This is more of an imperative for technology-based SMEs operating in fast-changing economies where they are engaged in producing and developing complex and advanced products and/or solutions. Intrapreneurship can be seen as a strategic approach for many of these organizations to empower their engineers so as to contribute effectively to the success of their organizations through their creative ideas, initiatives, and innovative skills. While many authors, such as Åmo (2010) and Moriano et al. (2014), view intrapreneurship as an individual-level behavior in which an employee proactively brings initiatives in a bottom-up process, this study considers intrapreneurship as an organization-level phenomenon by which the firm can become more intrapreneurial through their engineers' initiatives and innovative efforts. These initiatives will not succeed if the entire system of the organization does not support recognizing these ideas and pushing them forward for implementation. Innovative capabilities of engineers will remain untapped in the absence of an organizational framework that supports, harnesses, and cultivates these capabilities. In this context, it was necessary to investigate and explore the organizational factors and the overall organization systems and contexts, including its culture, management practices, hierarchal structure, and strategies that influence an intrapreneurial organization in an engineering setting.

Today, the current literature shows a scarcity of studies on engineering and intrapreneurship phenomena. There is a lack of understanding of how technology organizations can engage their engineers with intrapreneurship and, in this context, how they can engage with its culture, interact with managers, and work toward shared goals and vision. In light of the increasing expectations from engineers to play a more pivotal role in innovation, authors such as Alam et al. (2020) emphasize the need to conduct more research to explore and test the phenomenon. Technology organizations seeking intrapreneurship must understand how to motivate their engineers and identify the factors that would encourage them to develop new ideas and increase their ability to think and act as intrapreneurs. This study addresses these gaps by studying the phenomenon of intrapreneurship within the context of four technology-based SMEs chosen purposefully for this research. Therefore, this research empirically explored the organizational factors that can support, enable, and motivate engineers to engage with intrapreneurship within their roles. This qualitative research is based on critical realism philosophy to explore and understand the underlying organizational contextual factors that can effectively nurture

intrapreneurship. A case study approach was adopted using four leading technology-based SMEs operating in heterogeneous technological industries in the UK. These firms are non-homogeneous and have different organizational characteristics and contexts so as to get a deeper understanding of how intrapreneurship is facilitated within different setups. The drivers for engineers to engage with intrapreneurship in these firms follow different approaches based on the unique contexts of each firm. Therefore, specific factors emerged for each firm based on its distinct characteristics.

The takeaway from this research is that intrapreneurship can offer a lot of benefits to firms in the technology sector. Different organizations may have different structures and setups, but they can still make the most out of their engineers by adopting the intrapreneurial culture and engaging engineers with intrapreneurship. This study answered the main research question of *"How can technology-based SMEs drive intrapreneurship and nurture innovation by harnessing the intrapreneurial capabilities of their engineers?"*. It is found that some organizations applied Kaizen and Spotify models. Some focused on developing 'well-rounded' engineers. Some emphasized a flexible and friendly culture, and in some, the focus was on an in-house consultancy team to drive innovation. This study clusters these common factors that can drive intrapreneurship under three main areas:

1) Developing an intrapreneurial culture: this includes factors related to having effective and flexible ways of communication across teams and management levels, effective and wide mechanisms of reward and recognition systems, teamwork and multidisciplinary collaboration, flat and organic organization structure, job design based on providing freedom and ensuring flexible and dynamic roles, a culture that encourages taking risks and accepts failures as part of learning, and a culture of learning that facilitates knowledge sharing among teams.
2) Leadership and management support: adopting a transformational leadership style with no micromanagement and providing continuous support for employees' initiatives throughout the innovation process.
3) Organization vision and strategic orientation toward intrapreneurship: this includes clarity on the vision and strategies and overall direction of the business, strategic engagement and alignment of engineers, an effective recruitment process that focuses on recruiting skillful employees, having timely performance reviews, CPD opportunities, and designing in-house training and education programs.

Organizations, especially technology-based ones, can benefit from the results of this study in their route to develop intrapreneurship. They can look at the recommendations and findings of this study to understand how different factors within the existing organizational settings, systems, and culture can facilitate intrapreneurship and how they can utilize the skills of their engineers effectively. These factors work collectively and hence, will need to be supported by the wider organizational mechanisms at their highest levels in order to maximize their effects and yield the most advantages.

