SCHOOL OF ECONOMICS AND MANAGEMENT

Open Innovation and Disruptive Capacity

AN EMPIRICAL STUDY ON THE IMPACT OF OPEN INNOVATION PRACTICES ON DISRUPTIVE CAPACITY WITHIN THE ALTERNATIVE FOOD INDUSTRY

by

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Abstract

Understanding the drivers behind open innovation (OI) activities to enhance disruptive potential on a firm level is critical for managers to make rational decisions regarding knowledge exchange beyond organizational boundaries for increased innovativeness. Nonetheless, while open innovation and disruption theory have experienced increasing attention from scholars and practitioners alike, existing literature shows a gap in combining both concepts. In response, we explored the cause of connection between implementing open innovation practices and accelerating disruptive capacity (DC) throughout a theoretical and empirical study to derive a framework illustrating the indicators of 'Open-Approach Disruption' (OAD).

Therefore, a qualitative multiple case study approach was selected, investigating the innovation strategies of four start-up businesses within the alternative protein industry from Europe and Asia-Pacific by conducting a series of four semi-structured interviews with executive leadership in a virtual setting. The primary data collection was complemented with qualitative secondary data sources on the industry and the cases, as well as with two additional interviews through video conferencing and email for validating and extending the derived findings.

In essence, our research indicated that leveraging open innovation practices can be effective to drive disruptive capacity if managed in accordance with the firm's internal and external conditions. Thereby, the most critical success category, 'Strategic Knowledge Exchange', was dependent on internal innovative capacity and technological features, as well as on external marketplace dynamics and the environmental context. Our findings imply that knowledge exchange can be especially promising when disruptive intent and high R&D efforts are given, but may also lead to a loss of intellectual property, competitiveness, and innovational speed if managed poorly. Therefore, the introduced OAD-model provides practical implications for open innovation practices around market entry strategy and R&D management.

Keywords: Open Innovation, Disruptive Capacity, Selective Revealing, Innovation Strategy, Alternative Food, Market Entry.

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List of Abbreviations

Alt	Alternative
BM	Business Model
CEO	Chief Executive Officer
CIO	Chief Innovation Officer
CSO	Chief Scientific Officer
CTO	Chief Technology Officer
DC	Disruptive Capacity
EU	European Union
GFI	Good Food Institute
HR	Human Resource
IP	Intellectual Property
KSC	Key Success Category
KSF	Key Success Factor
NIH	Not Invented Here Effect
NSH	Not Sold Here Effect
NPO	Non-profit Organization
OAD	Open-approach Disruption
OI	Open Innovation
RBV	Resource-based View
R&D	Research and Development
SDG	Sustainable Development Goal
SME	Small and Medium-sized Enterprises
SSI	Semi-structured Interview
UN	United Nations
USP	Unique Selling Proposition
VC	Venture Capital
VUCA	Volatility, Uncertainty, Complexity, and Ambiguity

1 Introduction

"The work of building ever-better theory is never finished" (Christensen & Raynor, 2003a, p.71). As one of the most influential business academics of the 21st century, Christensen's call to continuously enhance existing theories, built this study's foundation around innovation strategy. Accordingly, this first chapter covered the project's empirical and theoretical background to therefrom construe its problematization, scope, and finally the distinct purpose.

1.1 Empirical Background

How can R&D-intensive firms boost their innovation process to finally disrupt existing markets? For years, we have experienced how the increasing complexity of technological progress or more interconnected organizations have changed the characteristics of today's markets and accelerated the competitiveness within them (Seville, Opstal & Vargo, 2015). Considering this intensification, established firms repeatedly struggled upholding a leading position when start-ups entered the market; due to agility and innovative drive (Braganza, Awazu & Desouza, 2009; Chandy & Tellis, 2000). Accordingly, both managerial (Gerstner, 2002; Lock & Grothe, 2017) and academic literature (Christensen, 1997; Christensen & Raynor, 2003b) profoundly treated the issue of rapid market transformation and disruption.

Business is influenced by a variety of external factors, such as society, politics, and environmental change (Issa, Chang & Issa, 2010), which lately have been predominated by the megatrends of sustainability, digitalization, and globalization (Lubin & Esty, 2010). As a consequence, innovations hold great disruptive potential if they live up to the broad public's expectations by ideally, fostering global prosperity and aiming to solve pressing societal issues (Christensen et al., 2006). The UN (2018) offer a general guideline for such aspects to be considered for their member states in the form of the 17 Sustainable Development Goals (SDGs). For instance, the SDGs 'Zero Hunger' and 'Responsible Consumption and Production' highlight the importance of innovation in the food sector. Currently, the global industry for conventional meat and seafood production alone amounts to a total market value of $1.7 trillion annually (Byrne, 2020), but at the same time causes up to 37% of the total anthropogenic greenhouse gas emissions globally, out of which more than half are attributable to livestock and fisheries, their feed, and related land use (Crippa et al., 2021; Ritchie, 2019). Hence, in the challenge of enabling a reliable food supply to the continuously growing population without causing further environmental destruction (Doolittle et al., 2002; Van Kernebeek et al., 2016), alternative (alt) food products hold great potential. Consequently, this represents an opportunity

to reduce the food system's carbon footprint, while challenging the established players in the market. Due to the existing need and urgency for innovations in that field (Ercili-Cura & Barth, 2021) and because of early-mover advantages, fast innovation cycles are of critical importance.

One strategy to speed up R&D processes for demonstrating flexibility amid unexpected challenges, is implementing OI techniques to encourage interorganizational partnerships and knowledge exchange (Chesbrough, Vanhaverbeke & West, 2014). In light of the current global situation around COVID-19, the need for corporate resilience becomes especially clear. Since many companies faced an existential crisis, particularly in industries involving lengthy product development cycles, rapid innovation to reduce the time to market equals competitive advantage (Ercili-Cura & Barth, 2021). The two biotechnology companies, BioNTech and Pfizer, demonstrated the success of following a collaborative OI strategy to allow for high quality, as well as early market entry for their COVID-19 vaccination (Silberner, 2021). The partners managed to introduce the worldwide first vaccine to be approved with an effectiveness of 95% in December 2020; only about one year after the first recorded cases of the virus (Meo et al., 2021). Consequently, OI can be a promising tool to effectively prepare for unforeseeable and complex problems.

1.2 Theoretical Background

In recent years, the interest in OI theory has experienced an immense increase in scholarly research and industry conferences for practitioners. Studies have put particular emphasis on knowledge exchange, external absorptive capacity, and learning effects, as well as on the potential of OI practices to enhance corporate competitiveness as a result of these (Abbate, Codini & Aquilani, 2019; Aliasghar, Rose & Chetty, 2019; Chesbrough & Appleyard, 2007; Paiva, Ribeiro & Coutinho, 2020; Xie & Wang, 2020). Moreover, the impact of OI on technological progress from a product development perspective has been widely researched; showing enhanced performance in terms of speed, quality, and cost efficiency (Chesbrough & Appleyard, 2007; Monsef & Ismail, 2012; Xie & Wang, 2020). Some academics highlighted the arise of new opportunities for firms to apply OI techniques throughout their R&D processes as a consequence of advancing digital technologies; particularly, around data analysis and cloud computing (Björkdahl, 2020; Chesbrough, 2020). At the same time, the drawbacks of digitalization and the related risks in terms of corporate value destruction and exploitation by opening up the innovation process were pointed out (Dahlander, Gann & Wallin, 2021; Trittin-Ulbrich et al., 2021). Finally, research has identified different types of OI strategies in a

deductive manner, starting with the differentiation between outside-in and inside-out approaches (Bogers, Chesbrough & Moedas, 2018; Chesbrough & Bogers, 2014; Enkel, Gassmann & Chesbrough, 2009) and leading to more specific subcategories, such as selective revealing. This technique should help firms to avoid losing their core business's competitive edge (Alexy, George & Salter, 2013; Henkel, Schöberl & Alexy, 2014; Sarkar & Costa, 2008). Correspondingly, due to the high R&D investments within the alt food industry and the consequently strong tendency to protect intellectual property, literature on selective revealing is particularly suitable to derive market-specific insights (Henkel, Schöberl & Alexy, 2014).

Despite the assumed connection between OI strategies and innovational success, research on the impact of selective revealing on a firm's ability to bring forth disruptive innovations is still scarce (Alexy, George & Salter, 2013). Therefore, these scholars argued that literature on OI's potential to improve known technological trajectories and thus drive DC may be valuable. Hence, they identified the combination of OI practices and disruption as a research gap.

Moreover, existing studies in the OI field are largely limited to the broader IT and computer component industries (Enders, Wolff & Satzger, 2020; Henkel, Schöberl & Alexy, 2014). To complement current research on OI theory, the applicability of past projects' implications left space for validation through a wider set of industries. In this study, the focus was on the nascent field of alternative food products, with the intention to better understand innovation in the research-heavy biotechnology branch within the heavily regulated and vastly matured food sector. These characteristics describe a typical, initial market situation that new entrants may disrupt in the future (Christensen, Raynor & McDonald, 2015; Lee, Hwang & Choi, 2012). While there is some existing literature on OI in the food industry that highlights a potential for enhanced competitiveness; overall, the engagement of traditional food companies in OI activities is limited and so is the available research in the field (Sarkar & Costa, 2008). Additionally, academics have paid predominant attention to successfully implemented OI strategies in large, established enterprises; such as Siemens, P&G, and IBM; rather than smaller firms (Enkel, Gassmann & Chesbrough, 2009; Lee, Hwang & Choi, 2012). Due to obvious differences in terms of budget, human resources, and networks, innovation tends to be managed differently depending on the firm size (Rogers, 2004; Symeonidis, 1996), which may lead to distinct consequences of the same applied OI practices. Thus, OI strategies and their impact on the innovativeness of small and medium-sized enterprises (SMEs) is yet to be elaborated on and especially by the use of empirical case studies (Henkel, Schöberl & Alexy, 2014).

1.3 Problematization and Scope

In research and business alike, the possible benefits of OI strategies and the power of disruptive innovations have brought forward the desire of combining the two fields and were thus drivers behind contributing to the existing literature.

This study addressed the theoretical research gap as illustrated in intersection 1 in Figure 1, by exploring how the established model of disruptive innovation (Christensen & Raynor, 2003b) and OI theory (Chesbrough, 2003; Wheelwright & Clark, 1992) were connected, to potentially discover new insights for the impact and practicality of OI practices on disruptiveness. Moreover, existing frameworks on OI or disruption predominantly focused on either internal or external influencing factors towards success (Felin & Zenger, 2014; Subtil de Oliveira, Echeveste & Cortimiglia, 2018). In response, with this study, we aimed to provide an overarching model equally considering drivers from within and outside a firm. In practice, there were numerous reasons for companies to implement OI strategies, such as product success and profitability (Enkel, Gassmann & Chesbrough, 2009), in turn implying disruptive intent. While disruptive companies from various industries demonstrated the use of such practices, the cause of connection between these and an organization's disruptive capacity was but superficially studied. Moreover, intersection 2 in Figure 1 represents the combination of the theoretical and the empirical problem as the foundation of this project by including the perspective of the alt protein industry. There is an intensifying need for affordable and accessible alternatives to conventional food products in order to create long-lasting, positive change. Regardless of the characteristics of such innovations, however, changes in the field of food and dairy are inevitable and yet to be explored in the context of OI practices and disruptive potential.

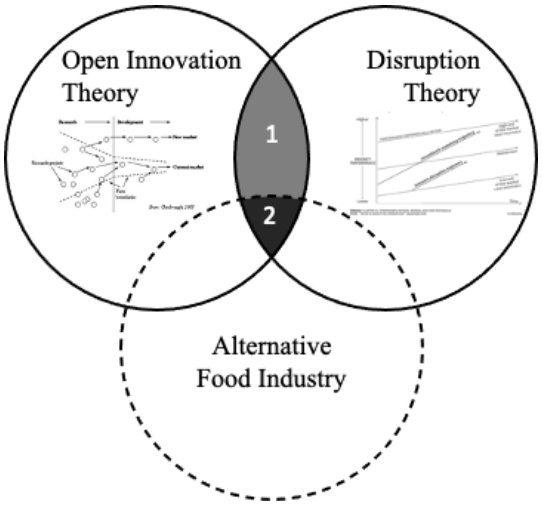

Figure 1: Research Domains with the Resulting Gaps

1.4 Contribution of this Study

A study on the effects of OI strategies on DC in start-ups within the alt food industry is relevant for multiple reasons and in turn of interest to several audiences.

First, the combination of the two research branches, open and disruptive innovation, within the alt food industry, was expected to offer new findings for researchers of all three fields. This study attempted to test the applicability of implications from existing literature on the impact of OI on innovativeness in a different sector. Thereby, it contributed to the existing body of academic studies, also the larger field of strategic management, and moreover, to research that served as an information base for governmental bodies to derive regulations and policies that allow for food innovation in a controlled and safe manner.

Second, exploring the key success factors behind openness throughout the innovation process to enhance a firm's DC offered new insights for the executive management of SMEs, leaders of R&D departments, innovation managers, and strategists in related areas when deciding on their respective innovation strategies. Additionally, managerial implications for knowledge exchange may also apply to decision makers within various research-intensive industries, as well as to those working with larger, established organizations. These leaders could benefit from the study in terms of developing a more perceptible eye for initially unimposing developments in the market that might bring forward severe, disruptive competition.

Third, this project may serve as an information base for potential collaborators in OI practices with the interviewed biotechnology start-ups. Among others, such partners may include universities and other research institutions, pharmaceutical companies due to well-established R&D procedures, as well as current players in the food industry and corporate or private investors. For the latter, this study may aid the decision-making around portfolio extensions to include potential future disruptors within the food sector.

1.5 Purpose Statement

The research objective of this qualitative case study was to enhance the understanding of how OI practices can foster DC by exploring innovation strategies around both concepts, the motivation behind them, as well as their possible cause of connection.

Therefore, over the course of this project, a series of four exploratory interviews with CEOs and innovation or R&D managers of biotechnology start-ups within the area of alternative food was conducted in a virtual setting. A secondary study aim was to improve the understanding of the disruptive intent of small firms within the established food sector. At this stage in the research, OI was defined as an "innovation process based on purposefully managed knowledge flows across organizational boundaries" (Chesbrough & Bogers, 2014, p.3), while disruption was understood as a particular technological trajectory "whereby a smaller company with fewer resources is able to successfully challenge established incumbent businesses" (Christensen, Raynor & McDonald, 2015, p.3). While this project's focus was neither on discovering some of the market's competitive characteristics, nor on estimating the participants' probability of future success, some of our findings may lead to such implications. The formulation of a research question was refrained from, as the aforementioned problematization and study purpose sufficed to conclude in operationalizing the preliminary framework according to theory and the required empirical data. This dynamic model was described in section 2.3 Preliminary Theoretical Framework.

1.6 Thesis Outline

This thesis opened with an extensive theoretical study to review existing literature on the research fields of OI and disruption theory. This served to derive a preliminary framework in an attempt to explain the cause of connection between OI strategies and DC of SMEs in industries with prolonged R&D cycles. The theoretical findings were followed by outlining the applied research approach and methodology throughout this project. Thereafter, the empirical study detailed the research observations on applied OI strategies, innovational intent, related drivers, and challenges. This section transitioned into the thorough analysis and discussion of the findings to serve the purpose of this study of enhancing the understanding of OI practices and DC. Correspondingly, the preliminary framework was adjusted according to the newly gained insights to adequately describe related key success factors. The study concluded with reflections on aims, theoretical contribution, practical implications, and current limitations leading to possible future research.

2 Literature Review

On the basis of the aforementioned problematization, theoretical and empirical, and motivated by fulfilling the study purpose, this section covered the underlying theories with the guiding concept of OI as a tool to improve technological trajectories, which could thus affect the potential for future disruptive innovations. Therefore, the relevance of disruption theory was discussed thoroughly, followed by an elaboration on OI theory. The summarized contents from both fields were synthesized into a preliminary framework to visualize the influencing factors on innovativeness in one merged illustration. This laid the foundation for further challenging and testing regarding validity, relevance, and the combination of the two concepts.

2.1 Relevance of Disruption Theory

As commonly known, innovative products, services, and solutions drive organizations' profits. However, successful innovations are motivated by more than the aspect of profitability and in fact, can affect people beyond the corporate boundaries. For instance, radical innovations can be a driver behind economic growth on a regional, national, and international level and thereby, influence economic key figures, such as the unemployment rate. Thus, through increasing productivity and the launches of new products and services, innovations can contribute to society by facilitating a steady economic growth and the elevation of the standard of living. Due to the affordability and accessibility of a particular innovation to a large customer base, disruptive innovations are especially impactful for such developments (Ahlstrom, 2010).

The worldwide economic growth and overall enhancements of quality of life have also caused environmental issues to intensify. Hence, the increasing energy demand as well as the need to manage carbon emissions efficiently calls for sustainability as a new imperative in the business world (Ahlstrom, 2010). Thus, balancing the desire for corporate growth and expansion on the one hand, while taking responsibility for the natural and societal environment on the other hand, is one of today's most difficult challenges for managers of established firms to handle. This implies that disruption represents an effective strategy in order to realize increased profits, without neglecting the needs and demands posed by society and the larger business environment and therefore, explains why "the development of disruptive innovations … should be the number-one goal of business" (Ahlstrom, 2010, p.22).

2.1.1 Fundamentals of Disruption Theory

Due to new implications for technological change over time, disruptive innovation theory has experienced tremendous attention from scholars as well as practitioners and developed into a vastly matured research field. Even though the model of disruption dates back to the late 1990's, it is still among the most acknowledged, yet criticized theories within management research (Ritala, Huotari & Kryzhanivska, 2021). The idea of disruptive innovation was first popularized in Clayton M. Christensen's book *The Innovator's Dilemma* in 1997. Therein, based on a multi-method study, Christensen (1997) elaborated on the various possible reasons behind the failure of leading companies to seize the next wave of innovation as introduced by emerging competitors within their respective markets. Officially, disruptive innovation is defined by the Christensen Institute (2021, n.p.) as:

> a process by which a product or service initially takes root in simple applications at the bottom of a market – typically by being less expensive and more accessible – and then relentlessly moves upmarket, eventually displacing established competitors.

DC thus refers to a firm's ability to bring forward a disruptive innovation. Christensen (1997) further distinguished between sustaining innovations by incumbent firms and disruptive ones that are typically introduced by new market entrants. In general, disruption theory describes an observed phenomenon, visualized in a diagram with two upward-moving trajectories for an incumbent's innovation and a disruptor's one. Both trajectories are placed within the dimensions of performance as the y-axis and time as the x-axis. This framework can be reviewed in Figure 2, which illustrates the incumbent's sustaining trajectory as the upper black line, and the disruptor's one at the bottom.

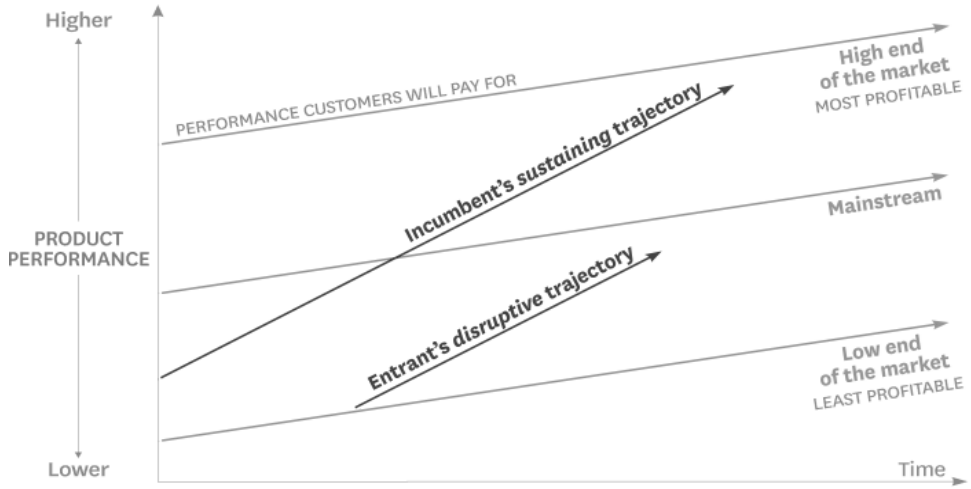

Figure 2: Disruptive Innovation Model (Christensen, Raynor & McDonald, 2015)

To satisfy the market's high end, established firms tend to follow incremental innovation processes to improve their product performance by building capabilities around one single technology trajectory (Christensen, 1997). The focus on the customer segment with the highest possible profitability per capita demands for consistently high product performance to live up to customer expectations. Considering the technology s-curve, innovation at mature stages of a particular product or service, however, leads to slow and only minor improvements in performance despite tremendous investments (Christensen, 1992). At the same time, new entrants can disrupt mature industries by entering the market at the low end (Christensen, 1997). The initial framework was supplemented with more recent studies, which focused not only on 'Enabling Technology', but on the components 'Innovative Business Model' and 'Coherent Value Network'(Christensen Institute, 2021). Both represented the 'New Market Disruption' that occurs beyond the inherent market or existing value network and includes "new contexts of consumption and competition" (Christensen & Raynor, 2003b, p.44), which extended the model by an additional layer. This newer model can be reviewed in Appendix A. Instead of poaching customers of incumbents' offerings, the challenge is to overcome non-consumption.

Despite the concept's popularity, the term 'disruptive' is frequently misunderstood and explained out of context (Christensen, 2006). To prevent further disarray and to set the stage for elaborating on disruption theory, we differentiated between breakthrough and disruptive innovation (Christensen, 1997), as illustrated in Table 1. At market entry, breakthroughs are typically superior to their predecessors regarding technological performance targeting enhanced quality. In contrast, disruptive innovations tend to be inferior in terms of technology, but more accessible and affordable in order to reach a larger customer base (Christensen Institute, 2021). Even if the primary goal of these innovations differs, one innovation can integrate both types simultaneously and be especially threatening to the competition (Sood & Tellis, 2011).

