



SCHOOL OF  
ECONOMICS AND  
MANAGEMENT

# Entrepreneurial Firms in Pursuit of Resilience

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*An Empirical Study of Dynamic Capabilities in the  
Lab-Grown Food and Dairy Industry*

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## **Abstract**

This thesis contributes to the exploration of business models with an aspect of change, by applying the concept of dynamic capabilities. The aim is to explore how entrepreneurial firms utilise dynamic capabilities in order to create resilient business models in times of technological change and uncertainty. Therefore, a multiple case study was conducted on the lab-grown food and dairy industry. The dynamic capabilities of sense, seize, and transform were the units of analysis and different activities pursued by the firms were identified within.

Sensing is about acknowledging opportunities, threats and barriers from technological change and the competitive environment. Seizing of opportunities directly influences a firm's BM, interdependencies must be considered carefully and strategic choices supporting flexibility should be favoured. Transformation regards the reconfiguration of the established organizational structure and processes within. The empirical results led to the replacement of transform, with shape. Shaping rather regards actively shaping the organisational structure and culture as the company grows to facilitate agility, thus is more applicable to start-ups. A firm that senses the environment, creates strategic options, and seizes them through adjustments in the business model while shaping culture and organizational structure in times of technological change and uncertainty, will eventually create long-term competitive advantages and thus, acquire a resilient business model.

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# 1 Introduction

## 1.1 Background

The world we live in today is constantly changing and becoming increasingly complex and uncertain (Schoemaker, Heaton & Teece, 2018). In our everyday lives, change occurs as trends and perceptions shape our decisions, values, and beliefs. On a larger scale, climates, politics, consumer demands, as well as increased globalisation, influence various markets and industries worldwide. One of the major drivers of change is innovation, which has the potential to disrupt existing markets and drastically change common practices (Chandler, 2020; Wirtz & Torregrosa, 2020). Innovations can stem from an array of sources, such as, changes in markets or industries, demographics, or consumer perceptions (Drucker, 2002). For instance, the Japanese paid close attention to the change in demographics in the 1970s, acknowledging a shift in the workforce away from traditional manufacturing. Hence, they addressed this need through the development of robots to do the work and are now considered a leading country in robotics technology (Drucker, 2002). Another source of innovation is evident in the rise of the electric vehicle. A change in consumer perception as the negative externalities of combustion engines became prominent, forced car manufacturers to innovate and adopt greener approaches (Seebode, Jeanrenaud & Bessant, 2012). In fact, this change in environmental perception resulted in what Seebode, Jeanrenaud and Bessant (2012) refer to this as the 6th long wave of innovation. By responding to sustainability challenges, new opportunities arise for businesses to innovate and to even promote whole system perspectives (WBCSD, 2010).

Often changes are anticipated and driven by technological advances (Schilling, 2017). In fact, academics claim that technological change has become one of the single-most important driving forces of innovation in many industries (Brynjolfsson & McAfee, 2011; Schilling, 2017; Teece, 2010). Examples of technological innovations that have had drastic influences on society, include such as the rise of the Internet of Things (IoT). The IoT has been exploited in many fields, from both an individual and business perspective (Atzori, Iera & Morabito, 2010). The technology is for example used in e-health. Diabetics nowadays have a sensor placed on their arm which constantly monitors their blood sugar level and can predict hypoglycaemia in real time. It then notifies the patient on their smartphone or smartwatch, to prevent fatigue and the loss of energy. Thus, the innovation provides greater quality of life. Technological innovations can disrupt industries, creating many opportunities for the future of technology.

When a new technology fulfils a similar market need through the establishment of a new knowledge base, it can be considered as a discontinuous innovation, making another technology rendered obsolete (Schilling, 2017). Such innovations rarely come from incumbents as they primarily focus on refining mature technological products, failing to see new opportunities (Christensen, 1997). Instead, radical innovations often arise from start-ups. Newcomers are often focusing on niche markets first, where they can advance their technology at a faster pace than what is demanded by customers. They often have the potential to disrupt the larger market that is relying on the old and often mature technology.