A true note is that engineering is an exciting field with lots of potential for development. The multiple branches in engineering and changing nature keeps the roles of engineers challenging and full of exciting prospects. COVID-19 brought a lot of new changes and room for engineers to experiment and develop intrapreneurial capacities under the support of their organizations. For engineers, there are several benefits of choosing an intrapreneurial route. They not only get access to resources from their organization, but they can also potentially get mentors/guidance to develop their ideas and get credits/recognition for implementing innovation which can significantly boost their job profiles. A lot of intrapreneurial organizations allow flexibility for engineers to innovate without any fear of punishment in the event of a failure, as we saw in the case studies in this research. Thus, the risks for engineers are minimal. For organizations, they can benefit a lot from intrapreneurship. They can utilize in-house skills effectively, reduce employee turnover, improve job satisfaction and productivity, increase employee commitments toward the organization's vision, maintain continuous innovation, develop new products and solutions, and build and sustain their competitive advantage in today's complex market.

11.1 Research contributions

The research findings contribute to the literature on intrapreneurship in SMEs by investigating the factors that enable technology organizations to act more intrapreneurial and build competitive advantage through their engineers. This research provides one of the first empirical studies to explore intrapreneurship in an engineering context in the UK and how engineers engage with intrapreneurship in technology firms. The empirical findings of this research have implications for managers and leaders in technology-based organizations. They can understand how to tap into the intrapreneurial potential of their engineers. Therefore, they can foster and create the proper intrapreneurial culture in which engineers are motivated and encouraged to take on more intrapreneurial roles with their jobs. The organization will learn to apply best management practices to support engineers and develop and retain them to maximize its innovative activities. The findings will help organizations to implement their strategies more effectively and adjust their management processes and internal procedures to facilitate intrapreneurship, including their recruitment process, reward system, and training and competence development programs for their engineers. These results can also be applied to other organizations that deal with innovation and innovative behaviors of their employees in general. Following the investigation at the organization level, the research study developed a practical framework to develop intrapreneurship which includes key cultural, management, and strategic intrapreneurial factors.

In light of the complex business environment of technology firms today, the role of engineers seems to be constantly evolving. The industry requires them to embrace a range of additional skills that go beyond traditional engineering and technical skills. Today's engineers must have an open mind to take a comprehensive and active role in addressing industry challenges, building their business acumen,

developing their technological expertise, and producing new innovative products and solutions that can enhance people's lives. The findings can support engineers in their path to becoming active intrapreneurs. They can be more aware of their roles in advancing technologies and accelerating innovation. The results can give them a view and a better understanding to be more proactive and step outside their technical comfort zone by immersing themselves in more innovative responsibilities in their jobs and contributing effectively to the firm's success.

The empirical findings from this research expand the literature in the fields of intrapreneurship and engineering and technology innovation. This study can help academics/researchers in expanding their knowledge, building more understanding of these areas, and comprehending the complex phenomenon of intrapreneurship on the organizational level. This research has three main empirical objectives:

- Explore the factors by which an organization can promote and facilitate the engagement of their engineers with intrapreneurship
- Explore the best leadership and management support practices for empowering engineers, developing a supportive culture, and aligning specific organization strategies toward intrapreneurship
- Propose a list of guidelines that offer practical steps and recommendations to promote intrapreneurship within the context of technology organizations

These empirical objectives have been achieved in this research which made the following contributions, specifically, it has:

- Explored and provided an understanding of the key factors that can influence and contribute toward the success of an intrapreneurial SME
- Built an understanding of the role played by intrapreneurship in driving and building competitive advantage and achieving organizational success in technology-based SMEs
- Built an understanding of how technology organizations can tap into the intrapreneurial potential of their engineers
- Explored the evolving role of engineers in today's technology organization and how they can potentially engage with intrapreneurship within their roles
- Discussed how different setups of organizations operating in different technological industries impacted the level of intrapreneurship among engineers by investigating the commonality and differences in their approach to intrapreneurship
- Provided some of the practical steps and recommendations for leaders and managers within technology organizations to facilitate intrapreneurship
- Built an understanding of how intrapreneurship can be promoted in different organizational settings and environments