	Breakthrough	**Low-end Disruption**	**New-market Disruption**
Performance of New Technology at Entry	Superior to predecessors "Higher attack" in established markets	Inferior to predecessors "Lower attack" in established markets	Different measure of performance
Consumer Expectation	High	Low-to-medium	None
Key Challenge	Superior performance to matured technology	Cost reduction and accessibility	Need creation for non-consumers through new value network
Strategic Focus	Technological prowess	High accessibility and affordability	Exploration of potential in niche markets

Table 1: Distinction between Different Types of Innovation

2.1.2 Evolution of Disruption Theory

The concept of the original framework from 1997 opened up for subsequent research to test the framework's overall applicability, validity, and reliability across various industries (Christensen, 2006). Thereby, several research branches originated from the prevailing idea.

First, scholars focused on the incumbent trajectory, in particular the factors that caused the path dependencies, such as the inertia towards change or even ignorance of the value of technologies, creating the entrants' opportunity in the first place (Garud & Ahlstrom, 1997; Lucas & Jie Mein Goh, 2013; Slater & Narver, 1998). In the further course, strategies from an ex-post perspective received attention for offering an explanation for this phenomenon. Hence, another stream of research included implications, which derived from the preceding insights on the lack of incumbents' attentiveness towards the developments in and beyond their direct markets, especially the established firms' missed chances to take precautions for potential intrusions (Christensen, Anthony & Roth, 2004). These topics addressed the required awareness towards signals for ex-ante prediction that determined particular outcomes (Gilbert, 2003), possible downsides to disruptive innovation, such as losing a company's unique value network (Garud & Munir, 2008), and recommended actions to be taken prior to market disruption, as well as response strategies (Charitou & Markides, 2003; Christensen & Raynor, 2003b; Gilbert, 2006).

Some factors regarding innovation strategy were particularly discussed. For instance, McElheran (2015) emphasized the vital role of the customers in a disruptive market situation, which was specified in later research (Gans, 2016). More precisely, he distinguished between leading incumbents' focus on either the demand or the supply side of the market. In this context, one nascent explanation for why incumbents often missed new emerging technologies, pointed at a passive posture of the companies' managers who were solely driven by market-demand. Guo et al. (2019) argued that cognitive inertia and a lack of knowledge in innovation prevented these managers from paying attention to future competition. In contrast, Ben-Slimane, Diridollou and Hamadache (2020) discovered that an active resistance towards early innovations could also be at the bottom of incumbents' failure to prepare for disruption.

Another literature branch focused on examining the disruption trajectory in more detail. Christensen et al. (1998) discussed the probability for new entrants to develop into the dominant design. More recent studies extended the definition with further classifications. For instance, Markides (2006) distinguished between three types of disruption: technological, business model (BM), and product innovation. Moreover, literature primarily studied the perspective of

established firms, whereas the entrants' viewpoint was largely disregarded. For instance, instead of exploring radical innovations from a start-up's viewpoint, the practice of corporate venturing was discussed (Raynor, 2011). This can be attributed to the disruption's relativity, meaning that one innovation can be perceived as disruptive by a company and as sustaining by another depending on their position in an industry (Christensen et al., 2018). Therefore, the incumbent trajectory in the framework typically serves as a reference point in the discussion.

In addition to the rather one-sided perspective on incumbents, other critics have continuously tested the model from new angles. Sood and Tellis (2011) mainly highlighted the model's limitations due to its focus on low-market disruption, even after Christensen and Raynor (2003b) had introduced the revised version. More specifically, they argued that in practice, affordability was less critical for innovations to be disruptive than had been assumed initially. Further, they supported Lant, Milliken and Batra (1992) in describing how some incumbents took on the role of disruptors, by deploying and leveraging their accumulated knowledge, network skills, and financial assets to create new technological trajectories. In fact, low-market disruption originated from incumbents at a similarly low frequency as from new entrants. In comparison, disruptive innovations by established firms represented a larger challenge to the competitors due to the amount of resources and networks at their disposal (Sood & Tellis, 2011). Nonetheless, they acknowledged that disruptive innovations with higher accessibility and affordability than previous technologies were particularly threatening to the respective markets.

Meanwhile, alternative approaches to solving the innovator's dilemma (Christensen & Raynor, 2003b) have emerged. Especially, establishing an autonomous business unit to be more dynamic through ambidexterity, enabled organizations to continue exploiting their core business while also exploring new opportunities (Gilbert, Eyring & Foster, 2012; Kim & Sungwook Min, 2015; O'Reilly & Tushman, 2008). Nevertheless, Christensen et al. (2018) pointed out that even the purposeful resource allocation towards building disruptive capabilities remained a challenge during implementation. Amid the increasing complexity, the model was further supplemented. For instance, 'Creative Accumulation' described incumbents' innovative capacity as competition intensifies (Bergek et al., 2013). Furthermore, the scenario of a new entrant and an incumbent collaborating was presented as a promising strategy to enhance innovativeness (Marx, Gans & Hsu, 2014), while the influence of external allies in order to overcome inertia was emphasized (Kapoor & Klueter, 2015).

Additionally, research addressed companies' ecosystems, the combination of their internal and external environment, as an impactful factor on corporate innovation. For instance, Adner (2002) argued that with advances in product performance, the overlaps across various market segments multiplied. Adner and Kapoor (2016) further elaborated on interdependencies of different components and parties within an ecosystem to highlight the complexity of market developments over time. They identified this interconnection as critical for disruption to occur in the first place. More recently, research on the external environment of organizations as a critical moderator for early-stage disruptive innovation has gained popularity (Ben-Slimane, Diridollou & Hamadache, 2020; Guo et al., 2019).

2.1.3 Influencing Factors towards DC

Overall, some research branches within under disruption theory have received little scholarly attention so far, in contrast to mature fields such as incumbent trajectories. In order to refine the established model around disruption and enhance its practicality, Christensen himself called for additional research in the field (Christensen, 2006; Christensen et al., 2018).

Christensen et al. (2018) identified three main shortcomings in existing literature that were central for enriching the model in future research. First, they mentioned the lack of attention on response strategies and suggested identifying several alternatives with an emphasis on 'hybrid responses' to combine emerging innovation features with existing offerings. Second, different metrics and measurements that can enable disruption were identified as future topics. Finally, possible variations within the process of disruption, especially regarding performance trajectories, could be further elaborated on. Thus, "where and how rapidly disruption occurs" (Christensen et al., 2018, p.1065) was deemed a relevant question going forward to better understand the time horizon between discontinuities and innovation cycles.

Guo et al. (2019) addressed the latter two shortcomings in their qualitative case study to derive a measurement model for evaluating the disruptiveness of innovations. Therefore, they identified three distinct categories with underlying influencing factors towards the degree of disruptive potential: 'Technological Features', 'Marketplace Dynamics', and 'External Environment'. To enhance the understanding of the connection between DC and OI practices, the model by Guo et al. (2019) served as a foundation for one side of the preliminary framework, presented in section 2.3 Preliminary Theoretical Framework. The three categories and the subordinate indicators for disruption were discussed in the following and adjusted according to the research purpose.

Technological Features

By attributing five out of ten indicators to ‘Technological Features’, Guo et al. (2019) introduced this category as key for evaluating disruptiveness. First, ‘Integration’ referred to the degree at which a technology is merged with existing concepts to create a higher innovational deed, thus enhancing market acceptance. Second, ‘Leadership’ described “the possibility of fostering related markets” (Guo et al., 2019, p.254) and the potential of integrating related technologies. For simplicity, we therefore renamed this indicator to ‘Technological Potential’. The third indicator, ‘Maturity’, measured the timing of an innovation’s market introduction and related technologies’ status and readiness that are relevant for successful commercialization. Further, ‘Diffusivity’ implied the pace at which an innovation can be spread across its target audience after market entry. Due to the current pre-market phase within most parts of the emerging alt food industry, we disregarded this indicator to minimize speculations around DC. Finally, ‘Simplification’ described an innovation’s functionality and ease-of-use compared to former, substituted technologies, which eventually improves customer acceptance. As Guo et al. (2019) attributed a minimal impact on disruptiveness to this factor, it was excepted from this study’s framework.

Marketplace Dynamics

‘Marketplace Dynamics’ comprised further three indicators for assessing innovations’ disruptiveness (Guo et al., 2019). ‘Niche Market’ indicated whether a novel technology is introduced to an unsatisfied market, thus creating the need for new innovations from the demand-side to seize disruptive potential. Further, ‘Value Network’ addressed the ability to create value through the innovation ecosystem, including stakeholders and their collaborative realization of profitability. Lastly, ‘Cost Reduction’ implied the ability to drastically decrease cost and thereby enable affordability of an innovation (Guo et al., 2019). Christensen (1997) described how cost reduction throughout the product life cycle allowed for low-end market entry to increase an innovation’s accessibility early on. Even though this indicator contradicted specific requirements for new market disruption, we incorporated it for the relevance to the original model (Christensen, 1997) and since regardless of the type of disruption, lower retail prices typically enhanced disruptiveness (Sood & Tellis, 2011).

External Environment

The final category identified by Guo et al. (2019), 'External Environment', described external conditions beyond a firm's direct ambit by the use of two indicators. First, 'Policy' referred to both positive and negative effects of regulations on the development and introduction of an innovation. Second, 'Macroeconomics' assessed the influence of macroeconomic factors; such as economic growth, unemployment rate, and educational standard; on an innovation's R&D and adoption (Guo et al., 2019). For a clear distinction between the two indicators' scope, we renamed the indicator to 'Economic Prosperity'. In response to critique towards the model, highlighting the neglection of social aspects as influencing factors on the degree of disruptiveness (Ben-Slimane, Diridollou & Hamadache, 2020), the preliminary framework of this study was supplemented with the indicator 'Social Legitimacy'. Thus, a cultural and cognitive dimension for social acceptance was considered as part of environmental factors.

Figure 3 illustrates the first part of the preliminary framework addressing disruption theory.

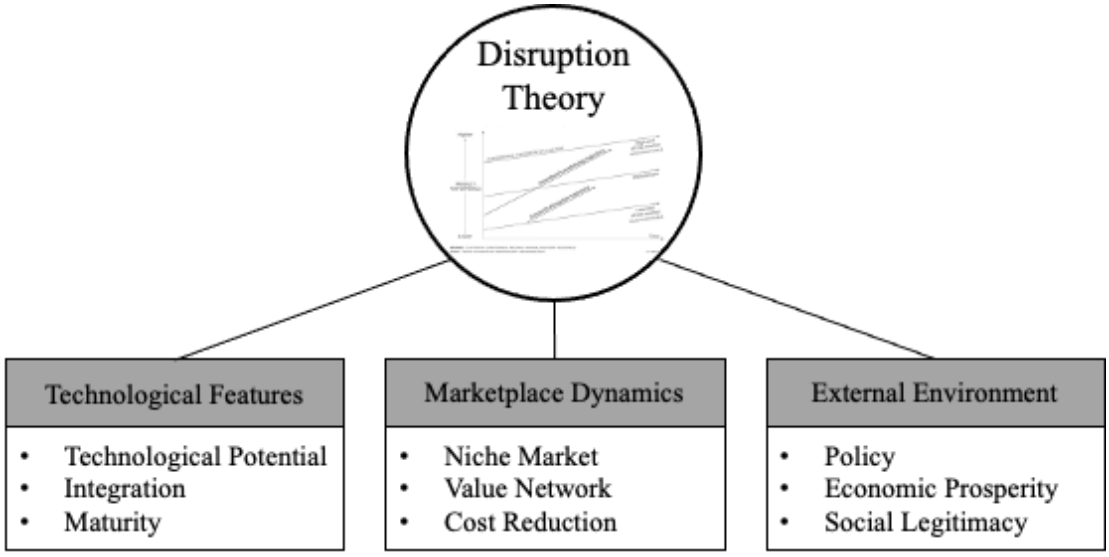

Figure 3: Influencing Factors towards Disruptiveness

2.2 Open Innovation Theory

Amid the fast-changing environment and accelerating complexity within today's business world, developing a deeper understanding of the principles of innovation has become increasingly relevant. Consequently, the attention to the research field of OI surged at a similar rate to that of disruptive innovation (Dahlander, Gann & Wallin, 2021; Felin & Zenger, 2014). Corporate innovativeness is driven by absorptive capacity and a firm's large knowledge base at its disposal (Su et al., 2013). Accordingly, exclusively managing innovation within the corporate boundaries holds several disadvantages, which gave rise to the influence of OI practices on a firm's innovative drive as a critical field of future research (Chesbrough, 2003; Dahlander & Gann, 2010).

2.2.1 Fundamentals of OI Theory

The concept behind the widely used term 'open innovation' was originally coined by Henry Chesbrough (2003) in his book, *Open Innovation – The New imperative for creating and Profiting from Technology*, with which he gained broad recognition among academics in innovation management. He described the shift of the innovation paradigm by the means of practical examples from the IT and computer component industry; particularly, examining his former employer Xerox. With his research, Chesbrough (2003) introduced a new approach to corporate innovation management that opened up a firm's innovation process to a firm's external environment. This represented a drastic shift from the previously prevalent concept of closed innovation where a company relied on the 'virtuous circle'; the return of investment in the form of technological breakthroughs observed within different markets that in turn resulted in liquidity for re-investing in R&D (Chesbrough, 2003).

> Open innovation means that valuable ideas can come from inside or outside the company and can go to market from inside or outside the company as well. This approach places external ideas and external paths to market on the same level of importance as that reserved for internal ideas and paths to market during the Closed Innovation era (Chesbrough, 2003, p.43).

Consequently, OI created a different knowledge landscape, in which operating sources and idea flows followed a new logic contrary to former knowledge monopolies of the centralized R&D silos (Chesbrough, 2003). R&D departments still took on a critical role in creating internal innovations; however, a restructuring was vital to access the knowledge that was spread out

across several stakeholders to exploit the various possible paths to market. With OI, Chesbrough (2003) suggested an R&D strategy that combined externally and internally accumulated knowledge to derive innovative ideas. Consequently, the approach to managing intellectual property (IP) shifted from excluding stakeholders from utilizing intra-organizational technologies through to publicly disclosing internal IP and processes, so that direct rivals could leverage the insights. This in turn, enhanced a firm's own BM and innovative drive due to enriched technological prowess in response to knowledge exchange. Moreover, established firms could better explore opportunities through collaboration with larger and smaller players, including promising start-ups. Furthermore, depending on a firm's particular BM, specific parts of the value chain could either be created internally through R&D activities or be linked to the network to provide additional value to the customers. Generally, Chesbrough (2003) distinguished between two overarching OI strategies: inside-out (outbound) and outside-in (inbound). In other words, the flow of knowledge from a source external to a firm inwards and vice versa. He suggested implementing either one approach depending on an organization's strategic intent (Chesbrough, 2003).

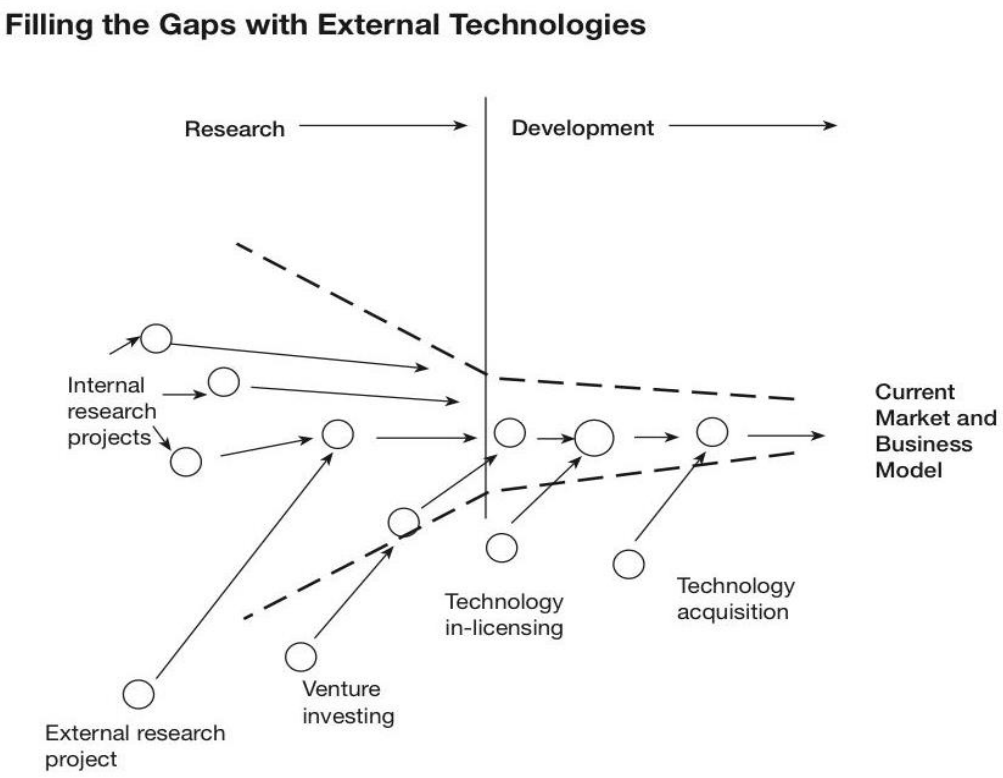

Figure 4: Outside-in OI Strategy (Chesbrough, 2003, p.44)

Chesbrough (2003) identified several mechanisms to realize a company's BM, such as licensing or IP protection to some extent. For a firm to focus on and advance the current business, an innovation roadmap should be created to display the current gaps within a firm's R&D portfolio and thus, show where inbound innovation may be effective. Figure 4 illustrates the utilization of external knowledge to improve the existing business, thus visualizing the most valuable points of application for external ideas, which correspond to the BM's blind spots. The funnel implies chronology from left to right; hence, the more left, the less mature an innovation's development, and the more uncertain the requirements and projected success of that innovation. In this context, Chesbrough (2003) emphasized the so-called 'not-invented-here' (NIH) effect, which entails integrating R&D managers in future-relevant decisions to minimize internal resistance. Accordingly, evaluating the alternative strategies in terms of timing, risks, benefits, and appropriability with regard to a specific BM was critical (Chesbrough, 2003).

The innovation funnel in Figure 5 represents the value creation through the expansion of a firm's current business by the use of external knowledge. According to Chesbrough (2003), this alternative was considered more risky, as the majority of these innovations tend to fail. However, at a point when the original business reached its limits, initiating innovation processes through make-or-buy decisions may be inevitable for the continued existence of a company. In either case, continuous corporate growth was vital for value creation. Moreover, the external knowledge landscape represented a critical resource for realizing new business opportunities. For instance, new start-ups with visionary aims for challenging an industry were deemed particularly promising, as they remained largely disregarded in the initial innovation roadmap and thus, held tremendous potential for unexpected disruption. Additional resources for value creation included learning from ventures to identify market potential, and building an innovation project in-house with internal R&D (Chesbrough, 2003).

Nonetheless, 'outside' commercialization can still be valuable when R&D could not be funded internally. However, introducing a product or service to market through alternative paths, such as alliances, spin-offs, or licenses held a counterparty risk; the so-called 'not-sold-here' (NSH) problem, which implies the loss of control, the fear of exploitative competitors stealing the technology, and lacking direct revenue streams. Nonetheless, Chesbrough (2003) argued that instead of shelving a technology, sharing the knowledge with external parties may indeed be advantageous for a firm's innovative drive. For instance, Schiller (2017) described how public disclosure of a critical innovation prior to competing technologies' maturity, can aid developing into the new dominant design and create a winner-take-all market situation with strong first-

mover advantages. Generally, these strategies can enhance the overall timing and velocity of commercial launches and finally create sustained competitive advantage, as the ability to quickly adapt to changes, may lead to outperforming the competition (Barney, 1991).

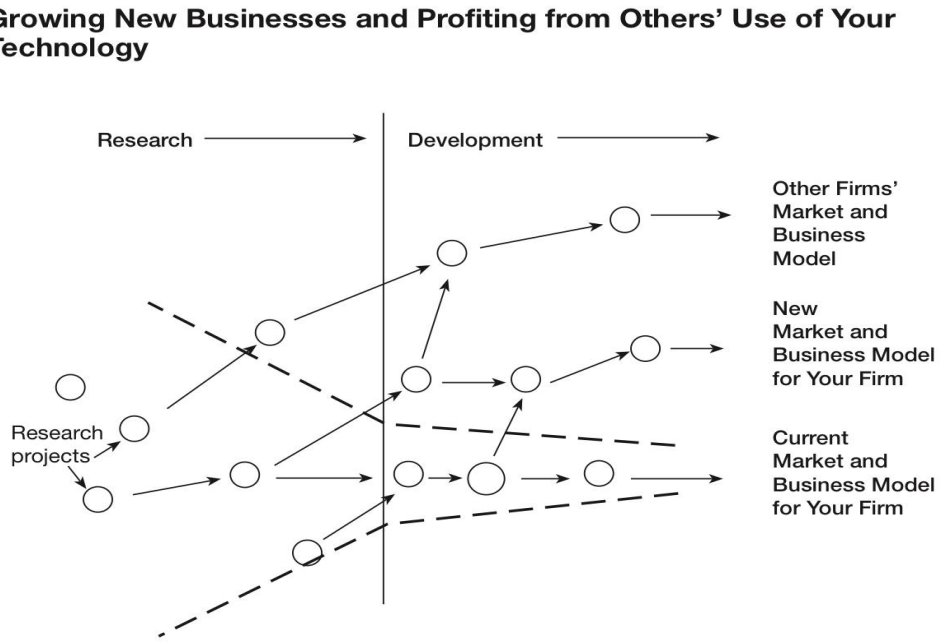

Figure 5: Inside-out OI Strategy (Chesbrough, 2003, p.44)

Later, Chesbrough and Bogers (2014, p.4) argued that "open innovation ought to be conceptualized as a distributed innovation process that involves purposively managed knowledge flows across organizational boundaries". This more recent definition was based on the addition to the initially two key types of OI to then include the outside-in, inside-out, as well as a coupled approach to enhance structure and consistency in future research. These different approaches were discussed in the following section for a more profound overview.