In recent years, the acknowledgement of a change in demographics has grasped the world's attention again. According to the United Nations (UN) (2019), the world population is expected to reach 9.7 billion by 2050. In order to feed the world population, farmers would have to produce 70% more food (United Nations, 2013). With a limited amount of available resources, it will be challenging to satisfy the wants and needs of future generations. Moreover, the negative externalities of industrial agriculture are threatening the sustainability of the world's resources (National Geographic, 2014). According to the UN (2021), livestock and fish farming are responsible for 14,5 % of the world's greenhouse gas emissions. That is more than the combined total of the world's emissions produced by road and air traffic.

In addition, many consumers have become more sustainably aware and see a need to protect the environment and therefore cannot support the industrialized livestock-farming any longer (National Geographic, 2014). A need for change has thus become a mutual understanding.

Entrepreneurs in the food industry have acknowledged the aforementioned changes in demographics and consumer perception. Many start-ups have taken these concerns and turned them into opportunities, meeting them with technological innovations evident in the rise of the lab-grown food and dairy industry. The ultimate goal of the lab-grown food industry is to produce milk, cheese, fish and meat that is identical to the product harvested from live-stock, or even better (Schwartz & Bomkamp, 2019; Specht, 2021). The industry's growth began in 2013 and has been growing ever since, with new entrants from all over the globe. In 2020, the investment in lab-grown food was three times as high as in 2019, reaching \$3.1 billion (Byrne, 2021). According to a report by the Boston Consulting Group (BCG), it is predicted that 10% of the consumed meat, eggs, and dairy around the globe will be replaced by an alternative by

2035 (Witte et al., 2021). Alternative proteins based on microorganisms (precision fermentation) that are realistic in taste and texture might reach cost parity with conventional protein as early as 2025. Products produced through the cultivation of animal-cells, might reach parity by 2032. These alternative protein sources will not just fill the gap between supply and demand, as production plants can be placed anywhere and produced at any time, they will also have much less environmental impact. Alternative proteins produce 80% less greenhouse emissions, require 99% less land use, and 96% less freshwater than livestock farming (Future Meat, 2021). This is thereby a market with nascent technologies, extreme growth potential, and high relevance for the world and the climate. No technology has become dominant yet; hence, everyone is in the race for technological maturity and being among the first on the market of lab-grown food and dairy.

The success of these start-ups does not only depend on the technology they are developing but also on their business model (BM). A BM is a pathway in which the elements of a firm are converted into a model for performance and a stream of profits (Christensen, 1997; Schilling, 2017; Teece, 2018). Whether it's a new venture or an established player, a good BM remains crucial to the success of an organisation (Magretta, 2002). Chesbrough (2010, p.354) claims "it is probably true that a mediocre technology pursued within a great business model may be more valuable than a great technology exploited via a mediocre business model". Despite the importance of a BM, its mere implementation does not ensure firm success. Wirtz and Torregrosa (2020) further elaborate that ill-conceived or inconsistent BMs, and insufficient differentiability of BMs, resulted in a lack of survival of many start-ups in the New Economy. The concern with BMs is that they are often viewed as a blueprint of the firm's current activities, and not seen as an element that requires continuous development (Demil & Lecocq, 2010). As stated by Hamel and Välikangas (2003), adaptability is highly important in the context of today's firms and should be a priority for top management. The new management principles should consist of "variety, competition, allocation flexibility, devolution and activism... if the [end] goal is continuous, pre-emptive strategic renewal" (Hamel, 2006, p.79).

To address such concerns, concepts such as dynamic capabilities (DC), introduced by Teece (1997), aim to keep a BM constantly adapting, thus fostering a firm's long-term competitive advantage in dynamic environments. In particular, Teece (2018, p.40) implies "the crafting, refinement, implementation, and transformation of business models are outputs of higher-order (dynamic) capabilities... [and] the strength of a firm's dynamic capabilities is vital in many

ways to its ability to maintain profitability over the long term”. These capabilities, more specifically, the sensing and seizing of opportunities, and the transformation of an organization, allow a firm to generate long-term competitive advantages (Teece, 2007; Teece, Peteraf & Leih, 2016).