11.2 Study limitations

The thesis results and implications should be considered in light of its limitations. These limitations are inherent in the chosen research design, some of which are due to unpredictable circumstances which are beyond the researcher's control. According to the definition provided by Hancock and Algozzine (2006), 'limitations' are elements that have the potential to influence the outcomes of the study but are generally outside of the control of the researcher. Authors such as Miles and Huberman (1994) identified several limitations associated with conducting qualitative research, which is labor-intensive and requires a significant investment of time and effort for processing and coding a large amount of data. Qualitative case studies are also constrained by the sensitivity and integrity of the researcher, who depends significantly on his/her own instincts and skills throughout the research. This makes the research susceptible to bias (Merriam, 2009). While some generalization within a particular setting is possible, qualitative studies are limited in terms of statistical representativeness and cannot be replicated to other settings of a wider population. Credibility, validity, and quality of findings are often questioned when conducting qualitative research studies (Bryman and Bell, 2011).

One of the biggest challenges in this study is recruiting managers in these firms to participate in the study, especially when a lot of them had to navigate their organization through the challenges of COVID-19. According to Bryman and Bell (2011, p.473), *"Interviewing managers often raises specific issues; the status and power held, particularly at a senior level, mean that gaining access to this group of people can be extremely difficult".* Due to the managers' time constraints and priorities, some of the interviews took time to conduct.

The in-depth analysis of the intrapreneurial factors in previous chapters is limited to the four case studies. Each case is unique in terms of its setup and characteristics. Other factors influencing intrapreneurship could potentially emerge if a large-scale study is conducted on these areas. Interviewing business owners and top managers might create some bias and provide a different image of what happened in reality, limiting the ability to convey and understand accurate data. This potential bias may also be seen when interviewing engineers and when they discuss their own thoughts and opinions about their managers, other teams and peers, and the entire organization. Some of the interviewees, on some occasions, were highly conservative in some parts of the interview and did not discuss innovation and their role thoroughly due to confidentiality, trade secret, and a competitive environment. Some of them even requested to exclude some specific details from their interviews. This limited some aspects of the analysis and the ability to use the information to build the case study. Saunders et al. (2016) highlight that some bias can result from the nature of participants who agreed to be interviewed. It may happen that only participants who are satisfied with their jobs agree to participate and favor a more positive experience than a negative one. Participants who refused to participate may have different opinions and perspectives.

Other kinds of limitations concerning this research are related to the field study and data collection. Interviews were conducted during the peak of COVID-19 in the UK, where the health instructions and government regulations forced employees to work from home. Thereby, all interviews were conducted using online tools such as Skype and Zoom, and some participants chose not to use video options. In this regard, Walliman (2011) explains that interviews conducted over the telephone have certain limitations when compared to personal interviews, such as using visual aids to explain questions. This pandemic also limited some aspects of the triangulation of the primary data in order to cross-check findings. As site visits were prohibited due to health constraints, observations of the participants and their working environment were not feasible during this complex phase of a global pandemic. These factors are beyond the control of the researcher.

11.3 Further work and suggested future research

The relevance of intrapreneurship in today's business, regardless of organizational size, is demonstrated by the way it effectively drives corporate performance by pushing innovation to new limits. This study identifies many prospective research paths that might be pursued in the future. Due to this research's exploratory nature, many intrapreneurial factors and sub-factors emerged, which are related to the firm's culture, structure, work processes, management, and strategy aspects. Some of these results can be tested and verified using extensive quantitative research. This may entail prioritizing these factors and determining which have the most significant impact on developing intrapreneurial engineers. Further studies can focus on the interconnection and correlation between these factors in a more explanatory natured case study.

This research is with a specific focus on studying intrapreneurship at the organizational level. Teamwork is a fundamental feature of these intrapreneurial organizations, as found in this study. A suggested area for deeper study concerns intrapreneurial teams focusing on the team level as a unit of analysis. For example, a researcher could investigate team dynamics, cross-functional teamwork, and how they influence intrapreneurship on the individual, team, and organizational levels. This calls for multi-level case study research.

The insights into the different factors influencing intrapreneurship provided in this research have implications for scholars wishing to conduct additional studies in this domain. It is obvious that technology firms face many dramatic and continuous changes in the business and market and fast-moving technologies. A longitudinal case study can give more insights into how these organizations maintain the level of intrapreneurship when adopting new technology or responding to major business challenges. In this regard, it is imperative to understand the effects of the different organizational intrapreneurial factors, how they are changing and developing over time, and their impacts on empowering employees. The pandemic is an excellent example of this, as it imposed new restrictions

for many businesses, markets, and financial parameters. An in-depth study can investigate and compare the intrapreneurial setup pre and post-COVID time, as well as how these organizations responded to such unanticipated crises while maintaining a good level of intrapreneurship.