2.2.2 Evolution of OI Theory

Due to its subjectivity, the term 'open' was further classified for clarity in this study. The original distinction between inbound and outbound knowledge flows (Chesbrough, 2003), as touched upon before, was referenced back to in subsequent studies (Gassmann & Enkel, 2006). Further, Helfat (2006) expanded the common meaning with the dimension of money as exchange to differentiate between pecuniary and non-pecuniary interactions, thus deriving four categories for OI. She described the inbound processes with non-pecuniary (sourcing) and pecuniary (acquiring) attributes, as well as the outbound processes with non-pecuniary (revealing) and pecuniary (selling) characteristics to further present both benefits and

drawbacks related to each category. Fundamentally, the strategies including monetary exchange were accompanied by direct financial rewards as an advantage, whereas the non-pecuniary ones showed indirect benefits regarding capabilities, partnerships, and other long-term intents that were less tangible and more difficult to capture (Helfat, 2006). Moreover, Chesbrough and Bogers (2014) indicated the possibility for firms to simultaneously apply several practices by introducing the concept of 'Coupled Open Innovation', which was presented in Appendix B. Yet, this study put an emphasis on selective revealing strategies for its expected value-adding potential, while also considering other types of OI. Further, this method was among the most controversial categories under OI due to the associated risks of imitation by competitors and the possible loss of profit (Alexy, George & Salter, 2013; Lichtenthaler, 2011).

While some theories, such as Barney's (1991) well-established resource-based-view (RBV), call for knowledge concealing, other scholars emphasized the potential benefits of revealing knowledge (Alexy, George & Salter, 2013; Hallberg & Brattström, 2019; Henkel, 2006). For instance, Henkel (2006) recommended the use of selective revealing regarding internal technologies as a strategy for future collaborations without stringent legal bonds. Further, Alexy, George, and Salter (2013) described both direct and indirect benefits as a result of knowledge revealing with spillovers across companies. For instance, encouraging collaborations in new ways represented a direct advantage. They argued that traditional modes, such as contractual arrangements, created limiting conditions in terms of innovativeness and creativity with additional benefits that increased the overall knowledge base within a firm as a positive side effect. The scholars suggested when searching for new partners implied high costs, there would be a limited willingness for collaboration. Selective revealing could thus, improve a firm's innovativeness over time if compatibility among involved parties and the focal firm's absorptive capacity were given.

Finally, Alexy, George, and Salter (2013) classified selective revealing into four archetypes based on their mode of revealing, problem or solution related, and their objective behind OI, path extension or creation. This resulted in a matrix model with four categories; issue spreading, agenda shaping, product enhancing, and niche creating; which can be reviewed in Appendix B. One common example of a product enhancing archetype is open source software, indicating the combination of path extension and solution revealing. In response for the frequent confusion regarding OI and its relation to open source (Alexy, George & Salter, 2013; Felin & Zenger, 2014), it is critical to define open source as a form or subfield of OI in this study.

2.2.3 Influencing Factors towards OI

To understand the cause of connection between OI practices and DC, we derived additional influencing factors from the research on OI to be included in the preliminary framework. This should create a balance in the contribution of both fields for depicting their connection from both perspectives. Several sources were contrasted and merged into the following categories of relevant criteria, as presented in Figure 6.

Strategic Knowledge Exchange

We created this category with two underlying influencing factors to describe a firm's approach to OI in terms of intent and execution. In reference to Alexy, George, and Salter (2013), who detailed the strategic context regarding knowledge exchange by identifying four different types of selective revealing based on 'Objective' and 'Mode of Revealing', we implemented the indicator 'Revealing Strategy' as a combination of both factors. In addition, Felin and Zenger (2014) introduced the 'Governance Form' for OI practices to describe the most suitable type of partnerships for knowledge exchange depending on the degree of hidden knowledge and problem complexity. They analyzed this factor considering community channels, incentive systems, as well as the landscape around property rights to derive a comparative framework for the selection of effective governance forms. When a problem implied high levels of hidden knowledge, an open problem-solving approach was recommended, as opposed to centralizing the search when there was less hidden knowledge involved. Moreover, the more complex a problem, the more theory-guided the search should be to leverage directional trial-and-error approaches for simpler challenges (Felin & Zenger, 2014). For taking a narrow, micro-analytical perspective and incorporating only a selection of governance forms, their framework shows limitations. Yet, for a well-rounded representation of influencing factors on successful OI implementation, we integrated this indicator and renamed it to 'Type of Partnership' for simplicity.

Internal Drivers

In addition to indicators around Strategic Knowledge Exchange, a firm's OI strategy is also influenced by 'Internal Drivers', which were derived from the systematic literature review of 156 papers by Subtil de Oliveira, Echevester, and Cortimiglia (2018). Therein, they identified six themes: 'Leadership', 'Internal Innovation Capability', Network and Relationships', 'Strategy', 'Technology Management', and 'Culture'. For simplicity, we merged 'Leadership' and 'Culture' into 'Enabling People' for this study's preliminary framework. Similarly,

‘Internal Innovation Capability’ and ‘Technology Management’ were combined into ‘Innovation Capacity’. ‘Strategy’ was disregarded here, due to the previous category addressing strategic OI in detail. Finally, ‘Network and Relationships’ was kept as is to reflect a firm’s relationships to industry, governmental bodies, customers, and research institutions.

External Drivers

Lastly, ‘External Drivers’ behind a firm’s engagement in OI activities were based on a model by Hallberg and Brattström (2019), which explored the effect of knowledge revealing on the value, price, and cost of an innovation. They introduced a model demonstrating four conditions that could positively impact these aspects: ‘Indirect Network Effects’ (Value), ‘Competitive Intensity’ (Price), ‘Isolating Mechanism’ (Price), and ‘Technological Uncertainty’ (Cost). The study suggested that knowledge revealing generally led to value creation, especially in industries with significant indirect network effects, but could also decrease a firm’s profitability by “induc[ing] imitation, less differentiation, and downward price pressure” (Hallberg & Brattström, 2019, p.172). These drawbacks were accelerated within highly competitive markets with few isolating mechanisms in place. Moreover, they argue that under high technological uncertainty, knowledge revealing represented a cost-efficient method to extend the internal knowledge base (Hallberg & Brattström, 2019). While the study was limited due to the firm-level perspective and an exclusive focus on the financial effects of knowledge revealing, we incorporated the discussed indicators in the preliminary framework, as enhanced profitability could be directly linked to DC; especially, through cost reduction. To simplify, we merged ‘Competitive Intensity’ and ‘Isolating Mechanism’ into ‘Isolating Mechanism’ only for both addressing the effect on price.

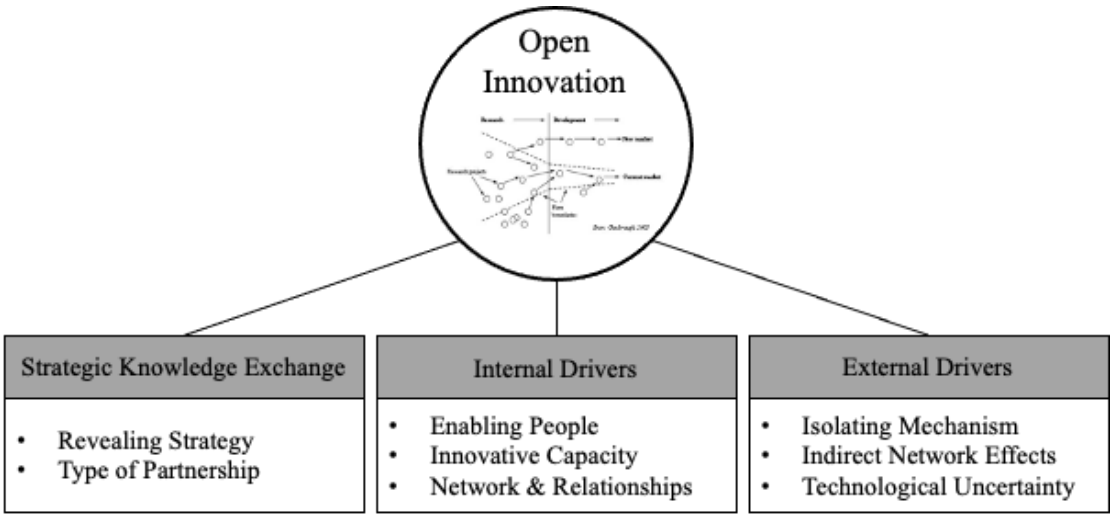

Figure 6: Influencing Factors towards OI

2.3 Preliminary Theoretical Framework

To serve the study's purpose and illustrate the connection between OI and DC, the previous content from both theories in the literature review was synthesized into a preliminary framework.

On the one hand, disruptive innovations as defined throughout this project, incorporated the potential of changing established market dynamics by being more convenient, accessible, and affordable to customers and thereby challenging existing industry players (Christensen & Raynor, 2003b). Accordingly, disruption described an observable outcome that occurred after launching a new technology, product, or service in the market. OI, on the other hand, referred to the approach of implementing a certain type of innovation strategy for knowledge transfer beyond organizational boundaries throughout the continued R&D phase (Chesbrough, 2003). Hence, from an innovation life cycle perspective, to realize a firm's strategic intent and boost innovation capabilities, OI is a potential antecedent for enabling disruptiveness. Correspondingly, a causal relationship between OI techniques and a firm's disruptive potential can be assumed. While both theories had derived from innovation management research and addressed competitiveness, and despite the seemingly logical chronological connection, existing literature missed to provide a framework connecting the two research domains. In response, the potential key success categories (KSC) behind both the degree of openness and DC were derived from research and integrated into the preliminary framework of this study. Figure 7 illustrates the presumed chronological order from implementing OI practices to enhancing a firm's DC with a rightwards arrow, and lists the six KSCs in the center, oriented towards their origin in literature.

This tentative framework was designed to be tested for accuracy and applicability. Accordingly, changes based on empirical data and newly gained insights therefrom could be implemented in section 5.1. The Final Framework: Open-Approach Disruption (OAD) In order to validate the derived KSCs, the preliminary framework was operationalized into interview questions for the process of primary data collection, and to further deduct themes from the empirical data in accordance with the research purpose. These served as a benchmark against which the model was contrasted and altered dynamically. The interview guide was more thoroughly discussed in section 3.3 Data Collection Method and can be reviewed in Appendix E.

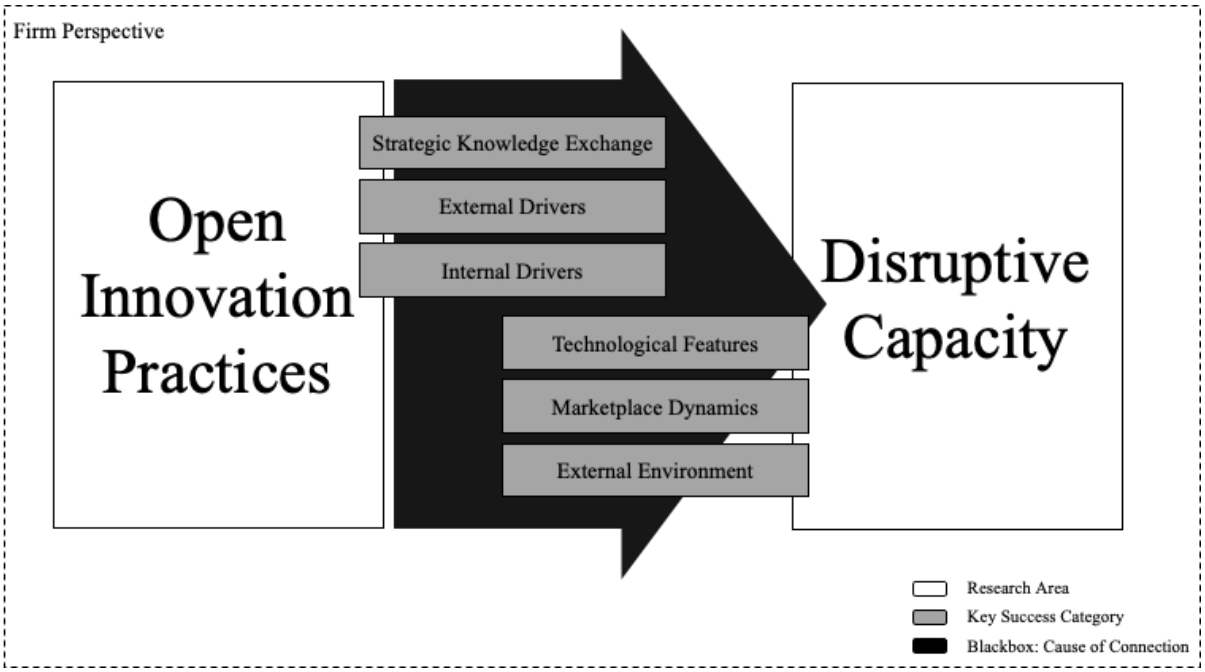

Figure 7: Preliminary Theoretical Framework

3 Methodology

The applied method for conducting this research to fulfill its purpose of exploring the cause of connection between OI practices and DC was reasoned in this section. Therefore, the strengths and weaknesses of the selected research approach and design were discussed addressing the qualitative research, theoretical study, empirical case study, and the role of the researchers. Thereafter, the case selection was described by reference to the industry, companies, and firm representatives. Afterwards, the data collection method was illuminated and broken down into data sources, interviews, and documentation and followed by presenting the process of data analysis for deriving valuable findings from the empirical study. To conclude, the study's quality regarding methodological limitations, issues of validity and reliability, as well as ethical considerations were addressed.

3.1 Research Approach and Design

According to Yin (2011), research design describes a 'logical blueprint' indicating how data is collected, analyzed, and interpreted, as well as how a study is structured to improve its validity. For a coherent and comprehensive thesis, the research purpose, problematization, and methodology need to be aligned and interconnected (Richards & Morse, 2013), wherefore this study qualitatively explored the preliminary framework with the aid of different cases in the alt food industry.

Qualitative Research

Over the last few decades, qualitative research has experienced increasing scholarly attention and was leveraged in studies across various disciplines (Flick, 2018). While quantitative projects allow for well-informed findings about cause-and-effect relationships among specific, pre-defined variables (Creswell & Creswell, 2018), qualitative research with the overall aim of exploring a particular phenomenon by comparing, contrasting, and categorizing the research object is particularly intriguing in newer fields where such variables might not yet be familiar to the researchers (Miles & Huberman, 1994). Thus, qualitative studies represent a highly investigative approach with the intent to understand a specific situation, event, or interaction. They consider the various possible interpretations of reality depending on context and individual perspective to derive, reject, or enhance theory (Yin, 2011). Although quantitative studies allow for statistical generalization, the procedure demands for a considerable amount of potential participants due to the large number of required data sets (Creswell & Creswell, 2018).

In emerging research fields, such as innovative industries with rather few firms, conducting quantitative studies is less feasible in practice as opposed to following a qualitative approach.

Amid this project's research aim, it stands to reason why a qualitative approach was selected. While quantitative studies offer some advantages, the method neither suited the study's purpose nor its time frame or when considering the small number of existing companies within the alt protein industry that could have served as a sample size. Thus, to match the exploratory nature of this project and gain an in-depth understanding of the participants' innovation practices, as well as their perception of the cause of connection between OI activities and DC, a qualitative research approach was chosen for the theoretical and the empirical part of this study.

Theoretical Study

The theoretical study was based on the idea that a research problem should be put into theoretical context for contributing to the respective research field by building on the identified gaps therein (Creswell & Creswell, 2018). Accordingly, this study attempted to combine two distinct research branches, OI and disruption theory. Moreover, scholars suggested collecting additional data that supported new findings around established theoretical frameworks and thus allowed for their extension or limitation to particular contexts (Creswell & Creswell, 2018). Further, Yin (2011) highlighted the importance of connecting the defined research objectives with the empirical data that was collected throughout a project. As discussed in the literature review, this study was built around the established model of disruption and technological trajectories as popularized by Christensen (1997) and complemented by Christensen and Raynor (2003b), and was brought into the context of OI theory as introduced by Chesbrough (2003). The theoretical study provided a thorough overview of both fields to ensure a common understanding of the definitions used throughout this project. Due to the lack of reliable information on the synthesis of both theories, the research objectives were phrased exploratorily to avoid devaluating unexpected learnings that might emerge during the empirical study.

By deriving a preliminary framework deductively from the existing body of literature on OI and disruption theory, and by adjusting this initial model according to the gained insights from the empirical research inductively, this study followed an abductive research design; meaning, the combination of a deductive and inductive approach to reduce the disadvantages of both (Creswell & Creswell, 2018). For instance, the empirical study valorized the previously derived theoretical model by enabling a more dynamic development based on the emerging data requirements.

Empirical Case Study

Within empirical research, case studies served to explore different processes, activities, events, or interconnections to better understand the research problem or a particular phenomenon (Creswell & Creswell, 2018). The empirical study thus applied the design of a qualitative multiple case study in order to fulfill the objectives of this project. According to Yin (2011), this method was especially helpful to analyze situations with a variety of contextual factors that can affect the findings depending on individual viewpoints. Thus, a strength of case studies lies in their idiographic richness; their ability to capture more complex contexts and interrelations than quantitative research can (Larsson, 1993). As illustrated in Figure 7, the preliminary model entails six KSCs with underlying influencing factors for both disruptive and open innovation, therefore, implying high complexity and interconnectedness of the research topic. Hence, the study required more attention to details than quantitative surveys could offer (Wikfeldt, 2016). The case study approach thus enabled a more thorough exploration of the participants' perspectives.

Further, while conducting quantitative studies in an attempt to prove particular hypotheses enables statistical generalization, the idea behind qualitative research is rather to create new hypotheses for scarcely researched phenomena (Wikfeldt, 2016). Qualitative case studies allow for analytical generalization; that is, when generalizing from cases, the researchers' findings can support or reject the preliminary framework, or lead to the construction of new theoretical models (Yin, 2013). Consequently, the strength of qualitative case studies lies in their descriptive accuracy (Wikfeldt, 2016). Nonetheless, cross-sectional analysis and contrasting of the different cases to identify patterns can enhance a multiple case study's generalizability to some extent (Larsson, 1993). Therefore, the design was selected for this thesis to better understand innovation strategy and more specifically, the position towards OI practices and DC at different firms within the alt protein industry to derive a realistic model. Moreover, the selected companies deserved a more thorough investigation by leveraging multiple sources of evidence to depict their strategic intent. Qualitative research offers a broad range of predominantly descriptive data sources for the scholars to review and convert into meaningful findings (Yin, 2011).

Role of the Researchers

In qualitative studies, the researchers take on a central role in collecting, analyzing, and interpreting the mainly descriptive data (Creswell & Creswell, 2018). Due to the required direct interaction for data collection and interpretation, the direction of a study is highly impacted by the researchers' preferences, values, and personal backgrounds. Consequently, their critical role creates biases when conducting qualitative studies due to subjectivism (Flick, 2018) and therefore, requires reporting about reflexivity in order to attenuate related concerns as far as possible (Creswell & Creswell, 2018; Yin, 2011). To provide transparency for the reader, the background of the researchers as this study's primary instrument was further elaborated on.

Our perceptions of innovation management derived from extensive university courses, additional self-study, and from practical experience working in agile, diverse teams. This resembled the fast-paced work environment within the start-ups that we selected as participants for this study. While one of us had a professional background within corporate innovation; especially, around the practical use of theories by Clayton M. Christensen; the other one was experienced in business communication with C-level executives within different R&D-prone industries. We believe that this enhanced our ability to communicate clearly with our interviewees and to comprehend their strategies, as well as their companies' challenges. Although, we conducted extensive self-study on the alt protein industry, this project's predominant focus was on influencing factors from a business perspective rather than a technological one, due to our educational backgrounds in economics and management.

We attempted to ensure objectivity throughout the interviews, analysis, and interpretation of the collected data; nonetheless, our backgrounds may represent a certain bias in the way we evaluated, understood, and finally presented the data in written form. Despite the central role of researchers, the strength of qualitative interviews to most notably explore the perspectives, opinions, and experiences of the participants, prevailed (Creswell & Creswell, 2018; Merriam, 2002).

3.2 Case Selection

To receive meaningful insights from the process of data collection, this study's participants were selected based on factors derived from the theoretical problematization. According to Larsson (1993), case selection criteria should in fact emerge from the theoretical research field of a study in order to be relevant for the construction of the related framework and serve the research purpose. In this multiple case study, a set of four companies was chosen for a more thorough investigation by the means of exploratory interviews with representatives, as well as by leveraging secondary qualitative sources on the selected firms, their business environments, as well as other players within the alt food industry. For further validating the findings, representatives of two additional companies were interviewed through video conferencing or email, though these firms were only investigated superficially. The selection of participants as the units of analysis for this project consisted of three layers of consideration:

1) the industry, 2) the companies, and 3) the firm representatives as interviewees.