In correspondence with Teece, Hamel and Välikangas (2003) call this form of long-term competitive advantage, *resilience*. Resilience is captured by a firm that enables the ability to sense the environment, create strategic options, and adjust its resources, faster than its competitors in turbulent times (Hamel & Välikangas, 2003). Hence, there is an evident link between DCs and resilience. It is therefore germane to create an understanding of how firms utilise their DCs in the drive towards resilience.

## 1.2 Problematisation

The rising interest in BM theory in regard to strategy (Zott, Amit & Massa, 2011), has generated a deluge of scientific contributions to explaining a firm’s value creation, performance, and competitive advantage (Casadesus-Masanell & Ricart, 2010; Hedman & Kalling, 2003; Osterwalder, Pigneur & Tucci, 2005). The perspective is commonly recognised as a holistic overview and strong compliment to stand-alone perspectives (Gibe & Kalling, 2019), such as but not limited to, the resource-based view (Barney, 1991) and the Five Forces Framework (Porter, 1985), which may otherwise limit aspects of the rich map of matters to address in an exhaustive and systemic strategic analysis. However, despite the significant increase in scientific contributions on BM theory, research in the particular context of BM *change* appears to be scarce. A review of existing literature reveals a significant gap that has yet remained underexplored in academic research.

The BM field isn’t particularly focused on change and how firms successfully manage to modify or expand BMs (Foss & Saebi, 2017). Strategists have initiated the discussion about change through the field of BM innovation (BMI) (Chesbrough, 2007; Johnson, Christensen & Kagermann, 2008; Markides, 2006; Osterwalder, 2004). However, BMI focuses on radical changes made to a BM, and primarily addresses incumbents who already have an established BM (Wirtz & Torregrosa, 2020). Wirtz and Torregrosa have however, shifted the focus of BM change to refer to general change, which is more suitable for an emerging industry consisting

of start-ups. The concept of DCs has also risen to prosperity in recent years, to address organisational success in changing environments. We thereby assume that the utilisation of DCs can possibly help to resolve the shortcomings of BM change and thus, aim to investigate the concept of BM change in relation to start-ups.

### **1.3 Research Question and Purpose**

Drawing on the background and problematisation, the purpose of the study is twofold. Firstly, the authors intend to contribute to academia by addressing the literature gap of BMs and its relationship with change, through the combination of DC and BM theory, thus adding to literature. The study thereby appeals to the audience of researchers in the field of strategic management. This thesis contributes to the exploration of BMs with an aspect of change, and how DCs are applicable for start-ups, potentially opening new pathways for examination. Secondly, the study seeks to contribute to practice by enhancing the understanding of how entrepreneurial firms adapt when facing change driven by technological innovations. The exploration of BM change is thereby relevant for entrepreneurs. In particular, the research is relevant for entrepreneurs in industries undergoing changes due to technological innovation, such as those in the lab-grown food industry. By exploring the activities undertaken to pursue the capabilities of sensing, seizing and transforming, entrepreneurs can utilise the information as guidance on how to adapt their BM when facing uncertainty and dynamic environments. In summary, this leads to the following research question: How do entrepreneurial firms use dynamic capabilities in order to create resilient business models in times of technological change?

Addressing this RQ, a multiple case study examining decision-making in lab-grown food start-ups worldwide, will be conducted. The research approach and company selection will be further elaborated in the methodology section below.