It is also worth looking at and investigating how these different supporting factors are perceived by engineers, specifically why some respond and show a keen interest in benefitting from these and developing their behavior while others do not. This requires researchers to explore the behavior of engineers on the individual level and understand their different behaviors and attitude toward intrapreneurship.

Further studies could expand this research by incorporating large technology firms dominated by the engineering profession and investigating such intrapreneurial factors in different organizational contexts related to company size and how they correlate with this research results of SMEs. Further study can focus on whether intrapreneurship can flourish in a highly regulated and bureaucratic organization. A quantitative study can also be conducted on the skills and competence development of engineers and the effectiveness of training courses and development programs offered to them.

One of the exciting studies the researcher read is about the multiple culture theories by Menzel et al. (2006), who assert three types of cultures; national, professional, and corporate culture. A few studies have explored the interaction of these cultural types and how they influence intrapreneurship. In particular, Menzel et al. (2006) explain that the professional culture of engineers is different from other cultures of other teams, such as in marketing or finance. In this context, it might be worth investigating the interaction between these cultural types and how they influence the overall culture of corporate intrapreneurship.

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APPENDICES

Appendix 1: Interview guide for engineers

Q. No	Interview question
	Theme 1: General opening questions
1	Can you please give a brief description of your current role and what it entails? a. What was your motivation behind taking this role? b. How important is innovation in your current role? Please explain c. What expectations do you set in your roles?
	Theme 2: Understanding the engagement of engineers with innovation
2	Do you consider yourself to be an innovative engineer? How? a. Can you highlight some innovative activities/projects (development of ideas, product services, or processes) that you have actively pursued and succeeded? b. What limits your ability to contribute to innovation? c. Have you ever faced failures with any of your innovations? How does your organization react to such failures? d. What drives your motivation in this role?
3	Where do you draw your inspiration for your innovative ideas/concepts?
4	How do you deal with difficult tasks/complex projects? Please explain your strategies?
5	How do you deal with risks associated with any of your innovation/ideas? Do you consider risk as a challenge?
	Theme 3: Exploring the intrapreneurial influencing factors for engineers
6	What factors within this organization drive your creativity and innovation? What is the role of culture in this context?
7	What, according to you, is an ideal organizational atmosphere to be innovative?
8	How are you engaged with the company's vision and objectives? How do you feel that you are committed to the innovation plan and firm strategies? How does the firm strategy affect innovative behavior or influence you to be more innovative?
9	Can you explain how engineers within your organization interact with the management team? a. What steps would you have to take in terms of taking your innovative ideas forward to the management? How are you going to sell your ideas? b. How supportive is the management in terms of recognizing good ideas from engineers and driving them forward?
10	Are there active collaborations between different departments in your organization? Please explain. a- Does this collaboration promote innovation in any way? Please explain. b- How do other intrapreneurs motivate engineers within an organization?
11	Would you ever consider leaving this role to set up your own company? Please explain.
12	How are engineers rewarded in this organization if they perform well in their roles?
13	Does the organization provide any specific training and development opportunities to help and support innovators like you?
	Additional questions developed during initial interviews
14	1- How are engineers' performance and innovative capabilities measured? 2- Can you explain your experience in the recruitment process? 3- How are you developing your competencies?

Appendix 2: Research consent form

UNIVERSITY of York
Department of Electronic Engineering

Research Consent Form

Research Project Title: How can organizations foster intrapreneurship effectively through their engineers?

Researcher: Maher Alzyadat

I would like to thank you for taking the time to participate in my research study. My name is Maher Alzyadat, a PhD student at the University of York (Department of Electronic Engineering) and I am interested in learning about your roles in the company.

My project focuses on innovative firms. This study aims to understand how firms can be more intrapreneurial and innovative through developing their engineers' intrapreneurial initiatives. In addition, how firms utilize the intrapreneurial capacity of engineers, nurture and harness engineers to be more intrapreneurial and develop new capabilities for innovation.

This interview should last approximately 30-40 min. I will be recording this interview session on an audio recorder as it will assist me in analyzing your responses more accurately. The data will be stored in a password-protected university computer/laptop and will be stored until the end of the PhD study. All your responses will be used only for this research purposes and the output will be used for my PhD thesis and some publications in subject-related journals and conferences.