Industry

This thesis pursued the goal of exploring innovation strategies in a highly competitive market environment to spot links between OI and DC on a firm level. Thus, a specific industry, with an initial market situation where future disruptive innovations can emerge and with the desire to engage in OI practices was required to examine the topic empirically. Against this background, the emerging branch of alt protein within the well-established food sector was investigated. The continuously rising environmental pressure and the increasing protein demand as a result of the rapidly growing population, created a peculiar position for the alternative field with tremendous innovational potential (Crosser, 2019).

In 2013, the company Mosa Meat represented by Chief Scientific Officer, Prof. Mark Post, provided the proof of concept for cultured meat with a public tasting of slaughter-free hamburgers on live television. Amid their demonstration, the initially high cost per patty of approximately €250,000 at the time (Rischer, Szilvay & Oksman-Caldentey, 2020) had painted the commercial introduction of cultivated products in the far future. However, due to increasing investments and technological advancements, the first successful product launch occurred in December 2020 in Singapore at initially $50 for Eat Just's cultivated chicken nuggets (Vavitsas, 2020), the first case with regulatory approval for commercial sales (Zaringhalam, 2021).

Meanwhile, there are 51 companies exclusively dedicated to fermented food products (Crosser, 2020) with over 70 start-ups in the cultivated space (Byrne, 2020; Rischer, Szilvay & Oksman-Caldentey, 2020). Simultaneously, the interest in alt food from sides of investors, NPOs, educational and R&D institutions, as well as from governmental bodies has grown (Byrne, 2020; Crosser, 2020; EIT Food, 2021). In 2020, the total investments in the cultivated meat industry increased sixfold from $60 million to $366 million, while those in fermentation nearly doubled to $587 million (Byrne, 2020). The growing popularity indicates the likeliness of soon expected product launches that may be accompanied by the conventional food sector's disruption. Accordingly, the timing for market entry of different innovations is among the strategic priorities (Bashi et al., 2019). More specifically, multiple scholars described key challenges and drivers behind rapid innovation, including legislative frameworks and funding, as omnipresent at this stage of maturity (Rischer, Szilvay & Oksman-Caldentey, 2020; Zaringhalam, 2021). Such aspects could thus affect the selection of particular OI strategies and the vision behind innovations. Hence, conducting exploratory interviews with representatives of such companies solidly matched the purpose of this study.

Due to the industry's recent emergence, a brief overview of the most central terminologies was provided below for clarification, with more detailed information in Appendix C. The Good Food Institute (GFI) (2021), an NPO with the mission to accelerate "the transition of the global food system to alternative proteins" (Crosser, 2019, p.43), distinguished three subcategories of food products based on technology and ingredients.

a. **Plant-based** refers to products that consist of a mixture of plant ingredients to substitute animal-based food and dairy products (GFI, 2021).
b. **Fermentation** describes a process that was originally derived from food conservation and the production of alcoholic beverages, but here, refers to cultivating microbial organisms to process plant-derived ingredients and finally mimic animal products or enhance flavor profiles (Specht & Crosser, 2019).
c. **Cultivated** implies the process of culturing animal cells outside of an animal to produce genetically and nutritionally identical meat or seafood products without slaughter. It also referred to as cultured, clean, cellular, cell-cultured, or cell-based meat. Since 'lab-grown' does not sufficiently describe the conditions for cultivating products on a larger scale, the term was considered less appropriate. (Byrne, 2020)

Companies

The alt protein industry in itself represents an extreme branch within the food sector, while the selected cases therein ranged from unique to common for the alt food area regarding the technology and products when compared to direct competition. The selected cases leveraged either fermentation or cultivation processes to produce alt food products, thus, containing living or once lived cells, which is referred to as cellular agriculture (New Harvest, 2021). These two technologies follow the same vision of substituting traditional animal-derived products at large-scale, implying disruptive intent, but required tremendous R&D efforts for technological maturity and economic viability (Byrne, 2020; Crosser, 2020).

We investigated firms within both fields for enhanced applicability of the theoretical framework by contrasting the two perspectives to derive more realistic, and general insights. For the same purpose, we selected cases at slightly different stages in terms of number of employees, lifetime, and amount of investment, as well as with varying geographic locations. Nonetheless, to address the existing research gap, as discussed in section 1.2 Theoretical Background, this study's participants were start-ups or SMEs. The comparison was perceived as enriching to this study's findings for identifying possible differences per process, size, or lifetime, and for finally fulfilling the research purpose. A more thorough overview can be reviewed in section 4.1 Case Descriptions.

Firm Representatives

The selection of the individual interview partners was based on their areas of responsibility in accordance with the data requirements derived from the preliminary framework. To gain insights into innovation management and market entry strategy related to the R&D and the business side of the company, executive-level positions overseeing innovation were selected as participants. Hence, we interviewed CEOs, a Chief Innovation Officer (CIO), and Supply Chain and Manufacturing Manager.

3.3 Data Collection Method

For the process of data collection in qualitative studies, Creswell and Creswell (2018) identified three key elements to be discussed: establishing the project's boundaries through sampling and recruitment, setting up procedures for collecting the data, and creating a protocol for recording it. Therefore, the leveraged data sources throughout this project, the interview procedures, and those for documenting the gained information were presented.

Data Sources

Data should be collected from different types of sources for the subsequent analysis and discussion to derive valid findings from an empirical qualitative study, and to enhance a project's reliability (Creswell & Creswell, 2018). Generally, qualitative data sources can be divided into four categories; observations, interviews, documents, audiovisual or digital materials. Qualitative observations were deemed inappropriate for this project due to this study's limited timeframe of ten consecutive weeks in Spring 2021, as well as for reasons of feasibility regarding international travel. For instance, this method requires taking field notes when observing the participants in natural settings, thus the cases' globally spread out headquarters, and they occupy prolonged research times for enhanced descriptive accuracy (Creswell & Creswell, 2018). Therefore, we leveraged the remaining three types of data sources to enable a high standard of credibility and validity of gained insights.

Primarily, we conducted a small series of exploratory, semi-structured interviews in a virtual setting utilizing the online video conferencing tool provided by Zoom Video Communications. To explore the interviewees' experience with OI practices and disruptive innovation within their companies, this primary source of data collection was considered critical (Adams, 2015). The participants were contacted initially through connection requests with brief introductions on LinkedIn and recruited through further email communication.

These data sets were supplemented with public and private documents including official industry reports, organizational papers, and press releases, as well as relevant newspaper articles. Thereby, the utilized language could be adapted to the industry standards for minimizing the risk of miscommunication during the interviews and for enhancing the accessibility of the final report to the different target audiences. In consideration of time restraints of both the researchers and the individual participants, the option to answer the most critical interview questions via email was provided alternatively. Including recent secondary data sources was time-efficient and value-adding to the data collection through creating a more holistic understanding of the selected cases' business environments and contextual factors impacting their disruptive potential and utilization of OI practices. Nevertheless, potential risks such as varying levels of accuracy depending on the type of qualitative document were taken into consideration during data collection. (Creswell & Creswell, 2018)

Finally, this study utilized qualitative audiovisual and digital materials for a realistic depiction of the cases' innovation strategies, critical challenges, and drivers behind their chosen approach.

These sources included industry-related podcasts, recorded conferences, previous footage of interviews of company representatives, official websites, and social media contents of various players in the field, as well as email communication. While these qualitative data sources provided further and at parts more personal insights into the participants' experience towards our research topic, the level of sincerity of the information required special attention due to potential biases per source (Adams, 2015; Creswell & Creswell, 2018). For instance, these sources were rather used to validate and contrast primary data or official information, as opposed to the other way around.

Interviews

As the central part of the empirical study, the interviews were thoroughly discussed in this subsection. Regarding primary data collection, Adams (2015) distinguished statistical surveys, focus groups, and semi-structured interviews (SSIs) as approaches learn about people's opinion and gather information. Besides the previously discussed quantitative surveys with closed-ended questions, also focus groups were deemed inappropriate for this study. They refer to loosely structured sessions with small groups discussing a series of open-ended questions, thus enabling extensive elaboration on the individuals' opinions and experiences. Nonetheless, organizing focus groups is generally time-consuming and executing them virtually in response to current safety regulations, may create communication barriers during the meeting. Therefore, this study leveraged SSIs as a blend between the two alternatives. (Adams, 2015)

According to Adams (2015), SSIs describe meetings with usually one participant at a time in virtual, face-to-face, or phone settings. They typically include a mix between open-ended and closed-ended questions with the possibility of changing the order or include further probing to explore the participants' point of view thoroughly. SSIs usually last less than 60 minutes to ensure a high level of focus by both the participant and the interviewer (Adams, 2015; Harrell & Bradley, 2009), which also facilitates the recruitment process due to relatively short time commitments. Compared to focus groups, SSIs can ensure a similarly high level of exploration, while enhancing the sincerity of the participants' responses due to a more private setting, and possibly reducing the total time needed; depending on the sample size. However, SSIs demand for well-informed, sensitive interviewers in order to maintain a fluent conversation, which in turn can lead to a higher level of candor (Adams, 2015; Yin, 2011). Due to boundary conditions regarding time and location, as well as the variety of data sources, conducting a small series of

one-time, exploratory SSIs with one representative per case plus the opportunity for follow-up questions via email, was deemed most effective for the project's purpose.

After identifying and recruiting the potential interviewees based on the selection criteria described earlier, an interview guide with a total of 13 questions and additional comments for potential probing was created in preparation for the meetings. An interview guide refers to "the outline of planned topics, and questions to be addressed, [and] arrayed in their tentative order" (Adams, 2015, p.496), thus allowing for flexibly reacting to the participants' responses. To thoroughly comprehend the individual cases and to enable the direct, numerical comparison of the different companies' core innovation strategies, the SSIs leveraged open-ended and a small number of closed-ended questions. The initially 16 questions, which operationalized the preliminary framework, were tested in a pilot interview with an industry representative via phone. As a result, the guide was shortened for clarity and the order was adjusted for a smoother transition. In between the interviews, minor changes in phrasing were made to enhance comprehensiveness. To maintain an interested, non-judgmental tone and avoid evoking pressure to respond in a certain direction or according to societal expectations, language was a critical element for revision (Adams, 2015). Moreover, confidentiality was addressed at the meetings' opening and closing to minimize biases and concerns about sharing information. Figure 8 illustrates the interview guide's five key sections, with the full guide in Appendix E.

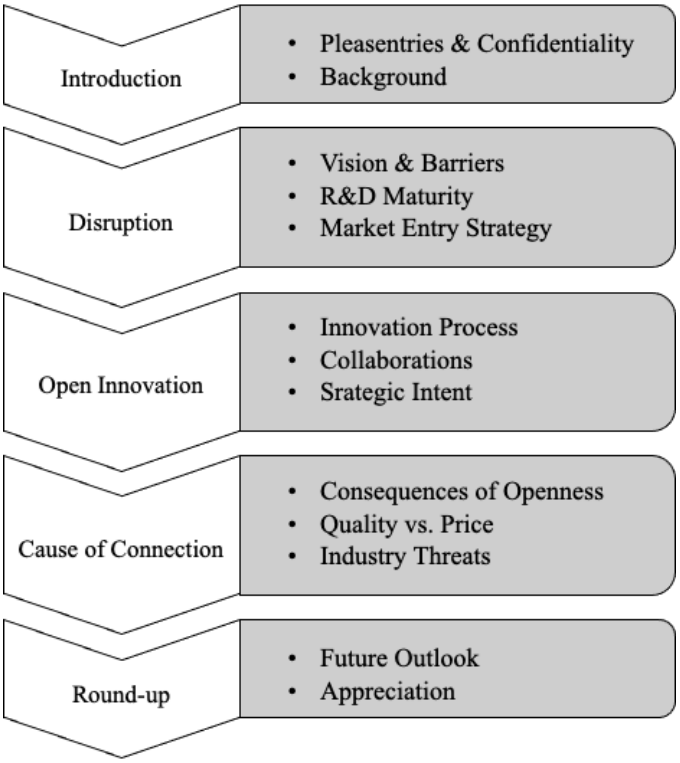

Figure 8: Interview Guide Sections

Documentation

As suggested by Adams (2015), the interview guide was used consistently throughout all interviews, even though minor changes were made to further improve the line of questioning. During the interviews, digital and handwritten protocols were utilized as guidance for the questions to be addressed, as well as to enable taking notes of the responses. Both researchers took on the respective roles of either the interviewer or note-taker during each interview for a dynamic conversation and detailed documentation of the participants' reactions, considering changes in tone, such as laughter or nervousness (Adams, 2015).

After having received the interviewees' permission at the beginning of each session, the meetings were audio-recorded and transcribed with the aid of the transcription tool Otter.ai. Even though, the confidentiality was ensured at the beginning of each interview according to the respondents' preferences, we were aware of potential biases as a result of audio-recording and considered these when interpreting the information.

The additional collection of qualitative data through public and private documents, as well as through audiovisual and digital materials represented a thorough preparation of both researchers for conducting the interviews and understanding the different companies, as well as their market environments. This enhanced the participants' level of trust during the interviews, which can alter the substance in their responses and lead to a more open conversation (Zaltman & Moorman, 1970). The different secondary data sources aided the classification of newly gained information from the respondents by cross-checking their accuracy with publicly available and privately obtained data. Therefore, the variety of leveraged data sources contributed to noticing biases during data collection (Creswell & Creswell, 2018).

3.4 Data Analysis

While keeping in mind the timely limitations of this project, we applied simultaneous procedures for data analysis to gain a thorough understanding and add meaning to the collected data. Accordingly, the content from conducted interviews was analyzed and contrasted to secondary data, while additional interviews were set up and conducted. Overall, qualitative data analysis proceeds in two layers (Creswell & Creswell, 2018). First, the collected data undergoes a more general procedure of organizing and understanding each piece of information. Second, analyzing the data and contrasting it with the preliminary model follows. Yin (2011) described five general phases of data analysis in qualitative research: database compiling, disassembling, data reassembling and interpreting, and concluding with findings from the entire project and relations to the previous steps.

For this study, a process of six sequential steps was applied. First, to match the case study approach, we described the cases, setting, and interviewees for the conducted. Further, the data obtained through interviews, emails, and secondary sources was organized in the text processing program Microsoft Word as preparation for the analysis. Thereafter, all the data was repeatedly read by both researchers to contrast individual interpretations of distinct data and to thereby ensure comprehending the essence. The data was then coded to identify patterns across the interviewees' responses, as well as the secondary data. We utilized predetermined codes based on the initial framework for ensuring the results served the research purpose, but also paid attention to emerging information from data collection to allow for developing unexpected or unusual codes. This step laid the foundation to generate brief descriptions and brought forward four themes. Here, the data was separated according to the relevance for this study to winnow irrelevant information accordingly. Finally, these descriptions and the themes' interpretations were presented in written form and compared to findings from existing literature. Here, we chose a detailed descriptive format to contrast the different cases per category as derived from the preliminary framework. (Creswell & Creswell, 2018)

3.5 Quality of the Study

In order to guarantee high quality, transparent research, this section summarized and supplemented previous information on noteworthy limitations resulting from the research design, the claim of validity and reliability, as well as ethical considerations.

Limitations of Qualitative Multiple Case Studies

While qualitative case studies bring various advantages to research as elaborated on in the subsection on the empirical case study, they are also associated with shortcomings to be acknowledged when evaluating a study's quality. Creswell and Creswell (2018) emphasized a lack of consistency and objectivity with regard to data collection, analysis, and interpretation. Due to the central role of the researchers in qualitative studies that is due to interpreting the descriptive data, the results of such studies are highly dependent on the researchers' tacit knowledge and experience. Despite the researchers' attempt to follow the same procedures per case, in multiple case studies, discrepancies in available data sources and their level of detail can occur, which devaluates the results. When conducting interviews as part of multiple case studies, the participants add another layer of potential biases and misunderstandings during data collection that could influence the direction of the findings (Yin, 2011). While this study demanded for some subjectivity by the researchers in order to ensure the results served the research purpose (Eisenhardt, 1989), our priority was on providing transparency in data collection, analysis, and interpretation to conclude with realistic insights. Therefore, our role and background was described in section 3.1 Research Approach and Design to enable fully comprehending this study's general conditions.

Yin (2011) described a comparably low degree of generalizability as a popular limitation of case studies. Nonetheless, while the overall intent behind qualitative research does not lie in statistical generalizability as is the strength of quantitative studies, Larsson (1993) pointed at case studies' analytical generalization. Further, limitations in time can represent a weakness regarding the level of detail and accuracy during data collection and analysis (Easterby-Smith, Thorpe & Jackson, 2015). For this study's limited timeframe of ten consecutive weeks, we focused on start-ups and SMEs within one specific industry. With a selection of four cases to discuss, the multiple case approach, while contradicting the time limitation, was justifiable with the related gains in terms of more reliable conclusions due to a larger reference group at their foundation. To further facilitate data collection, we refrained from visiting the different cases in-person, but rather engaged virtually.

Validity and Reliability

In order to ensure a high quality throughout this project, several procedures were undertaken to appropriately address the matters of validity and reliability. Overall, validity refers to the level of accuracy and credibility of a study's proposed findings, whereas reliability describes how consistent and replicable the researchers' approach taken in a particular study actually is (Creswell & Creswell, 2018).

More specifically, "a valid study is one that has properly collected and interpreted its data, so that the conclusions accurately reflect and represent the real world" (Yin, 2011, p.78). Even though validity is generally high in qualitative studies due to the mainly descriptive data sources, in order to enhance the overall authenticity of a project, Creswell and Creswell (2018) suggested leveraging multiple validity procedures. Thus, this study utilized several data sources for collecting converging evidence, for contrasting the information, and for deriving themes. This process is referred to as triangulation and contributed to the project's validity (Yin, 2011). Further, by thoroughly describing the study's setting and participants in the empirical part, the conclusions' trustworthiness was enhanced, due presenting rich perspectives. Moreover, our own potential biases were reflected on to create a transparent, open narrative for the readers. To further improve the data interpretations, the practice of member checking with the different interviewees was also leveraged by cross-checking specific descriptions for their accuracy when deemed necessary. Lastly, throughout both the theoretical and the empirical parts of this project, contents that were discrepant or contradicting to the preliminary framework and related themes were presented transparently to finally increase the study's validity. (Creswell & Creswell, 2018)

In terms of reliability, Creswell and Creswell (2018) proposed an in-depth documentation of as many of the applied procedures as possible to allow for qualitative generalization and replicability. For this purpose a detailed case study protocol was kept. The constant discussion and comparison of two perspectives during data collection, analysis, and interpretation as a result of two researchers collaborating in this study, further added to its qualitative reliability (Yin, 2011). As part of a research group at Lund University addressing the alt food industry, this study leveraged various viewpoints, a broader interaction, and the constant consultation of our supervisor, Prof. Dr. Thomas Kalling. In the phase of data analysis, the conducted interviews' transcripts were checked for obvious mistakes directly after execution to minimize potential misinterpretations later on. Moreover, to avoid shifts in the intended meaning behind

different codes throughout the project's duration, short definitions were added to the transcriptions whenever a new code was introduced. By sharing the independent analyses of both researchers, the communication within the research team was enhanced, which in turn facilitated cross-checking the individually developed codes for more reliable results (Creswell & Creswell, 2018).

Ethical Considerations

Research involving participants for primary data collection implies that ethical issues may arise throughout the research process, which should be anticipated by the researchers to ensure the protection of the study's respondents by applying different procedures (Creswell & Creswell, 2018).

Especially during recorded interviews, participants may be nervous or worried about their responses, as well as about potential consequences for their company and themselves, which in turn can create biases (Adams, 2015). Therefore, researchers have an obligation to treat their respondents' rights and values respectfully. Accordingly, the topic of confidentiality was addressed in written form through email or LinkedIn messaging prior to conducting the interviews to ensure upholding the interviewees' privacy rights. Further, in an attempt to create a safe environment for the participants, the agreed upon level of confidentiality was reassured at the beginning and at the end of each interview, and the possibility to remain anonymous for the final report was mentioned. Hence, the final decision on anonymity rested with the participants. Moreover, if it seemed appropriate and necessary during the interviews, the respondents were reminded on the possibility to deny the answer to particular questions in order to keep potential biases at a minimum (Adams, 2015).

4 Empirical Results

In this section the empirical results collected from primary and secondary data sources were presented in detail. In addition to direct insights into the four selected cases, also other information was leveraged in order to valorize the study and mitigate possible biases on the sides of the researchers and the participants (Creswell & Creswell, 2018). To allow for a clear understanding of the empirical results around different aspects of innovation management and strategy, the four cases were introduced below. Thereafter, the data was presented in accordance with the themes derived from the interview guide and the related responses. This procedure should ensure that data presentation, analysis, and interpretation were in line with the research purpose, while embracing potentially unexpected findings to minimize possible biases on the side of the researchers. The two additional participants and their respective companies were listed in the interview overview in Appendix D.

4.1 Case Descriptions

The selected cases for this qualitative multiple case study covered four distinct start-ups in the alt food industry across Europe and Australia. To provide a well-rounded overview of the chosen companies, the following case presentations included descriptions of the firms' geographic location, their foundation, brief information about recent investments, their current technologies and products, as well as the corporate vision for the future. Further, a brief introduction of the interviewees was given.

Generally, all four cases are part of the alt food industry and thus contribute to solving the problem of feeding ten billion people in the future (GFI, 2021); hence, attempting to counteract the current protein shortage. As mentioned in section 3.2 Case Selection, this study included cases from both the fermentation as well as the cultivated field to explore whether there were any patterns or significant differences with regard to innovation strategy around openness and DC. Overall, all four start-ups expressed the aim of eventually disrupting the current food system once cost and prices can be reduced to reach the broad public. The descriptions were ordered by technology, starting with fermentation, and then by chronology of the conducted interviews:

1) eniferBio, 2) Mycorena, 3) Vow, and 4) Alife Foods.