### **1.4 Outline of the Thesis**

Following the introduction, chapter 2 includes a review of beginning with a common understanding of BMs and BM change. The literature review thereafter provides an understanding of DCs and its relevance to BM change. DCs and BM change are thereby brought together to

understand and support the relevance of resilience in terms of firm survival. The chapter is concluded with the establishment of a preliminary framework which draws on the presented literature and is intended to serve as a template for the subsequent data analysis. The third chapter elaborates on the methodology that pursues this study. This section provides motivation for the research approach and design, prior to outlining data collection and analysis. The chapter concludes with a reflection on reliability, validity and ethical considerations of the study. The fourth chapter motivates the chosen case, providing a comprehensive description of the lab-grown food industry. Following, the empirical findings are presented and analysed. The fifth chapter utilises the information gained from the empirical findings and compares them to theory on DCs, by applying pattern matching. It concludes with the modification of the preliminary framework, thereby deriving a final framework. Ultimately, chapter six concludes the thesis by providing theoretical and practical implications. The limitations of the study will be addressed and possible avenues for further examination are proposed.

## 2 Literature Overview

According to Webster and Watson (2002), it is essential for all academic research to conduct a review of existing literature. Therefore, the following literature review seeks to provide an overview of existing research and theories. Following this, a theoretical framework should be conceived for the consecutive analysis (Levy & J. Ellis, 2006). A literature review should be conducted across different fields, establishing an appropriate level of depth and breadth and, thus ensuring the quality (Webster & Watson, 2002). The first synthesis revealed a gap in existing literature and aided deriving the research problem for this thesis. Whereas the following review will focus on identifying an approach to create a resilient BM. These theoretical findings will be organized and combined in a preliminary framework which then provides guidance for the following analysis.

### 2.1 Fundamentals of Business Models

#### 2.1.1 Evolution of Business Models

The term BM was first used in an academic paper in 1957 but did not rise to popularity until the late 1990s and early 2000s (Osterwalder, Pigneur & Tucci, 2005). In the early 1990s it was primarily used within Information Systems (Zott, Amit & Massa, 2010). With the start of the digital economy the term BM gained relevance (Ghaziani & Ventresca, 2005).

Wirtz and Torregrosa (2020) identified three historical approaches within the development of BMs. First, the *Information Technology* approach focused on computer-based business modelling and was established between 1975 and 1995. It is the aim of business modelling to develop a business compliant architecture by defining an enterprise's goals and identifying available resources. The second approach known as, *Organizational Theory*, was defined in the early 1990s (Wirtz & Torregrosa, 2020). The BM became a tool to promote managerial instructions, rather than a mere concept to implement decisions (Deelmann, 2007). Since then, the BM was seen as a representation of a company's architecture (Wirtz & Torregrosa, 2020). By 2000, the BM concept was extended by strategic management ideas and gained more public attention which in turn led to the third stage, namely the *Strategic Approach* (ibid.). During

this time, different schools of thought like the *Market-* and *Resource-Based-View* or the *concept of innovation* impacted the BM concept significantly (ibid.). The Market- and Resource-Based-View (RBV) were first seen as divergent, but now as complementary theories. Therefore, the value chain analysis (Porter, 1985), Schumpeterian innovation (Schumpeter, 1976), RBV (Barney, 1991), strategic networks theory (Burt, 1992) and transaction cost economics (Williamson, 1979) were incorporated in BM theory (Hedman & Kalling, 2001). Over time, the three different approaches converged, and BMs are now seen as an integrated management concept (Wirtz & Torregrosa, 2020) or as Magretta states: “A business model’s great strength as a planning tool is that it focuses attention on how all the elements of the system fit into a working whole” (2002, p.92). When innovation gained relevance in BM literature, many innovative web-based businesses were founded (Magretta, 2002). However, many of the new ventures failed due to a missing understanding of BMs, bringing BMs into discredit. Therefore, since 2000, the term has been more frequently used in academic articles, newspapers and within the business environment. By this frequent use, the term BM became a buzzword with no consistent definition (Osterwalder, 2004; Zott & Amit, 2010). Magretta argues, “today, ‘business model’ and ‘strategy’ are among the most sloppily used terms in business; they are often stretched to mean everything—and end up meaning nothing. But... these are concepts with enormous practical value” (2002, p.92). Therefore, although many authors have tried to find a definition, there are only a few with a universal comprehension (Wirtz & Torregrosa, 2020).