You have the full right not to answer any question that you are uncomfortable with and you can end the interview at any time of your choosing.

I, the participant, confirm that:

I have been briefed about this research project and its purpose and agree to participate □

I have discussed any requirements for anonymity or confidentiality with the researcher □

I have been briefed about how the interview data will be stored during the research □

I agree to this interview to be audio-taped □

Participant's name and signature: ----------

Researcher's name and signature: Maher Alzyadat

Date: / /

Appendix 3: Initial NVivo coding for C1

Name	Files	References
Intrapreneurial success factors	0	0
Vision and strategic variables	4	8
Articulating clear vision	5	16
Company values and strategies	4	6
Engineers' commitment to the strategy	5	5
Engineers' feedback on the strategy	1	3
Ideas out of the core business	2	2
Innovation strategy	4	9
Provide constraints for innovation	3	4
Recruitment process and strategy	3	7
Job rotation and flexibility to work in different areas	2	4
Building new competencies and upskills	3	5
Mentoring and coaching schemes	4	6
knowledge sharing with other tribes and squads	5	7
Training programs	4	5
Inspirational role models	3	5
Intrapreneurial culture	6	15
Freedom to engineers	6	18
Motivation of engineers	4	7
SME agility and flexibility	6	18
Accepting failure	5	10
Availability of Resources	4	8
Time	4	10
Recognition, appreciation, and rewards	6	11
Communication and meeting	8	29
Collaboration and teamwork	7	14
Management and team structure	8	20
Leadership and management support	2	2
Encourage risk-taking and work independent	5	6
Support with the innovation process stages	4	8
Encouraging new ideas	4	7
Challenging engineers in the initial phase of idea generation	4	7
Engineering and technical background of managers	4	7
Take idea forward with business process	5	7
An ideal manager	4	5

Appendix 4: Validating case selection

Case	Rich profile of innovation within the firm	Intrapreneurial culture
C1	• Participant C1P6 declares, *"Innovation is an important one, we advertise ourselves as an AI data-driven tech company which is a very fast-paced area than traditional Software Engineering; there are new research papers every week. So that means we need to be fast innovative to have an advantage over our competitors in this advanced technology space".*	• *"Our company culture makes everything we do possible. It drives our innovation and nurtures our personal growth. It helps us change the world"* Internal document • Participant C1P3 explains, *"It is very important to innovate and that our culture really helps people progress our product and make our clients happy… We need our engineering team to be super innovative and keep building on the ML technology in order to be unique in our industry. That is what sets us apart and helps us become leaders if we are innovative and try to do and implement new things and new ways of working across the tech industry".*
C2	• *"We offer customers a wide range of innovative technologies that can be applied to any project. With a breadth of knowledge and experience across a multitude of manufacturing technologies, we are recognized as experts around the world"* Internal document • *"Innovation is who we are. It is woven throughout the entire business and steers the direction of our product, process and production ethos. We pride ourselves on providing our customers around the world with a competitive advantage by bringing innovation to all areas of their product development"* Internal document	• *"The founding members have always sought to foster this kind of culture (family-like, open, collaborative culture) in the business, encouraging every employee to have a voice, to contribute new ideas and to influence the future direction of the business for mutual benefit"* Internal document • Participant C2P3 described the culture *"It is a culture with intrapreneurial spirit to discover opportunities and seek a potential solution and create a business out of it"* • Participant C2P2 adds, *"trusting engineers is a big part of the culture, showing the trust but also setting a high expectation… you know, we expect engineers to come forward with ideas and contribute and challenge"*
C3	• *"Throughout our journey, we have developed our reputation for innovation and providing custom solutions for the complex challenges our customers face"* Internal document	• *"We believe in making our company a fantastic place to work. With an innovative and supportive ethos and culture, a flexible working environment, and some of the best people you could hope to work with, we offer a career for you where you can excel at what you love doing"* Internal document
C4	• *"We pursue technologically innovative solutions to energy challenges that deliver the best outcome possible for our clients"* Internal document • *"We solve your energy challenges through innovative solutions, delivering resilience, cost efficiency and sustainability to deliver a bright energy future. We are at the forefront of the energy transition, enabling the decentralization of energy to a more sustainable, affordable and secure system"* Internal document	• *"We pride ourselves on our culture, and the rewards, benefits, training and development opportunities we provide our people"* Internal document