(1) eniferBio

First, this study examined the case of the biotechnology start-up eniferBio, located in Espoo, Finland. Through biomass fermentation, the company produces a fungi-based protein (mycoprotein) to upcycle industrial side streams from biorefineries (eniferBio, 2021a). The company's five co-founders are "on a mission to re-establish PEKILO production" (eniferBio, 2021b), which refers to a particular mycoprotein product that was first developed in the 1970's and used as a raw material for agricultural feed. With their product, PEKILO P65, they offer a sustainable, locally produced alternative to soy protein concentrate for the production of aquacultural feed. Due to the high protein composition of 65%, the product is particularly suitable for the feed of carnivorous marine organisms, such as salmon or shrimp (Ellilä, interview, 5 May 2021). Accordingly, eniferBio is an indirect member of the global competitive landscape of the alt food industry at this point, but by leveraging industrial side streams, the company can boost the circularity within the food system and economy (eniferBio, 2021b). The start-up was founded in 2019 and currently employs three people in addition to the executive team comprising the five co-founders. The company is privately held and VC-backed with a first seed round funding of $1.2 million in October 2020, after having received a first grant of approximately $60,000 in September 2020 as part of an incubator program. (Pitchbook, 2021b)

The interview partner for this thesis was the company's CEO, CTO, and co-founder, Simo Ellilä (Pitchbook, 2021b). Before founding eniferBio, he had studied molecular biology with a focus on biorefining processes. According to him, he "entered the field of cellular agriculture by accident" (interview, 5 May 2021) when he came across the PEKILO process and started exchanging ideas with his now co-founders. Ellilä described that for the moment, the preliminary focus of their business was on the aquaculture market due to much enhanced financial feasibility compared to past applications in agriculture (interview, 5 May 2021).

(2) Mycorena

The second case for this study represented the biotechnology start-up Mycorena, headquartered in Gothenburg, Sweden. After a few years of research around the creation of fungi-based protein from industrial side streams, the company was founded in 2017 by CEO, Dr. Ramkumar Nair, and leveraged a biomass fermentation process to upcycle these resources (Mycorena, 2021b). While originally, the company released a protein product for fish feed, meanwhile their focus has shifted to creating an environmentally sustainable, vegan protein based on fungi with applications in food production (Mycorena, 2021b). Their mycoprotein, Promyc, represents a

resource-efficient alternative to plant-based and animal protein, requiring less water and space, and causing fewer CO2 emissions, while delivering a nutritional value of 60% protein and 12% fiber (Mycorena, 2021b; Promyc, 2021). Their vision is to become "the world's leading brand for fungi-based products" (Mycorena, 2021b) and to make the best use of the power of fungi (Texeira, interview, 12 May 2021). Currently, Mycorena is a privately held start-up with more than 20 employees and backed by 15 investors. These include grants, accelerators, as well as early stage VCs (Pitchbook, 2021a) amounting to $1.78 million (Crosser, 2020). In January 2021, the company opened a pilot production facility in Gothenburg, Sweden (Mycorena, 2021a) to allow for launches of pilot products.

The interview partner for this study was the start-up's CIO, Dr. Paulo Teixeira, who had joined the company's executive team as one of the first employees. With a PhD in bioengineering, he is responsible for product development and management and could therefore address relevant technological and business aspects for the purpose of this study.

(3) Vow

The third case for this study was the food start-up Vow, located in Sydney, Australia. Founded in April 2019 by CEO, George Peppou, and CCO, Tim Noakesmith (Vow, 2021), the company has taken a novel approach to cultivated meat production. According to CSO, Dr. James Ryall, by focusing on undomesticated animals for the ethical production of cellular food, so to not replicate what is primarily consumed as of today, Vow can create a wide variety of new food products that could not be accessed previously (Cultured Meat Future Food, 2020a). Moreover, Peppou understands the field of cultured meat as "a food technology [and] a way of inventing a new category of food" (interview, 12 May 2021) to explore opportunities around cells of animals such as kangaroos, emus, or tortoises. Vow's long-term vision is "to make sustainable food both irresistible and available to billions of people" (Vow, 2021) to finally tackle the protein shortage, while preserving human and animal welfare, as well as the larger environment. First and foremost, Vow appeals to enjoying food for the sake of taste and sensory experience and with sustainability as a positive ancillary effect, rather than as the central argument (interview, 12 May 2021). The start-up is privately held and VC-backed, with the latest seed round alone amounting to $6 million in January 2021 (Keating, 2021; Pitchbook, 2021c). According to Tim Noakesmith, Vow "is one of the fastest-growing cultivated meat companies in the world" (TEDx Talks, 2020, 00:14:55), with currently over 25 employees (Vow, 2021). The start-up gained attention on the basis of the two founders' creative drive and passion for

having developed the proof of concept for cultivated meat within only a few months, while working full time, and with financial resources amounting to only $60,000, whereas other cultured meat companies needed one to two million dollars of initial investment, more manpower, and much more time (Wild Hearts, 2020).

The start-ups CEO and co-founder, George Peppou, represented the company as an interviewee for this study. With a strong interest in both science and commercial cooking, as well as with a professional background having started an accelerator for agricultural technologies, he regards the combination of food and animals as the "biggest opportunity to solve the problem of our food system's fragility" (interview, 12 May 2021).

(4) Alife Foods

Alife Foods, a German start-up in the cultivated meat industry and based in Leipzig, was the final case for this project. The company was founded in 2019 and originally spun out of a larger corporation's cultivated meat initiative, but is now privately-held by the four employees in order to gain a greater scope of action and to move at a more rapid pace of innovational progress than was possible under corporate control. The firm is advertised as "the Cultured Schnitzel Company"(Alife Foods, 2021) with the vision to offer guilt-free products, so to maintain eating meat as "a celebratory part of our many different cultures" (Alife Foods, 2021) through a better, more sustainable meat production. Alife Foods argued that shaping the world proactively through technology was part of modern human nature and that meat would be part of humanity's collective culture (Alife Foods, 2021). Overall, Alife Foods is not a typical biotechnology food company, referred to as full stack, but rather a forward integrator that processes cell mass from other companies within the cultivated space into their final cultured schnitzel product. Consequently, there is fewer available information from established, reliable research institutions, such as the GFI.

For this study, Dr. Bernd Böck, who is one of the part owners and acting Supply Chain and Manufacturing Manager, represented the start-up as an interview partner. His motivation to join the company and the industry as a whole was the goal to contribute to a positive transformation of today's food system (interview, 17 May 2021). According to him, the cultured meat area in particular can have a much greater impact on people's consumption of traditional products than plant-based alternatives could, as it still offers the access to actual meat products without demanding for the adoption of a vegetarian or vegan lifestyle (interview, 17 May 2021).

Case Summary

To allow for a better understanding of the selected cases and to enable a direct comparison on several dimensions, the four companies' key information as of May 2021 was summarized in Table 2.

	eniferBio	**Mycorena**	**Vow**	**Alife Foods**
Technology	Biomass Fermentation	Biomass Fermentation	Cultivated Meat Full Stack	Cultivated Meat Forward Integrator
Founding Year	2019	2017	2019	2019
Lifetime in Years	1.5	4	2	1.5
Latest Investment Deal (in Million)	$1.2 October 2020	$1.2 May 2020	$6.0 January 2021	Undisclosed
Number of Employees	5-10	20-25	25-30	1-5
Founding Team	5	1	2	4
Location	Finland	Sweden	Australia	Germany

Table 2: Case Overview

The three most critical dimensions regarding innovation strategy; Lifetime, Number of Employees, and Latest Investment Deal; were further visualized in Figure 9.

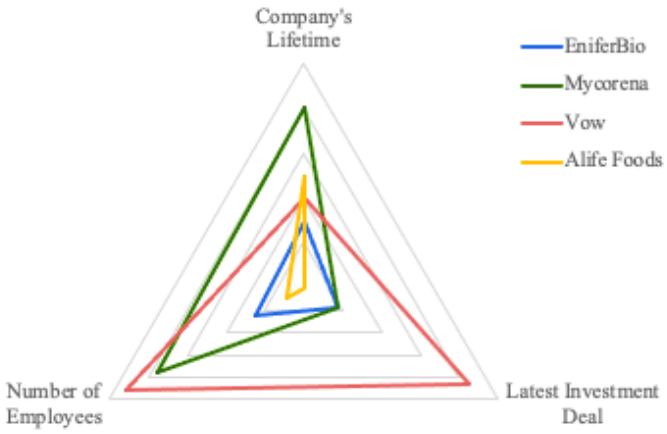

Figure 9: Case Comparison

4.2 R&D Maturity and Technological Potential

To allow for a well-rounded analysis of the empirical results, the data was presented according to the derived key themes and thereunder structured case-by-case. For a more complete foundation for innovation strategy, the current status of R&D was explored. Maturity in this sense provides information about technological readiness, so to link the technologies and products to a time component around market entry (Guo et al., 2019). While the four cases were all start-ups founded between 2017 and 2020, the R&D maturity per company varied from conceptualization through to a demonstration scale phase within reach. One notable difference in this regard was the more advanced stages of the two firms leveraging fermentation processes in comparison to the two start-ups from the cultivated field, and was further illuminated below.

eniferBio: Process Validation Phase, Exploratory Approach, and Focus on Quality

Despite being among the younger firms within this study, eniferBio could already proceed to the final stages of technology validation. As part of an incubator program organized by the co-founders' former employer, VTT Technical Research Centre of Finland, they were able to validate the overall concept and identify different interest groups early on, which helped to secure a seed round funding in October 2020 (Ellilä, interview, 5 May 2021). According to Ellilä, "eniferBio is in very early stages" (interview, 5 May 2021) and focuses on two key milestones: developing their product and securing a partnership for the construction of their first plant. After having completed their process piloting trials, the company has recently entered "the next step towards validating PEKILO protein through salmon feeding trials" (Nutreco, 2021) in Norway. Even though, the process had been used for the production of animal feed in the 1970's and 1980's in Finland, and while it faces rather light regulations in the aquaculture industry, Ellilä remarked the importance of a long-term focus for this project in order to eventually create profit (interview, 5 May 2021). He clearly stated that when it comes to testing a product "if the quality isn't good enough, you won't get another try" (interview, 5 May 2021), indicating a slightly subordinate role of speed and timing. In terms of technological potential to reach alternative markets and apply their process to different industries, he described it as a platform that could be tailored in different directions and would not restrict eniferBio to the fish feed industry. In fact, he pointed out that the company's main investor, Nordic Food Tech VC, was "very interested in exploring the food side of things" (interview, 5 May 2021) in the future, indicating an exploratory approach.

Mycorena: Pilot Scale Phase, Exploratory Approach, and Focus on Quality

Similarly, Mycorena was described as a technology company that could produce different products beyond the food industry on the basis of fungi. Teixeira regarded fermentation processes as "an important stepping stone for people to go away from just animal protein" (interview, 12 May 2021) while explaining the applicability of such organisms to other materials and the production of vegan leather with very few resources. He highlighted that the company currently offered both their mycoprotein as well as their derived expertise and knowledge for R&D projects around this ingredient (interview, 12 May 2021). Mycorena entered the pilot scale phase with the recent opening of their first production facility early 2021 (interview, 12 May 2021). According to Teixeira, they "want to keep scaling and establishing their offer" (interview, 12 May 2021) in order to produce 3,000 tons of their protein in 2022. Additionally, the company announced the construction of their demonstration facility in Falkenberg, Sweden, for large-scale production to be operational by the end of next year (Mynewsdesk, 2021), which would mark their transition to a demonstration scale phase. Here, Teixeira pointed at the importance of quality due to an especially low margin of error from the perspective of final consumers, as they would not tolerate compromises in quality (interview, 12 May 2021). Nonetheless, he highlighted the continuous monitoring of market developments to spot potential opportunities for the future; both within and beyond the food sector; as they "try not to put all [their] eggs in one basket" (interview, 12 May 2021).

Vow: Lab Scale Phase, Specialized Approach, and Focus on Speed

In contrast, both start-ups within the cultivated field were more exclusively set on the food industry. More specifically, Vow in Australia was referred to as a company that in a future with widely available cultivated products would be "offering hundreds of different products across every continent to feed billions of people" (Klar, 2021). Peppou pointed at the critical phase of R&D where timing and speed would be key to innovational success by arguing that "the more you are comfortable with shortening time and accepting failure, the faster you improve" (interview, 12 May 2021). He described how the current focus was on working on the technology and preparing to move into technology transfer, so to be able to commercially offer the product in the near future, hinting at the race for early market entry. As a best case scenario, a first product launch could be expected by the end of 2022 with few "very high impact, experiential products" (Peppou, interview, 12 May 2021). Peppou discussed the prevalent importance of speed, timing, and a trial-and-error approach at their current R&D scale to drive

innovation and product development (interview, 12 May 2021). He further pointed out that with transitioning to manufacturing and to the interaction with regulators, the focus of innovation strategy would need to switch from speed to quality. Currently, however, the company's priority was to increase the number of cell types and different species that could be leveraged for food production (Cultured Meat Future Food, 2020a). Accordingly, the company is in a lab scale phase of R&D conceptualization.

Alife Foods: Lab Scale Phase, Specialized Approach, and Focus on Quality

Finally, the R&D maturity at Alife Foods is highly dependent on the cultivated meat companies that would supply them with cell mass, due to not being a classic biotechnology firm in the food sector. On that note, Böck highlighted that oftentimes the technology was actually less matured than stated by cultivated meat companies' (interview, 17 May 2021), indirectly hinting at the competitive intensity in the industry. While Alife Foods sees cultured meat as a massive opportunity to preserve resources (Alife Foods, 2021), Böck pointed out the prolonged R&D cycles in the field, leading to the expected product launches of industry leaders by the end of 2022. As a forward integrator, Alife Foods is thus in a pre-pilot scale phase where the focus is on R&D around one particular product. Nonetheless, according to Böck, the company's goal is to release a first prototype of their cultivated Schnitzel by the end of this year (interview, 17 May 2021). He clarified, however, that the actual launch in the targeted region would realistically be expected around 2025. To him, was more important than timing and speed, as he described the failure regarding safety, taste, and consumer acceptance of one single player within the cultivated meat space as detrimental to the whole industry (interview, 17 May 2021).

Summary: Scale-Dependent Technology Strategy and Varying Expansion Intents

In their current stages, three out of four interviewees prioritized their innovations' quality over speed, highlighting that there would be a maximum of two chances to test and validate a particular product with different companies or partners before being disregarded for future product launches. In accordance, all four interview partners implied a clear focus on quality as soon as the company would enter customer and regulator-facing stages in order to enable rapid market acceptance and thus allow for subsequent disruption. The companies' technological potential and desire to apply their respective processes to additional fields seemed to be connected to their overall technologies. For instance, both fermentation start-ups described an exploratory approach regarding their processes' long-term applicability, whereas both cultivated companies saw themselves expanding within the food industry.

4.3 Market Entry Strategy

This theme addressed the cases' market entry strategies to illuminate their target customers, geographical markets, as well as their intended positioning and pricing. As this study's cases included companies within the fields of both fermentation and cultivated meat in order to gain a more realistic overview of the alt protein industry, their market entry strategies were expected to differ, which in turn might create more holistic KSFs in line with the research purpose.

eniferBio: Demand-Driven with a Focus on Aquafeed Companies

As a producer of mycoprotein that is focusing on the aquaculture industry, eniferBio is placed much earlier in the food system's supply chain, compared to the remaining three cases. Accordingly, at this point, their disruptive intent addresses the food industry around human nutrition only indirectly through the production of feed for carnivorous marine organisms that in turn would be sold as seafood (Ellilä, interview, 5 May 2021). Ellilä motivated the company's focus on aquafeed as more economically rewarding than their process's historical use in the production of agricultural feed. He argued that they were "placing the product as a drop-in replacement for soy protein concentrate" (interview, 5 May 2021) that was mainly used to feed high-protein organisms such as salmon, rainbow trout, and shrimp. He further explained how the company had thus implemented a straight-forward business model with very clear target markets and customers, but that they would eventually expand beyond aquafeed.

For now, eniferBio was targeting huge fish feed companies, such as Skretting and BioMar, to sell their mycoprotein. Ellilä described that these big firms were "really excited about this product … for leveraging a sustainable process using renewable raw materials and being extremely price competitive" (interview, 5 May 2021). As opposed to the other three cases in this study, eniferBio was hence following an efficiency-driven pricing strategy as part of their unique selling proposition (USP) already at market entry. Compared to cultivated meat, one big advantage of the firm's fermentation process lied in the upcycling of industrial side streams from the ethanol industry by growing their fungus in a low-value by-product, which enabled cost-efficiency. The company's target markets were selected according to the existing demand, as well as the location of large fish farms. For instance, eniferBio has recently started their process piloting trials in Norway (Nutreco, 2021) and besides Europe, South America and South East Asia were also of interest.

Mycorena: Technology and Opportunity-Driven with a Focus on Food Companies

Despite similar origins of producing fish feed using fungi fermentation with the initial launch of their aquaculture protein product in 2017, Mycorena shifted their production to their food protein Promyc that was released in 2019 (Mycorena, 2021b). In fact, Teixeira indicated that the primal focus on aquaculture was their strategic entry point to enable reinvesting in the development of the technology to eventually expand to different fields (interview, 12 May 2021). He depicted the food sector as "one area that [was] really craving for sustainable solutions" (interview, 12 May 2021); hence, the target customers were now food companies. According to Teixeira, these could be subdivided into those who wanted to purchase the mycoprotein ingredient, those who required help in developing the products, and the ones who wanted help in developing it, and in finding a partner produce it for them (interview, 12 May 2021). In terms of geography, he pointed out that there were no restrictions currently, as they were working with customers from around the world. Similar to eniferBio, Mycorena could also demonstrate tremendous potential with regard to cost-efficiency when scaling up; nonetheless, Teixeira described it as a long-term goal (interview, 12 May 2021). According to him, the initial pricing would set the expectations going forward and it was thus critical to attribute a certain price to the product. More specifically, he explained that even once commercial production is properly set up, they would still "aim to be on the higher range and as volumes go up, the price offer will go down" (interview, 12 May 2021).

Vow: Regulatory-Driven with a Focus on High Impact Markets and Differentiation

On a similar note, Vow's Peppou mentioned that "nothing that need[ed] to go in, was intrinsically scarce or expensive and the cost of every expensive part was scale-dependent" (interview, 12 May 2021) with regard to cultivated meat. As opposed to the other three cases, however, Vow followed a different approach in terms of product development. For instance, their focus was on cultivating meat from undomesticated animals in order "to start with highly differentiated species and highly differentiated products to be sold at a very high premium" (interview, 12 May 2021), which would initially be offered at low volumes but in high impact markets. Peppou described that the overall goal of feeding billions of people required extensive reinvesting in the technology in order to eventually reach high scalability to in turn reduce the prices (interview, 12 May 2021). Therefore, by initially leveraging the distribution channel of fine dining restaurants, Vow intends to address a specific customer segment of early adopters who are be willing to pay extra. More specifically, in collaboration with chefs, such as Neil

Perry (Slatterys, 2020), Vow's "early products are going to be predominantly experiential, they're going to be sold on the basis of novelty" (interview, 12 May 2021) to get people excited and educated about the unfamiliar offerings. Accordingly, the company would progress from boutique style products, over niche value propositions for smaller groups of motivated consumers, to more habitually consumed products, and through to an everyday format (interview, 12 May 2021). To address the sensitivity of the industry with regard to consumer perception, Vow indicated the conceptualization of a "house of brands" (Wild Hearts, 2020) to mitigate the risk of one product's failure affecting the success of additional ones. From a geographic perspective, the company applied a regulatory-driven strategy to focus on the first markets that adjust policy and, which ideally included rather few incumbents to allow for a rapid expansion. Therefore, the company did not "think of Australia as an important or particularly impactful market" (interview, 12 May 2021), but instead evaluated Singapore and other Asian countries as more critical.

Alife Foods: Experience-Driven with a Focus on Early Adopters

In contrast, Alife Foods clearly targeted the German-speaking countries in Europe, despite the rather strict regulatory framework in the DACH region. Instead, Böck highlighted the importance of the company's regional experience, as well as the obvious match between the local demand and the firm's offering; with Schnitzel being a traditional food product in that market (interview, 17 May 2021). While he distinguished their pricing strategy from the luxury segment, Böck motivated the company's product focus with a compromise of feasibility and price potential in final sales, thus pointing at a slightly higher price range than conventional alternatives. In accordance, he described the target customer at market entry to be early adopters, in particular the younger generation that would be willing to pay a small premium for slaughter-free meat. While this approach indicated a skim-the-cream strategy, Böck also highlighted it as critical in order to eventually reduce the prices as a result of advanced technology and scalability. (interview, 17 May 2021)

Summary: Disruptive Vision with Multiple Approaches

In sum, all cases shared the vision of eventually disrupting their respective markets by gaining market share, reaching scalability, and realizing price parity to allow for affordable products. Nonetheless, initially, they all target specific customer segments to enable reinvesting in their technologies and product range. One notable difference with regard to market entry lied in the pricing strategy when comparing fish feed with human food products. While the latter tended

to follow a premium approach, aquafeed demonstrated cost efficiency as a USP early on, implying potential for classic disruption at the low end of the market. Additionally, the regulatory restrictions somewhat forced the cultivated companies to niche markets in geographical terms, whereas the fermentation companies' commercialization strategies were less affected by that dimension.