In Table 1 below, five common BM definitions can be seen. Often researchers highlight the value proposition, the involved players, or the external influences and view the BM as an architecture or tool (Weiner, Renner & Kett, 2010). The value proposition is the core of the definitions. For example, Osterwalder (2004) neglects external influences and concentrates on the content of the value proposition and the relationships between the components. This definition has a strong reputation and is highly accepted in academia and business. However, the purpose of this thesis requires a more holistic perspective that includes organization-external factors. According to Gibe and Kalling, the BM approach provides a more holistic view of strategy than “individual, bivariate causal strategy theories” (2019, p.10). Hence, the following in this thesis reflects on their comprehensive and holistic definition.



<b>Author</b>	<b>Definition</b>
Amit & Zott (2001)	“The design of transaction content, structure, and governance so as to create value through the exploitation of business opportunities”
Afuah & Tucci (2001)	“A Business Model is the method by which a firm builds and uses its resources to offer its customers better value than its competitors and to make money doing so. It details how a firm makes money now and how it plans to do so in the long term. The model is what enables a firm to have a sustainable competitive advantage, to perform better than its rivals in the long term. A business model can be conceptualized as a system that is made up of components, linkages between the components, and dynamics.”
Osterwalder (2004)	“A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing a company's logic of earning money. It is a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams.“
Johnson, Christensen & Kagermann (2008)	“A business model, from our point of view, consists of four interlocking elements that, taken together, create and deliver value“. These four elements are the customer value proposition, profit formula, key resources and key processes. With the value proposition being the most important one.“
Gibe & Kalling (2019)	“A business model is an idea concerning the interrelation of the things inside and outside an organization. It connects organization-internal features such as asset base, activities, structure, culture, control mechanisms and any other feature in the organization with organization-external entities, such as factor and product markets and customers, suppliers and competitors, along with societal issues, including politics, trends, technology development, regulations and more. The basic idea is that the intersection, which is the offering, has a cost, a price and a volume reflecting the internal competition and societal tendencies.”

*Table 1: Definitions of Business Models*

### 2.1.2 Business Model Components

Similar to the variety of definitions revolving BMs, there exists an array of perspectives regarding the components of the BM (Morris, Schindehutte & Allen, 2005; Zott, Amit & Massa, 2011). Osterwalder and Pigneur (2010) developed the Business Model Canvas to visualise and explain how a company does business in an easy and understandable way. The canvas incorporates nine different dimensions, namely: Key Partners; Key Activities; Key Resources; Value Propositions; Customer Relationships; Channels; Customer Segments; Cost Structure; and Revenue Streams. This framework has been highly accepted in academia as well as in practice (Gassmann, Frankenberger & Csik, 2014; Weiner, Renner & Kett, 2010). The components can be divided into two sections, representing efficiency on one side, and value on the other. The Canvas can be filled out with an existing or a new BM in order to break down the complexity of a business and to visualize the value creation (Osterwalder & Pigneur, 2010).

Schön (2012) provides a similar list of components, however, classified into the main categories of: Value Proposition, Revenue Model and Cost Model. Schön argues the BM is hardly modularised itself, however modularisation occurs with the elements within, thus increasing flexibility. The aspects of synergy and position thereby play major roles in understanding the strategic flexibility of the BM. Synergy regards the co-existence of multiple BMs, and position regards the firm's position on the value chain, whereby a stronger position allows a firm to define the rules and enforce adaptations as required.