4.4 Key Challenges to Future Success

By exploring the market entry strategies, as well as the cases' R&D maturity, it became apparent that there were several hurdles for the companies to be successful. In line with this project's research aim of investigating innovation strategies around OI and DC, the firms' key challenges and underlying drivers made up another aspect to be illuminated; especially, in order to understand their impact on innovativeness. In general, these main challenges that new food companies were facing can be divided into three categories, as mentioned by the author of the book *Clean Meat*, Paul Shapiro (Cultured Meat Future Food, 2018):

> 1) technology, 2) government regulation, and 3) consumer acceptance.

According to Shapiro, these challenges applied to the *cultivated food sector* in descending urgency, with technology being the most pressing one (Cultured Meat Future Food, 2018). In this context, he described that the two issues, finance and cost reduction, represented "two sides of the same coin, because bringing the costs down is contingent upon extra funding for R&D" (Cultured Meat Future Food, 2018). To solve the complex scientific task of growing ever-better meat products outside of the animal, constant reinvestments in the technology are needed, which can be achieved through scalability. At the moment, the challenge of scaling up the production is approached from multiple sides to include cell lines, scaffolding, cell culture media, and bioprocess design as relevant R&D topics that several companies work on (Byrne, 2020). Experts estimate that after the successful completion of pilot scale phases, which are currently initiated by the leading edge of the industry, global cultured meat production would reach millions of metric tons in the long-term future through industrial scale phases (Byrne, 2020). These developments would in turn increase cost-efficiency and overall productivity of the processes (Byrne, 2020). At the same time, Shapiro argued that regulatory concerns mainly derived from the unfamiliarity of cellular agriculture and were thus less critical than technology at this point (Cultured Meat Future Food, 2018). As a consequence of recent developments regarding the approval of cultivated meat products in Singapore, the regulatory burden has started to decrease and caused other countries to announce material updates (Byrne, 2020).

Finally, Shapiro described consumer acceptance as the currently least urgent barrier (Cultured Meat Future Food, 2018). This is due to recent polling results demonstrating an upward trend of people's interest in cultivated products, which in turn signals advancing consumer perception.

For companies that are active in the *fermentation space* of the alt food industry, the regulations represent a much smaller challenge due to well-established regulatory systems in place in most jurisdictions worldwide that should ensure high safety standards for fermented food products. In turn, technology bears some underlying difficulties that should be addressed for fermentation-derived food products to potentially disrupt the current food system through drastic upscaling. In order to enable large-scale production, companies need to ensure feedstock consistency, as well as easily scalable capacity, which in this case refers to the costly construction of new production facilities. (Crosser, 2020)

This initial ranking of the most pressing challenges for success in the alt food industry was used as a benchmark against which the interviewees' responses were contrasted. Below, the primary data was presented case-by-case, chronologically according to the conducted interviews and complemented with secondary information.

eniferBio: Scalability and Strategic Direction

As a small start-up that by definition rather quickly advances from one life cycle stage to the next one, "every day, the challenges are different in different stages" (Ellilä, interview, 5 May 2021). Depending on the firm's maturity, the most pressing issues may thus vary from technical details, to finding investors, through to defining the long-term strategy. Ellilä described that when founding eniferBio and joining the accelerator program in Finland, the key challenge was conceptualization to provide both a proof of concept regarding the technology and process, but also to demonstrate a solid business case with little-to-no business experience. Thereafter, the actual interaction with potential investors was a challenge, so to not only convince them of the technology's feasibility and expected return-on-investment, but to also choose the right investors to proceed with. Industrial production always requires tremendous investment to eventually construct production facilities once the technology matures. Therefore, investors with a long-term interest and perspective are crucial for success, so to match investment and expectations with the business at hand. Moreover, investors must be able to bear that kind of risk for a prolonged period of time until profitability can be expected (interview, 5 May 2021). Meanwhile, eniferBio's priority is on the continued development of the product, on technical

details, and on validating the process through trial phases with partners. For targeting the aquafeed industry rather than human food, customer acceptance is a subordinate issue at most, since efficiency, price parity, and sustainability are of higher interest to the large fish feed producers. On a similar note, the existing regulations in the aquafeed industry are much lighter than those in the food sector due to autoregulation and fewer concerns about human health. Nonetheless, Ellilä emphasized the importance of safe, high quality products and also hinted at their customers' high standard of expectations regarding safety (interview, 5 May 2021). When discussing possible applications of their process beyond aquaculture in the future, he highlighted that switching to exploring the food sector would immediately require "millions and millions of investment just to overcome those regulatory barriers" (interview, 5 May 2021). Regarding the future, he also expressed one clear advantage of fermented products compared to cultivated ones being a much shorter timeframe to reach price parity due to leveraging low-value raw materials, hence implying a challenge in the cultivated area.

Mycorena: Organization and Scalability

While pointing out the same challenges regarding investment and the continuous development of the technology, Teixeira described one of Mycorena's toughest challenges when starting the business being structure and organization (interview, 12 May 2021). For a young team of scientists, taking on a management role, organizing tasks, and building up an effective business environment was hard due to lacking previous experience in that area and especially, as the team continued to grow and reach gradually larger customers with more complex inquiries. On this note, the creation of a promising business model and solid strategy was of critical importance to move the business forward and represented another hurdle for the company to succeed sustainably. Further, Teixeira emphasized the current focus on scaling up the technology to enter demonstration phases where gradually larger amounts of their mycoprotein could be manufactured and sold at an increasingly faster rate, which would in turn enhance cost-efficiency (interview, 12 May 2021). Similar to eniferBio, as a producer of mycoprotein and hence of an ingredient for food products rather than the actual end products, the regulatory burden is not directly carried by Mycorena, but instead by their customers. As mentioned previously, however, the regulatory systems in the fermentation space are well-established and represent a minor challenge to possibly disrupting the market. While the same applies to consumer perception, consumer education continues to play an important role in the commercialization of fermented food products in order to create and drive demand. Overall, the public's sentiment towards alt food products holds room for improvement to say the least.

Vow: Scalability, Organization, and Regulation

Like Mycorena, Vow also struggled with getting started and setting up organizational structures that would encourage innovation. Developing a culture of creativity and efficiency by "doing things faster, cheaper, and better" (Peppou, interview, 12 May 2021) and maintaining that environment with a continuously growing team was challenging. Similarly, Tim Noakesmith described how they "learned the hard way" (Wild Hearts, 2020, 00:30:44) that exploratory R&D was difficult to manage effectively after having initially organized the company's R&D in vertical functions, which created a silo environment with little inter-functional communication and thus prevented multi-perspective solutions from being developed. Switching to a more agile approach with interdisciplinary teams and increased autonomy of the different employees in order to contribute to set goals was crucial for efficiency and progress in product development. One related challenge lied in hiring the right people, as there was no industry of cellular agriculture to recruit from (interview, 12 May 2021) and since convincing researchers to give up their stable working environments at research institutions in order to join the ever-evolving start-up environment was hard (Wild Hearts, 2020). Nonetheless, in order to convince investors, having experienced scientists in the team was key to demonstrate seriousness and integrity. Peppou mentioned that "there was literally nothing, which hasn't been challenging" (interview, 12 May 2021), but described the beginning phase as particularly difficult. Entering the life sciences industry is generally combined with extremely high investments due to quality standards, IP, bureaucracy, and stringent processes that often prevent access to certain equipment and ingredients. According to Peppou, it was extremely difficult to find lab space or purchase cell culture media as a start-up from a different industry (interview, 12 May 2021). Overall, the identified challenges at Vow somewhat contradict the beforementioned descending order of challenges in terms of urgency, as the company regards the production and commercialization of cultivated meat as a multidisciplinary challenge that simultaneously addresses science, regulation, consumer perception, and leadership (Wild Hearts, 2020). At this point, a focus is on the scalability of their cells to eventually reach a manufacturing phase, while both regulatory developments and evolving consumer perception are being monitored to flexibly determine a chronology for entering different markets. In terms of consumer acceptance, Peppou highlighted their competitors' need for complete replication as a key challenge, which for Vow is less relevant "since the sensory experience and the price [of their products] is not comparable" (interview, 12 May 2021) and will create a new culinary area that needs to be addressed through consumer education.

Alife Foods: Regulation, Technology, and Access to Raw Materials

A similar view point on consumer education was identified for Alife Foods. Böck classified customer acceptance as the currently least important challenge within the alt food industry, explaining that all players in the field would engage in solving technical as well as regulatory problems, but that only a few would actively work on changing consumer perception at this point (interview, 17 May 2021). According to Alife Foods (2021), their current attention is targeted at scaling up the technology from a lab to a production context. Due to the later position along the supply chain of cultivated meat products as a forward integrator of cultivated cell mass, Alife Foods' technological progress strongly depended on that of their suppliers of raw material. Böck emphasized that many such companies would still operate on lab scale; meaning, producing very small amounts of cell mass at extremely high cost. Accordingly, these companies would then have to decide between using the cells for validation to move forward in regulatory processes or selling it to firms to develop processing technologies, which will enable higher diffusivity at market entry (interview, 17 May 2021). Finally, the conservative system around novel food regulation in the EU represents a challenge for entering and potentially disrupting or transforming the local meat industry sustainably. Böck depicted the regulatory burden the highest, as without progress in that domain, purchasing the raw material for R&D would remain very difficult for Alife Foods.

Summary: Consistent Key Challenges with Varying Prioritization

In sum, regarding the most pressing challenges per case, generalizability was difficult amid the differing technologies, varying strategies, as well as the contextual aspects. More specifically, the initially identified challenges; technology, regulation, and consumer acceptance; were addressed in different order of urgency. While concerns about regulation as well as customer perception were subordinate for both fermentation start-ups, challenges in organizational structure and the overall business side of the firms were severe. Vow regarded technology, scalability, regulation, and organization as similarly critical, while ranking consumer perception as less pressing at this point. Alife Foods, as the only case, perceived regulation as the most urgent issue. This however, was likely due to their subsequent position from a supply chain perspective. In contrast, Ran Liu, co-founder of the Chinese start-up CellX, described the difficult regulatory system in China as beneficial for their own business, as it "keeps international competitors from entering the market any time soon" (interview, 24 May 2021). At the same time, he emphasized the difficulty to find and recruit qualified people who share

the same vision and want to change the food system for the better. As a new insight, organizational challenges regarding the internal coordination of increasingly large teams was derived from the empirical data. A slightly new perspective was introduced by Kimiko Hong, representing the Japanese start-up IntegriCulture, arguing that finding investors as a non-English-speaking company represented a serious challenge, since most investors in the alt food space were English-speaking wanting to invest in businesses within easily accessible markets from a global perspective (email, 23 May 2021). Finally, it was important to mention that during the interviews, we could notice some hesitations and frequent repetitions when answering questions around the companies' biggest challenges. Moreover, the level of detail and exemplary description varied largely from case to case for primary and secondary data collection. Therefore, the cases' empirical results were imbalanced in length.

4.5 Collaborations and Innovativeness

After having investigated the cases' key challenges to disruptive success; technology, regulations, consumer acceptance, investment, and organization; it became apparent that the alt protein start-ups may leverage collaborations beyond their organizational boundaries in an attempt to overcome the first three of them. In fact, according to Kai Steinmetz, due to the small size of the industry, "it is really important to stay connected with those that are in this field and try to collaborate as best as possible" (Cultured Meat Future Food, 2020b, 00:04:40). Therefore, in order to truly explore how OI practices can impact a firm's DC in practice, special attention was paid to empirical data regarding collaborations and innovativeness.

On that note, the first official start-up partnership between the cultivated seafood producer, Shiok Meats, from Singapore and the provider of culture medium, IntegriCulture, from Japan was announced in 2020. According to Kimiko Hong, collaboration is critical for accelerating the industry at large because "if you want to go fast, go alone. [But] if you want to go far, go together" (email, 23 May 2021). Moreover, through the acquisition of Peace of Meat, MeaTech closed the first M&A deal in the cultivated space (Byrne, 2020). Similarly, collaborations on the fermentation side proliferated, such as that between 3F Bio and Natural Machines (Crosser, 2020). In addition, the whole alt food area experienced growing popularity from the public sector with new partnerships globally. Several industry representatives highlighted the need for "companies and governments … [to] work in concert to successfully develop effective regulatory regimes" (Byrne, 2020, p.44), to fund open-access resources, enhance the infrastructure required for production capacity, and thereby advance the market (Blackbird

Ventures, 2021; Byrne, 2020; Crosser, 2020). Further, various NPOs have emerged throughout the field of cellular agriculture, which created additional opportunities for collaboration in research, consumer education, and regulatory efforts. Practitioners pointed out the potential spillover effects regarding applications of technologies across the fields of cultivated meat, fermentation, as well as plant-based food (Crosser, 2020). This serves as an explanation for the beforementioned difference in expansion intent between the two areas. For instance, firms leveraging fermentation processes seemed to be open to engage with cultivated meat start-ups to learn from each other (Teixeira, interview, 12 May 2021).

eniferBio: Leveraging Complimentary Skill Sets through Selected Partnerships

Originally spun out of the founders' previous employer, VTT, eniferBio was built around a collaborative mindset of the five founding members and towards research institutions and external partners. Ellilä argued that as a small company, it wouldn't make any sense to do everything internally, but instead outsource the tasks where external parties were more knowledgeable, such as the business side of the company and the larger aquafeed industry (interview, 5 May 2021). To define a clear, strategic direction, the different investors played a key role as business partners, whereas industry-specific knowledge exchange mainly derived from partnerships with large fish feed companies and universities; in particular, the Norwegian University of Life Sciences (NMBU). As the winner of the Nutreco Feed and Food Tech Challenge 2020, eniferBio accelerated interactions with the global producer of aquafeed solutions, Nutreco (Aquafeed, 2021), but also initiated a collaboration with the fish feed producer, Skretting, to test their mycoprotein in the Aquaculture Research Center in Norway (Skretting, 2021). Recently, the company also announced working with Tereos for salmon feeding trials in Norway (Nutreco, 2021). According to Ellilä, the start-up's main drivers behind collaboration were knowledge exchange and access to expertise and funding external to the company (interview, 5 May 2021). Overall, partnerships were about finding and exhausting win-win situations where everyone contributes complimentary skill sets or assets; nonetheless, any collaboration would typically create certain conflicts of interest. Accordingly, selecting partners required extensive pondering to prioritize those that would take the company forward without leaking critical know-how to the competition. That being said, Ellilä emphasized the general goodwill throughout the industry and that they were not trying "to step on anybody's toes" (interview, 5 May 2021), which may be due to the industry's larger vision of changing the existing feed and food sector for the better in the long-term. After all, partnerships were

regarded crucial in order to drive innovation strategy, especially as the technology progresses toward market entry and commercialization.

Mycorena: Enhancing Product Development through Industry and Public Sector

Similarly, Mycorena follows a rather welcoming approach to collaborations that was due to serendipity. Teixeira described including every employee, customer, and partner in their innovation process to some extent, as diverse ideas and feedback may lead to new findings for their own business and because there was no existing roadmap or process of success in the field yet (interview, 12 May 2021). With Mycorena, the characteristics and details of partnerships were very contextual and varied per situation. For instance, the start-up worked on projects funded by the EU, where specific outcomes were expected to be disclosed publicly, whereas with industry partners, Mycorena was either paid for R&D work or they outsourced R&D activities to external parties based on their own knowledge and expertise. Teixeira emphasized strong connections with universities, such as Lund University, in Sweden in the form of master thesis agreements and others, as they would allow accessing large data bases to address specific problems from a new perspective. Similar to eniferBio, Teixeira also hinted at some drawbacks with regard to partnerships. With universities, these included wasted time or less useful insights for the business than had been expected. Hence, these comparably minor risks were acceptable due to an outweighing positive impact on innovative capacity. In terms of competition, however, he did mention that the risk of know-how leaking was kept at a minimum, so that knowledge exchange would only occur superficially due to a well-established network throughout the industry. At the same time, Mycorena establishes strong partnerships within the food industry, such as with Peas of Heaven, Rollin Bistro Backyard, Kale United, and ICA in order to help developing and finally launching co-branded, consumable products based on their mycoprotein, and to learn more about effective positioning (interview, 12 May 2021; Mycorena, 2021a). Overall, according to Teixeira, “although it’s a friendly competition in the alternative food industry… it’s still a race” (interview, 12 May 2021).

Vow: Smoothing the Market Entry through Informal Knowledge Exchange

The general open-mindedness and willingness to engage in conversations throughout the alt protein field can be attributed to the high complexity of the technologies that are needed in order to realize the industry’s vision of sustainably feeding a growing population. While the related area of life sciences tends to be exclusionary with comparably high entry barriers, the need for small start-ups to collaborate in order to join the field becomes apparent. Peppou

pointed out that it would take multiple companies to disrupt the existing food system and that "at this stage, it is really not going to hurt [them] to share a few things because when others are successful, there is going to be more capital for all of [them]" (interview, 12 May 2021). Overall, the companies in the alt food space are thus taking a very open approach compared to other R&D-prone fields. He further mentioned a high degree of informal knowledge exchange among different, competing start-ups working to cultivate meat, especially with regard to suppliers, people, regulation, and nomenclature (interview, 12 May 2021). While technical details would not commonly be brought up in such interactions, they had been discussed in the past as a result of very good relationships among the different companies' founders. Vow's co-founder, Tim Noakesmith (TEDx Talks, 2020, 00:13:13), described the collaborations in the alt protein space as follows:

> To overcome the technical challenges that are associated with bringing cultured meat to market, we're going to need some of the greatest minds, the greatest entrepreneurs, scientists, engineers, and policy makers to start working together.

Nonetheless, choosing the right partners remained critical in order to enhance and speed up the innovation process, rather than slowing it down. Due to a "definite mismatch" (Peppou, interview, 12 May 2021) regarding the timescales of universities and the start-up, there was very limited engagement with academia, with exceptions of research groups whose leadership would eradicate the bureaucracy and allow for a similar pace. Peppou explained that long-term projects on a horizon of at least three years may hold promise for university partnerships. Such projects would be off the critical path and of high value for the business; thus, they would not prevent market entry if not delivered on time. Moreover, he emphasized the current lack of static regarding problems, which prevents such collaborations from being effective, so that "everything on a 12-month horizon needs to be done internally" (interview, 12 May 2021) to have as much control over speed as possible. The same applied to partnerships with large life science companies, where the engagement was limited to the most relevant interactions at this point. Instead, for the supply of equipment and goods, collaborations with start-ups in the respective fields were leveraged to match Vow's pace and agility and finally drive innovative capacity.

Alife Foods: Advancing Technology and Industry Landscape through Strong Networks

In contrast, Alife Foods highlighted a well-established network throughout the international landscape of higher education and the food industry, as well as frequent interaction with universities and large food companies. This is due to the start-up's small size and the still emerging industry of cultivated meat in Germany. While interaction among the few competitors was common, Böck stated that collaborations with various partners were necessary to develop the technology, advance the existing infrastructure, and encourage consumer education (interview, 17 May 2021). In fact, he emphasized innovation opportunities related to partnering with larger companies for their resources. At this point, there simply would not be an alternative to some type of collaboration as no one company in the world has all the expertise and infrastructure needed to develop cultivated meat products and reach scalability. Böck emphasized that the main drivers behind achieving the alt food industry's long-term vision; availability, price, and taste; could all be accelerated through collaborations (interview, 17 May 2021). The origin of most start-ups in the industry, having spun out of universities and other research institutions, offers one explanation for the general open-mindedness in the alt food sector, as the founders typically bring strong connections with these organizations to their new business. Further, interactions with universities can push for a new branch of studies targeted at cellular agriculture, thus advancing the market by training future experts.

Summary: Collaborative Industry with Varying Partner Preferences

While companies in the field of alt feed and food products are generally very open to collaborate with different partners in order to advance innovation and potentially disrupt today's food system, the preferences regarding the type of partners vary significantly. This may be due to the previously discussed distinction regarding the cases' focus on either quality or speed, depending on the start-up's current stage of maturity. For instance, the mismatch of timescales between the companies and potential partners with a rather stringent bureaucracy was mainly highlighted by Vow who are currently aiming for innovational speed. Moreover, knowledge exchange among direct competitors was more common within the cultivated as opposed to the fermentation space. This may be due to the more mature industry of fermentation processes where more companies are already selling their products commercially, in contrast to the cultivated field where almost no regulatory frameworks and technologies are market-ready. Hence, informally exchanging knowledge in the cultivated industry with enhanced technological uncertainty would be less risky for a single company to remain competitive.

5 Discussion

After presenting the empirical data according to the four discussed themes; R&D maturity and technological potential, market entry strategy, key challenges to future success, and collaborations and innovativeness; the insights were compared to the preliminary theoretical framework to test its accuracy and explore how it can further be developed. In accordance with the empirical observations, the initial model was adjusted to realistically depict the general cause of connection between OI practices and firm-level DC. For clarity, the final framework was presented at the beginning of this chapter to thereafter, contrast the results from both the theoretical and empirical study and identify the KSFs per overarching category.

5.1. The Final Framework: Open-Approach Disruption (OAD)

As a response to this study's problematization, the final framework showing the indicators for 'Open-Approach Disruption', was developed from existing literature on OI and disruption theory, as well as from the information gained throughout the empirical multiple case study. Visualized in Figure 10, the model shows the research areas on both sides, connected through an arrow leading from OI practices to DC to imply a chronological order. The arrow, termed 'Cause of Connection', incorporates five critical KSCs with the respective indicators underneath; hence, the preliminary framework's black box could be illuminated.

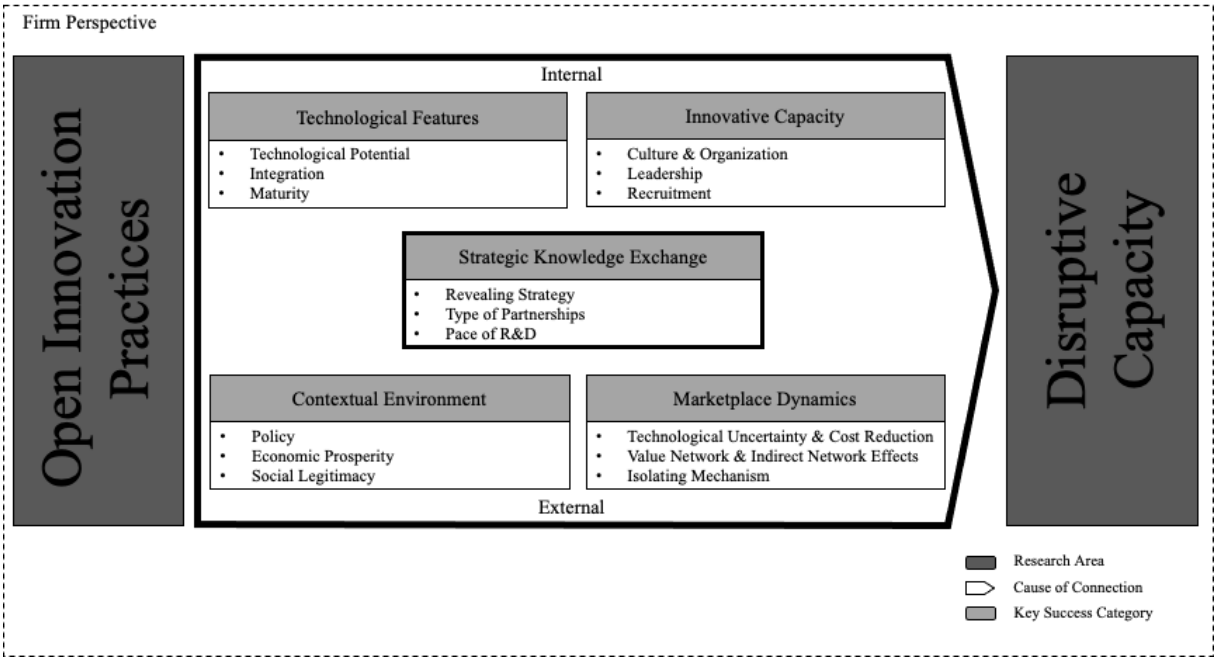

Figure 10: Final Framework 'Open-Approach Disruption' (OAD)

Moreover, the categories are presented as per origin; internal or external to the organization; from top to bottom respectively. The indicators under 'Strategic Knowledge Exchange' are impacted by the four remaining KSCs, thus positioned at the center of this framework. In comparison to the initial model in section 2.3 Preliminary Theoretical Framework, the empirical data led to changes in the KSCs and the KSFs. The final model was discussed from internal to external categories, concluding with the central one.

5.2. Technological Features

For disruption to occur, a company's product or process should demonstrate certain 'Technological Features'. As described in section 2.1.3 Influencing Factors towards DC, research suggested that the higher the 'Technological Potential', 'Integration', and 'Maturity' around a particular innovation, the more likely it is to disrupt existing markets (Guo et al., 2019). Overall, these three KSFs described the progress of complex technologies. In this study, all four cases aimed for fast technological advancements of their complex biotechnology processes within the alt food industry. Hence, the indicators indeed affected the implementation of OI practices to possibly reduce the time to market and enhance DC.

'Technological Potential' was deemed critical for disruptive success as a consequence of applying OI practices. Especially for the two fermentation cases, the aim and feasibility to leverage their processes and mycoproteins to reach different industries and markets in the future was emphasized in order to react to external changes and further grow their business. We understood high technological potential as an indication for resilience and open-mindedness toward disrupting the own business model for potentially disrupting the market. Similarly, the cultivated meat start-ups highlighted their interactions with the life sciences industry, direct competition, as well as with representatives of culinary arts to possibly enhance their own processes and learn from others' experience. The constant monitoring of arising opportunities beyond current target markets and customers implied the willingness to exchange knowledge with external partners to benefit from spillover effects across organizations, while implementing proven practices internally. Building and being part of both knowledge and business ecosystems was imperative for innovative drive; hence, *high technological potential can drive OI integration to in turn foster disruptive innovation*. Therefore, the empirical data validated the suggested relationship between technological potential and DC (Guo et al., 2019), but also implied a link with the involvement in OI activities. Overall, the connection from DC to the degree of OI implementation has not been drawn by OI scholars, which may be due to

there being multiple drivers behind DC (Guo et al., 2019), while knowledge exchange is often associated with the loss of competitiveness (Hallberg & Brattström, 2019).

Generally, the nascent industry of alt protein mainly originated from biotechnology, life sciences, and the overall food sector. Within less than ten years, different start-ups have applied technologies and practices around AI, advanced robotics, 3D printing, renewable energies, and circular economy; thus, demonstrating a high degree of openness and collaboration with more and less related fields. The whole sector leverages existing knowledge and skills to enhance innovativeness and speed up technological progress. At the same time, alt food products address multiple global challenges such as human and animal welfare, food shortage, and environmental sustainability. Therefore, the industry is highly integrated and the derived innovations fulfill a more sophisticated deed, which eventually facilitates market entry and acceptance. In accordance, *high degrees of integration imply a tendency to implement OI and finally drive DC*, coinciding with Guo et al. (2019).

Finally, while integration and technological potential were quite progressive for the selected cases, the 'Maturity' of related technologies varied and the reliability of supporting infrastructure was rather low due to the industry's adolescence. Empirical data showed, however, that much effort was put into advancing supply chains, partnerships, and far-reaching networks to enable commercialization once the actual technologies matured to be market-ready. Further, the infrastructure later on in the supply chain as part of the current global food and feed system was very well-established, in terms of retail, restaurants, and transportation. While *high maturity directly enhances an innovation's disruptive potential*, as discussed in theory (Guo et al., 2019), our empirical study suggested that low to moderate degrees of maturity implied high degrees of uncertainty with regard to market entry. Therefore, *less matured business ecosystems can encourage the participation in broad knowledge exchange* to establish reliable infrastructure, which in turn would eventually enhance firms' DC.

5.3 Innovative Capacity

The second category describing internal indicators for the successful application of OI to increase a firm's DC, 'Innovative Capacity', was derived from the preliminary KSFs 'Enabling People' and 'Innovative Capacity' under the category of 'Internal Drivers'. Due to extensive elaborations on innovativeness in relation to issues around HR management and organization during the interviews, we rearranged this category to depict more practical indicators for successful OI strategies. We identified three underlying factors; 'Culture and Organization',

‘Leadership’, and ‘Recruitment’; thus, acknowledging some of the discussed indicators by Subtil de Oliveira, Echeveste, and Cortimiglia (2018), but complementing the original literature with information about organizational structure and recruitment. Overall, the category refers to building, maintaining, and expanding innovation capabilities internally through effective people management.

While scarcely addressed in existing literature (Chesbrough, 2003), the empirical study emphasized the significance of creating an engaging, open culture, with a structure that enabled creativity and innovative drive. To allow for fast technological progress, an agile working environment where multidisciplinary teams would collaboratively follow trial-and-error approaches, was deemed vital. Thus, instead of structuring R&D in vertical functions, constant interaction across disciplines with rotating teams accelerated creative problem-solving, as well as fast communication and feedback cycles to continuously improve current processes. This reflects the critical restructuring of former R&D silos to promote a free flow of ideas, as suggested by Chesbrough (2003). Moreover, allowing for flexible working arrangements, such as home office opportunities, enhanced the overall sentiment towards the fast-paced start-up environment. Accordingly, the described culture and organizational structures imply a collaborative approach within and beyond the company’s boundaries for efficiently accumulating and exchanging knowledge to amplify the internal innovativeness. Therefore, *flexible working conditions paired with diverse teams encourage openness and consequently, drive DC*.

Closely related, ‘Leadership’ should incorporate certain characteristics to enable successful OI integration. Companies with disruptive intent naturally aim for rapid growth to launch widely accessible and affordable products. As teams grow, maintaining an innovative, open culture becomes increasingly challenging and thus, demands for effective, enabling leadership. The empirical results emphasized low hierarchies to uphold the collaborative spirit and autonomous teams for providing the necessary liberty to foster creativity and accountability. In accordance, leaders should consider themselves part of the team to encourage interaction across various people. Correspondingly, *approachable managers and shared leadership promote collaboration within and beyond corporate boundaries and finally contribute to DC.*

Lastly, the empirical data depicted attracting and recruiting the right people as business-critical and imperative to maintain the beforementioned organizational environment. Interestingly, while illuminating numerous internal KSFs for OI success, the research by Subtil de Oliveira,

Echeveste, and Cortimiglia (2018) did not address recruitment strategies in this context. For this study's cases, a learning mindset, an interest in transforming the food sector, as well as high educational qualifications were key characteristics of potential recruits to boost innovative capacity. Moreover, for its recent emergence, previous experience in the alt protein industry was rare, wherefore candidates with related expertise and an overall pragmatic approach were targeted. In response, the companies were mostly open to engage with universities for promoting new, specified programs to train future experts in cellular agriculture. This indicates a strong tendency to leverage OI practices for eventually driving innovativeness. In general terms, the degree of openness within the recruitment strategy should match the availability of qualified staff and educational infrastructure, while the recruits' values should be in line with those of the company. *The more immature a firm's direct business and educational ecosystem, the fewer the number of available candidates, and the more likely external knowledge exchange occurs to accelerate DC*.

5.4 Contextual Environment

Besides the two internal categories, we could empirically validate two external ones as derived from theory. The 'External Environment' with underlying indicators for success from the preliminary framework was renamed to 'Contextual Environment' to avoid confusion through repetitive nomenclature within the final framework and its captions. Thereunder, the previous factors; 'Policy', 'Economic Prosperity', and 'Social Legitimacy'; remained for the final model.

Overall, concerns around 'Policy' were ranked the second most critical indicator for innovativeness and successful commercialization by three out of four case representatives in this study. As a clear prerequisite of product introduction to the market, the impact of the maturity of regulatory systems on potential disruption is enormous. Especially, in the food sector, most jurisdictions worldwide are heavily regulated to protect consumers' health and undergo lengthy processes when updating these policies as new innovations, such as fermented and cultivated meat products, emerge. The duration for companies to gain regulatory approval is thus crucial for disruptive potential. Generally, *the better established the regulatory systems, the fewer financial resources are required for overcoming related barriers, the faster innovations can be launched, the higher a firm's DC*. In contrast, when a company managed to join a strictly regulated national market as the first within its industry, high regulatory entry barriers can actually boost this firm's DC by preventing competitors from entering the market, as exemplified by Ran Liu, co-founder of CellX in China (interview, 24 May 2021). Similarly,

regulations regarding environmental goals can further accelerate the introduction and acceptance of novel, sustainable innovations such as through the SDGs with alt protein products. At the same time, *immature policies encourage companies to apply OI practices* with both direct competition, and governmental bodies in order to advance the regulatory landscape to eventually enhance DC. Policies thus, strongly affect which organizations firms select as partners.

On a different note, the 'Economic Prosperity' in particular states and regions influences how effective OI techniques can be and how easily innovations can disrupt these markets. The overall standard of living, economic growth, unemployment rate, and level of education directly affect the regulatory framework, as well as consumer perception and vice versa. For instance, high economic prosperity indicates strong purchasing power, thus enhanced market potential. Simultaneously, good educational standards and infrastructure imply well-informed consumers and high quality research to foster innovation through OI practices. In the alt food industry, consumer education is critical to reduce skepticism toward unconventional food products. Currently, the global hubs for cellular agriculture are in the San Francisco bay area, Singapore, and Israel; mirroring these implications. Therefore, *moderate to high economic prosperity promotes knowledge exchange and drives DC.*

Closely related for being dependent on educational standards and transparency, 'Social Legitimacy' directly impacts firms' disruptive potential by indicating the degree of consumer acceptance. At the same time, the overall public sentiment toward a novel innovation also impacts the interest from investors and potential business partners, thus drastically driving or moderating DC, as well as the willingness to collaborate beyond companies' boundaries. Empirical data showed the dependency on timing and R&D maturity regarding this indicator's perceived importance. *The more mature an innovation, the more relevant 'Social Legitimacy' becomes*. Moreover, *as the consumer perception and cultural acceptance increase, OI practices gain popularity and in turn accelerate DC*. Even without considering the effect of OI strategies though, a connection to DC can be seen. Therefore, the lack of attention to societal aspects in previous research (Guo et al., 2019) was noteworthy and may be due to the beforementioned varying degrees of significance depending on the technology, industry, type of customers, and geographic region.

5.5 Marketplace Dynamics

The second external category, 'Marketplace Dynamics', combined the previous categories 'External Drivers' and 'Marketplace Dynamics', as their subordinate indicators all described the target market's conditions and development. The initial KSFs were further summarized to the following three indicators for successful OI implementation to enhance DC: 'Technological Uncertainty and Cost Reduction', 'Value Network and Indirect Network Effects', and 'Isolating Mechanism'.

Due to the direct connection between the degree of technological uncertainty and the ability to reduce cost through scalability of a technology, both indicators were merged from the preliminary framework. For instance, the empirical results presented technology as the most critical challenge for an innovation to be successful. More specifically, scaling up the technology to reach industrial production, would in turn enhance efficiency, while drastically reducing the cost. This however, was only feasible as technological uncertainty around a particular innovation would decrease, since large-scale production in itself implies vastly matured technology and processes. While all four cases expressed the eventual goal of price competitiveness compared to traditional food products, except for eniferBio, reaching "price parity initially is probably too big an [sic] ask" (Dr. James Ryall, Cultured Meat Future Food, 2020a, 00:20:00); especially, for cultivated meat businesses. Therefore, the cases' predominant market entry strategies can be described as new market disruption, which would allow for subsequently disrupting the newly created market once individual players could significantly reduce cost. Overall, *when a firm's technological uncertainty is low, DC is positively impacted*. Nonetheless, *when technological uncertainty is high, more knowledge exchange occurs* due to cost-efficient knowledge accumulation (Hallberg & Brattström, 2019), early-stage R&D, and the therefore insignificant risk of aiding competitors to commercialization. *As increasing the internal knowledge base reduces technological uncertainty, efficiency in production is enhanced, prices can be reduced, and DC is reinforced*; thus, agreeing with disruption literature (Christensen, 1997; Sood & Tellis, 2011).

Moreover, 'Value Network and Indirect Network Effects' was derived from three previous indicators as all addressed existing networks and the motivation behind expanding them: 'Indirect Network Effects' under 'External Drivers', 'Network and Relationships' under 'Internal Drivers', and 'Value Network' under 'Marketplace Dynamics'. To enhance DC, firms' relationships with competition, suppliers, regulators, and customers should be well-established

to benefit from knowledge exchange and spillover effects that would accelerate internal innovative drive and technological progress. Moreover, the existing value network throughout the industry, thus the degree of interconnectedness and collaboration, strongly impacts the different players' disruptive potential. For instance, in the emerging alt food industry, one company's success directly translates to increased attention to the whole industry from sides of investors and regulators, which in turn advances the regulatory frameworks and provides additional capital for overall R&D. Moreover, incumbent businesses increasingly engage with new entrants through accelerator programs to boost both partners' DC. For instance, two of the four cases could enhance their innovativeness early on, validating previous research results (Marx, Gans & Hsu, 2014). Consequently, *when networks within and beyond a firm's boundaries are well-established, OI involvement is promoted, and indirect network effects further enhance the overall DC of companies throughout an industry*. This was in line with the suggested effects of networks and disruptiveness (Guo et al., 2019), as well as those of indirect network effects and OI in well-connected ecosystems (Hallberg & Brattström, 2019).

Finally, the 'Isolating Mechanism' describes a market's competitive intensity and a company's response strategy. As suggested by literature, the focus on niche markets at market introduction enables an easier market entry where incumbents fail to react to new entrants for disregarding the indirect threat, which at later stages facilitates disruption from unexpected areas (Christensen, 1997). By targeting a distinct geographical region with one particular product, Alife Foods clearly follows the niche market approach. The remaining cases, while still prioritizing specific regions and customer groups at market entry, were slightly less niche-oriented due to larger product portfolios or planned extensions thereof. Generally, *the more niche, the more likely firms are to leverage OI practices due to distinct target markets and little direct competition at introduction, which finally enhances these companies' DC*. In contrast and validating the findings by Hallberg and Brattström (2019), *with high competitive intensity and broader market entry strategies, knowledge revealing can negatively affect competitiveness and DC*; especially, when there are no isolating mechanisms in place.

5.6 Strategic Knowledge Exchange

Finally, 'Strategic Knowledge Exchange' represents the central KSC for implementing OI to accelerate DC. For being based on all other factors for success, this category was positioned distinctively in the final framework to imply that the indicators were both internal and external, and that the category took on a critical role in responding to the research purpose. While the

relevance of ‘Revealing Strategy’ and ‘Type of Partnerships’ could be validated during the empirical study, a third success factor, termed ‘Pace of R&D’, emerged and was added to the final framework.

The ‘Revealing Strategy’ provides information about two important criteria. First, depending on the ‘Technological Features’, a firm decides whether to leverage OI practices for path extension, path creation, or both. This study’s four cases shared the objective of extending their technology to fully exhaust their BM and target markets in the future. Further, the two fermentation start-ups intended creating additional applications for their technologies, thus also aiming for path creation. This might be due to fermentation processes being regarded as an interim stage for the eventual disruption of the global food system with cultivated products holding the greatest potential. Second, this factor implies the type of knowledge that companies choose to reveal: problems, solutions, or both. Typical for R&D-prone industries, the selected cases primarily revealed specific problems as a result of competitive intensity and extensive R&D investments. Depending on the sensitivity of particular technical details and their importance to the business, however, solutions may be exchanged seldomly among partners or throughout well-established networks. For instance, informally exchanging knowledge regarding regulatory frameworks, consumer education, and supplier information was somewhat common among competitors. With increasing attention from the public sector, the push for open-access research, hence the revealing of solutions, is also accelerated. Therefore, when the ‘Revealing Strategy’ is in line with technology, value network, competitive intensity, as well as the regulatory system, OI practices can have a positive impact on DC. For instance, *when there is a strong value network, immature policies, high technological uncertainty, and low-to-medium competitive rivalry; OI can be used extensively to boost disruptiveness*.

On a different note, the ‘Type of Partnerships’ specify under which circumstances regarding hidden knowledge and the problem complexity, which type of OI can enhance a firm’s DC. Generally, whenever hidden knowledge is high, an open approach to innovation can accelerate innovative capacity and therefore, drive disruptive potential. Similarly, the more complex a particular problem, the more theory-guided the search for a solution should be, which in turn implies considering multiple perspectives from related fields, whenever an industry is scarcely researched. Here, OI practices hold great potential for breaking down complex challenges into simpler tasks, which can then be approached through trial-and-error search. While literature suggested open-access collaboration for complex problems with high degrees of hidden knowledge (Felin & Zenger, 2014), the empirical study showed partly contradicting results in

the alt protein industry. While the field is in fact very open and collaborative, thus coinciding with theory regarding the degree of hidden knowledge, despite the high complexity behind fermented and cultivated food products, business-critical technical details were shared with selected partners at most, and typically on a contractual basis. Accordingly, *the higher the hidden knowledge and the more complex, yet less business-critical a problem, the bigger the positive impact of OI on DC*, while minimizing IP leaking.

Lastly, responding to the empirical data, the 'Pace of R&D' was added as KSF for implementing OI strategies to enhance DC. While explicitly addressed by only one of the case representatives, the required match between the timescales that companies and their potential partners operated on was mentioned indirectly by each participant. For instance, the remaining three cases' focus on quality rather than speed enabled prioritizing strategic, long-term partnerships early on, thus implying a match in timing. Simultaneously, every interview partner described how in order to meet milestones, directly related innovation remained in-house to control the pace of R&D. Accordingly, *a match between innovational pace of both partners, promotes extensive OI and amplifies a firm's DC*. More specifically, *when both parties operate in similar and particularly rapid environments, OI's positive impact on disruptive potential is at a maximum*. Interestingly, neither the research on KSFs for OI implementation, nor that on indicators for DC addressed the pace of R&D and innovation. As many researchers represent universities, thus rather bureaucratic organizations as emphasized by our interviewees, the lack of attention may be attributable to close connections with academia and resulting conflicts of interest, or to unawareness of the matter.

6 Conclusion

6.1 Research Aims and Objectives

The purpose of this study was to better understand the underlying indicators for the successful implementation of OI practices regarding enhanced DC on a firm-level. In response to this research objective, after creating a preliminary framework on the basis of existing literature, a qualitative multiple case study was conducted to introduce a new framework that depicts our own assessment of the empirical, as well as the theoretical results. In essence, the intent was to address the identified research gap (Alexy, George & Salter, 2013) and complement the existing body of literature through combining the concepts of OI and disruptive innovation.

The insights from the cases, additional secondary data sources, and the literature review led to the final model 'Open-Approach Disruption'. It illustrates the cause of connection between OI practices and DC in the form of five key categories with underlying indicators for disruptiveness. The category 'Strategic Knowledge Exchange' is presented as the most critical cause of connection for being influenced by the remaining ones. Further, these categories were subdivided on the basis of being internal or external to the firm at hand. In comparison to the initial theoretical framework, some adjustments were made, including amalgamation and renaming of categories and subordinate indicators, as well as the addition of a new category with underlying success factors in response to empirical findings. These changes combined the previously isolated perspectives on innovation, namely OI and disruption, and highlighted a clear cause of connection between them, as contradicting factors were minimal at most.

Amid the increasing intricacy of the business world and larger environment, commonly referred to as VUCA (Mack et al., 2015), innovation theory needs to be continuously complemented by new models to depict today's high degrees of volatility, uncertainty, complexity, and ambiguity; hence, the evolving circumstances. Therefore, combining the two fields of innovation theory around disruption and openness responded to the need for up-to-date research that considers the fast pace of market development and transformation. The failure of incumbent firms to subsist in these turbulent environments, termed 'resilience gap' (Hamel & Välikangas, 2003), was thus addressed indirectly by exploring the success factors of potential future intruders, which in turn implied indicators for the continued existence of established companies. Moreover, to enhance the theory through a new lens, an ex-ante perspective on disruption was taken by illuminating young firms in pre-market or pilot scale phases within an industry that due to high R&D investments, holds great potential for disruptive OI.

6.2 Theoretical Contribution

By introducing a new model illuminating the KSFs for OI strategies to enhance DC, this study contributed to the existing research body in three ways.

First, we attempted to fill the research gap of the relation between selective revealing strategies and "the concept of disruptive innovation and the issue of overcoming internal forces favoring the extension of known technological trajectories (e.g., Christensen, 1997)" (Alexy, George & Salter, 2013, p.287). We therefore created a framework that was initially derived from existing theory on both subcategories of innovation management, wherefrom a cause of connection was suggested from the application of OI practices to a firm's DC. Here, half of the preliminary success factors were attributable to each research field. As a basis for OI, recent academic sources addressing OI and selective revealing (Alexy, George & Salter, 2013; Felin & Zenger, 2014; Hallberg & Brattström, 2019; Subtil de Oliveira, Echeveste & Cortimiglia, 2018) were leveraged to derive preliminary indicators for the success of these strategies. Moreover, we based the initial indicators for DC on the *Measurement Framework for Assessing Disruptive Innovations* by Guo et al. (2019).

Second, as the concept of OI had predominantly been analyzed by reference to the IT and computer component industry, we extended existing research by exploring OI with new empirical data. The focus on the alt food industry enabled further validation of previous literature on knowledge exchange.

Finally, past empirical research had largely prioritized the standpoint of large enterprises when exploring disruptive innovations, as well as the success of OI practices. This study's perspective from SMEs, and more specifically start-ups, added a new layer of understanding the previous literature.

6.3 Practical Implications

Combining both research fields, OI and disruption, and thereby extending the existing body of literature, also allowed to derive practical implications to be considered in the business world.

In essence, this study's findings suggested that for managers with the intention to enhance their firm's disruptive capacity, incorporating OI practices in their R&D strategy may be an effective approach to do so. The key indicators for successfully implementing such techniques can be summarized as 'Strategic Knowledge Exchange'. Nonetheless, additional internal and external clusters of success indicators, such as 'Technological Features' and 'Marketplace Dynamics',

need to be considered to strategically manage innovation. Particularly noteworthy was the category 'Innovative Capacity' as it emerged from empirical data as one of the key clusters of success factors, whereunder the recruitment strategy was strongly emphasized. When disruptive intent is given and R&D efforts are high, the degree of openness throughout the innovation process should still not be decided on lightly, as all critical success factors for OI's positive impact on DC should be contrasted with potential risks, including the leakage of IP. Moreover, 'Strategic Knowledge Exchange' should be dynamic and evolve over time as external and internal influencing factors continue to change. This study thus provided managers with a tool for revisiting their innovation strategy, while facilitating the practical implementation by reference to different cases.

Furthermore, additional types of organizations and institutions can benefit from the findings of this project. As the 'Pace of R&D' was identified as a key success factor for OI to accelerate DC, potential collaboration partners should demonstrate similar timescales of operation to speed up rather than restrict each other's innovation process. Due to typically prolonged bureaucratical processes as opposed to fast-changing environments, this is especially critical for partnerships between universities and start-up businesses. Although academia is highly appreciated for the quality of research and scientific results, for fast-growing companies, hiring new staff to develop technology allows for more efficient R&D. In an attempt to approximate these two extremes progressively, private research institutions increasingly offer more rapid engagement on a contractual basis. Nonetheless, if bureaucracy could be optimized for industry collaborations, knowledge exchange is likely to increase. Similar implications apply to interactions between industry and governmental bodies, as collaborations remain scarce, even though partnerships in this context are desirable to responsibly advance regulatory frameworks.

Finally, investors and incumbent businesses may leverage the presented insights to adopt a more receptible eye for potential future disruptors and react to market developments accordingly. For incumbents this could imply expanding their current business to include potentially disruptive innovations as perceived externally or leveraging the presented tool to test its validity within their own, larger organizations. Both established firms and investors may utilize the framework to assess start-ups' DC for consideration in future investments.

6.4 Limitations and Future Research

Following the closing discussion on this study's fulfillment of its research purpose in terms of theoretical contribution and practical implications, the research limitations were highlighted for transparency in this section. While this project could adequately satisfy the research aims and objectives as presented in the introduction, several areas for future research were proposed in response to the identified limitations.

First of all, the issues around analytical generalization need to be acknowledged. This study discussed four representative cases for the alt food industry, all being start-ups but from varying geographic locations with differences regarding lifetime and number of employees. Moreover, the cases could be distinguished on the basis of technology, with an equal representation of companies focusing on fermented and cell-based food products. Further, one case offered a perspective from the alternative aquafeed industry as a subcategory of the global alt food sector. Thus, nuanced dimensions were considered when discussing the cause of connection between OI practices and DC. Nonetheless, the industry in itself represents a rather unique viewpoint. While analytical generalizability from the selected industry to a broader range of IP-prone fields can be expected, the industry focus clearly implies a limitation of this research. Therefore, conducting this study with new empirical data in terms of different start-ups within the alt food space, as well as larger, well-established companies within and beyond the food sector can further test the derived framework for its general applicability.

Moreover, in consideration of this study's limitations regarding time and location dependency, a qualitative multiple case study approach leveraging exploratory interviews in virtual settings and in combination with secondary data sources was deemed most promising to derive realistic insights. For a more thorough investigation of the cause of connection between OI and DC, future qualitative research may be conducted for an extended period of time and by the means of qualitative observations at the respective firms' locations. To statistically validate the introduced framework for OAD, a quantitative study may be conducted. Here, the identified categories and underlying indicators for success could further be examined to identify an order of importance and urgency.

While this study's framework brought together two distinct research areas, OI and disruption theory, in order to explore their cause of connection, there certainly are other drivers behind DC that go beyond knowledge exchange with external parties; hence, representing another limitation. We suggest the extension of the framework with additional research fields to put the

identified success factors into a broader, more realistic context. On that note, absorptive capacity, resilience, and dynamic capabilities may be particularly interesting.

Finally, in accordance with the beforementioned intricacy of the world, it was important to acknowledge that this study represented a snapshot of current business and industry dynamics. The empirical data, thus mirrored people's opinions and individual perspectives that were shaped by the larger environment as of Spring 2021. This indicates that the more time passes, the less accurate this project's findings may become, unless revisited and tested continuously. Nevertheless, we hope to have nudged future discussions on the combination of OI and disruption theory for further application and extension of the presented framework. After all, we regard it as a dynamic model that should be changed as the contextual environment evolves.

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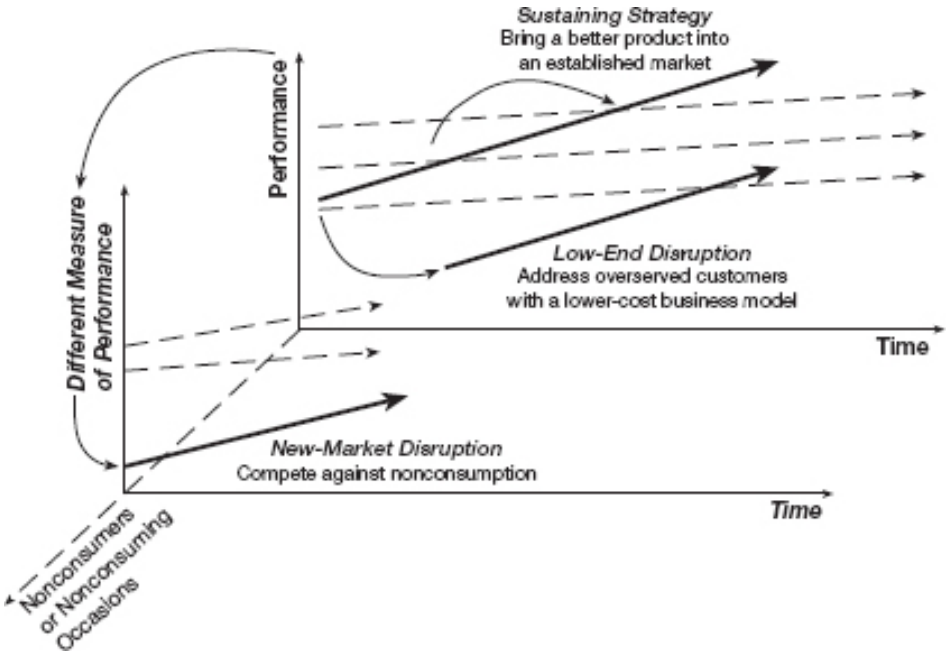
Appendix A

Disruptive Innovation

The third dimension of the disruptive innovation model.

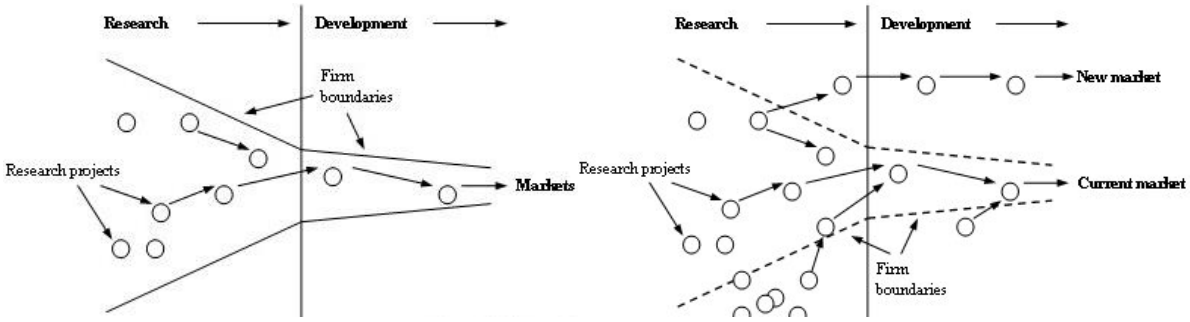


Source: (Christensen & Raynor, 2003a, p.44).

Appendix B

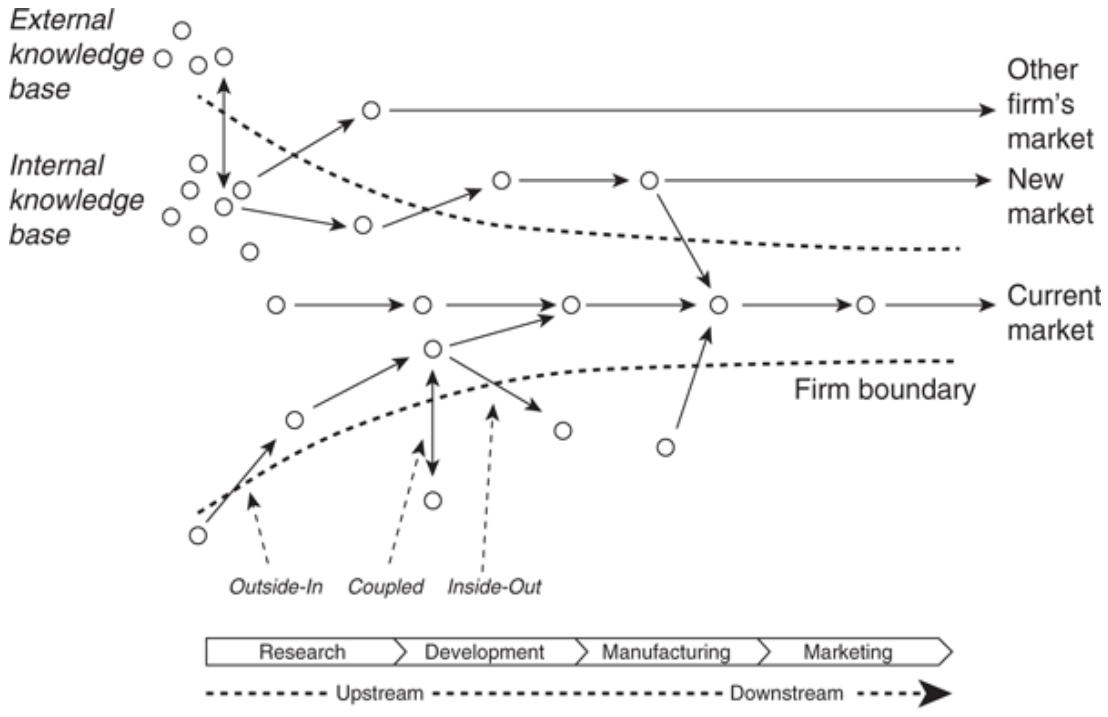
Open Innovation

Closed versus open innovation.



Source: (Chesbrough, 2003, p.44).

Coupled open innovation.



Source: (Chesbrough & Bogers, 2014, p.19).

Selective revealing strategies.

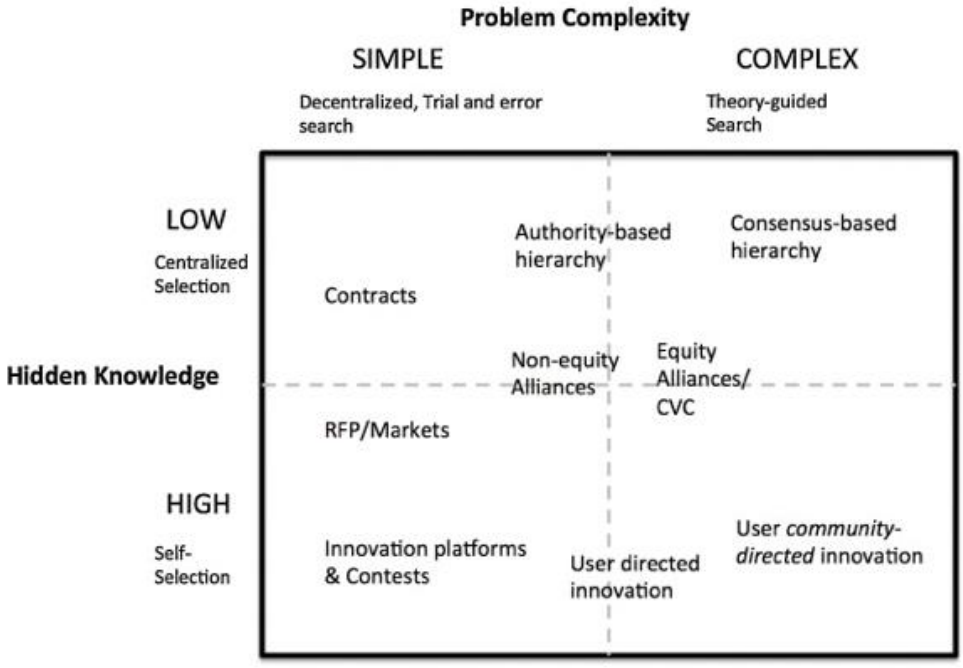
Selective Revealing Strategies

		Mode of revealing	
		Problem revealing	*Solution revealing*
Goal	*Path extension*	Issue spreading (broadcast search)	Product enhancing (open source software)
	Path creation	Agenda shaping (open research calls)	Niche creating (academic publishing)

Note: Exemplar practices embedding selective revealing are given in parentheses.

Source: (Alexy, George & Salter, 2013, p.282).

Optimal governance form for knowledge exchange based on problem complexity and hidden knowledge.



Source: (Felin & Zenger, 2014, p.918).

Appendix C

Alternative Food Industry

Distinction between plant-based, fermented, and cultivated food products.

	Plant-based	**Fermented**	**Cultivated**
Definition	Alternatives to animal-based products made from plants.	Fermentation refers to different things in different disciplines. In the alternative protein industry, it is subdivided into three different types: traditional, biomass, and precision.	Genuine animal meat produced through cultivating animal cells.
Included Types of Products	Plant-based meat, seafood, eggs, and dairy products.	1) Fungus rhizopus; lactic acid bacteria; MycoTechnology fermentation (e.g. eniferBio, Mycorena). 2) Biomass as main ingredient (e.g. Quorn/ Meatis filamentous fungi). 3) Produce enzymes, flavoring agents, vitamins, natural pigments, and fats (e.g. Perfect Day, Clara Foods, Impossible Foods).	Cultivated meat, seafood, and organ meats products.
Development over Time	Plant-based products have steadily increased for centuries. Initially, they were developed for vegetarians. Recently, plant-based switched to replicating or biomimicking conventional meat products for flexitarians.	Microbial cultures have been used for millennia to preserve foods, create alcoholic beverages, improve nutritional value, and bioavailability (e.g. kimchi; tempeh). Currently, a broader range of applications is possible.	New field that emerged after Mosa Meat's live demonstration of cultivated meat in 2013.
Market Size	Currently only about 1% of the retail meat market in the U.S.	Unknown	Unknown
Method/ Manufacturing Process	Growing crops as the source of raw material for processing and mixing the ingredients.	1) Traditional: utilizes intact, living microorganisms to modulate and process plant-derived ingredients. 2) Biomass: leverages the fast growth and high protein content of many microorganisms to efficiently produce large quantities of protein. 3) Precision: microbial hosts as 'cell factories' for producing specific functional ingredients.	Stem cells from an animal are acquired and harvested to grow cells in bioreactors (cultivators) at high densities and volumes. Oxygen-rich cell culture medium is fed with basic nutrients. Changes in composition that are often in tandem with cues from a scaffolding structure, trigger immature cells to differentiate into the skeletal muscle, fat, and connective tissues. The differentiated cells are harvested, prepared, and packaged into final products. Some companies are pursuing a similar strategy to create milk and other dairy products.

The table's content was derived from the GFI website on alternative protein (GFI, 2021).

Appendix D

Selected Cases

Interview overview (**Main cases**, reference cases).

Company	*Specialization*	*Primary Data Source*	*Interviewee*	*Date & Time*
AlifeFoods	Cultivated Meat (Schnitzel)	Video Interview	Dr. Bernd Böck Part Owner, Supply Chain & Manufacturing	May 17, 2021 18:15–19:00
CellX	Cultivated Meat (Cell Culturing & 3D Bioprinting)	Video Interview	Ran Liu Co-Founder	May 24, 2021 19:00–19:30
eniferBio	Fermentation of Fungi (Mycoprotein for Fish Feed)	Video Interview	Simo Ellilä Co-Founder, CEO, CTO	May 5, 2021 10:00–10:30
IntegriCulture	Cultivated Meat (Cell Culture Technology)	Email Interview	Kimiko Hong Team Lead CEO Office, Business Development	May 23, 2021
Mycorena	Fermentation of Fungi (Mycoprotein)	Video Interview	Dr. Paulo Gonçalves Teixeira Chief Innovation Officer	May 12, 2021 14:00–14:30
Vow	Cultivated Meat (Undomesticated Animals)	Video Interview	George Peppou Co-Founder, CEO	May 12, 2021 9:30–10:00

Appendix E

Interview Guide

A Introduction:

- Exchange pleasantries, introduce both researchers, seek recording consent, and ensure confidentiality as agreed

1. *Icebreaker:* Tell us about yourself and the company. How did you start working in this industry?

B Disruption:

2. *Easy:* What is the vision behind your company?
3. *Easy:* So far, what have you perceived as barriers in order to achieve these goals?
    a. Technology, consumer acceptance, policy, and investment – Which is the most challenging one?
4. *Content:* Talking about your product at the moment, where are you at right now in terms of R&D maturity and commercialization?
5. *Content:* Where do you (plan to) position your product in the market (compared to existing ones and the competition)?
    a. Who is the target customer at market entry and which geographical market are you aiming for right now?
    b. How do you estimate the (technological)potential of your product with regard to different markets? (Do you see that the technology could be applied in different industries?)
6. *Content:* What made you choose this specific market?
    a. Can you tell us more about the situation regarding policy, economic factors, and customer perception?
7. *Content:* As of right now, many products within the alternative food industry are quite pricy in production and final price. Can you elaborate on the situation within your company and how you expect it to evolve over time?
8. *Content:* How would you describe the innovation process with your company?
    a. More specifically, the different parties that are involved with innovation and R&D.

D Open Innovation:

9. *Content:* How would you describe your company´s engagement in collaboration beyond organizational boundaries?
    a. What does the setup of governance look like to encourage or prevent such knowledge exchange?
10. *Content:* What are the objectives behind this approach?
    a. What types of contents are you collaborating on with partners?
11. *Content:* What do you perceive as impactful influencing factors on the decision of whether to collaborate and open up or keep innovation in-house? (Rank them)
    a. Internal drivers: capability development, culture and leadership, and established links and networks
    b. External drivers: competitive intensity, network effects, and technological maturity
    c. Can you describe what is in it for you and the ones you collaborate with?

E Cause of Connection:

12. *Content:* Speaking of knowledge exchange and collaboration, how do you experience such practices to affect your company's innovative drive?
    a. Could you experience or are you concerned about negative consequences of openness?
    b. *Controversial:* In your opinion, what is more important to successfully enter the market: timing and speed or quality?
    c. *Controversial:* In the alternative food industry, a lot of people expect a shift in consumer behavior within the next 10-15 years from conventional, to fermentation, and through to cultivated products as the new norm. What is your take on that?

F Round-up:

13. *Easy:* What is the next big step on your journey?

- Final remarks?
- Express appreciation, offer sharing the report and findings, and seek possibility to follow up with a few questions