Despite various interpretations, or categorisation of aspects comprising a firm, most frameworks – in some way – include the components of: Offering, Customers, Revenue and Cost Structure (Afuah & Tucci, 2003; Gassmann, Frankenberger & Csik, 2014; Gibe & Kalling, 2019; Johnson, Christensen & Kagermann, 2008; Osterwalder, 2004; Zott, Amit & Massa, 2011). Essentially, the components comprising a BM enable a simple interpretation of what a firm does, and how they create value (Osterwalder & Pigneur, 2010). It is important that a BM is internally aligned and coherent (Ritter et al., 2014), particularly with the internal structure and overall management model of the company (Birkinshaw & Ansari, 2015). This is an important aspect to consider as there exists complex interdependencies among the various components (Schön, 2012; Johnson, Christensen & Kagermann, 2008). The firm is a complex entity, hence any alterations to a certain component can affect the company at large.

### 2.1.3 Modification of Business Models

In order to remain competitive in a dynamic environment, a company's BM must be well-understood and adapted accordingly to differentiate it from the competition (Hedman & Kalling, 2001). In a study conducted by IBM (Giesen et al., 2009), approximately 70% of companies affirmed that the BM often must be radically changed to deal with new technologies or customer needs, to stay competitive. Hence, *change*, often driven by external or internal forces, is at the core of BM Management (Linder & Cantrell, 2001). BM change affects an entire organization and all its functions, eventually even has an impact across industries (Zollenkop, 2006).

External forces include such as, but not limited to, political, economic, societal, technological, environmental or legal factors which cannot be managed by the firm itself and puts pressure on BMs (Gibe & Kalling, 2019). In addition to these macro factors, further externalities come from the direct context of firms e.g., power of competitors, customers and suppliers. From an alternative perspective, Wirtz and Torregrosa (2020) summarize external forces under technology, (de)regulation and market influences. Teece (2010), Schilling (2017), and Brynjolfs-son and McAfee (2011) claim that technological innovation is the most important driver for BM change. This is due to the advances in information technology that have increased the speed of innovation which allows "firms [to] develop and produce more product variants that closely meet the needs of narrowly defined customer groups, thus achieving differentiation from competitors" (Schilling, 2017).

Johnson, Christensen and Kagermann (2008) also identified various circumstances requiring BM change. These circumstances are of less general nature than the three drivers by Teece (2010), and those identified by Wirtz and Torregrosa (2020). One situation is when an existing technology is wrapped into a new BM, thereby introducing it to a new market. Second, the identification of a new customer segment can generate an opportunity, which can be exploited. Third, changes can be made once the identification of the need to improve an existing product has been carried out (ibid.). Gibe & Kalling (2019) state that internal factors can also have impacts on BMs. It can range from improvements within the value chain (Porter, 1985) to asset-based changes (Barney, 1991) that encourage a firm to modify their BM.

One opportunity is the identification of a new customer segment which has been excluded from the market for several reasons such as price or product complexity. The second option is to take an existing technology and design a new BM around it or leverage this technology by introducing it to a whole new market. Thirdly, they identified the “job-to-be-done” emphasis where the company focuses on improving the existing product (ibid.). Gibe & Kalling (2019) state that internal factors can also have impacts on BMs. It can range from improvements within the value chain (Porter, 1985) to asset-based changes (Barney, 1991) that encourage a firm to modify their BM.

Regardless of where the pressure comes from, authors highlight the relevance of considering all BM components, they must be dealt with systematically and simultaneously (Gibe & Kalling, 2019; Osterwalder & Pigneur, 2010; Wirtz & Torregrosa, 2020). Change is unlikely to only affect one dimension of a BM, therefore its impact on all dimensions must be carefully analysed and considered. BM modification can vary in the degree of impact and range from incremental to radical change, depending on how and which dimensions are affected (Afuah, 2004). Some authors claim there is “no point in instituting a new BM unless it is not only new to the company, but in some way game-changing to the industry or market” (Johnson, Christensen & Kagermann, 2008). However, others state that BM modification can also be incremental and still generate relevant benefits to the company in terms of e.g., cost saving and scalability (Zott & Amit, 2007). According to Gibe and Kalling (2019), BMs are constantly fine-tuned by just trying to deliver better services and products. As previously mentioned, BM modification can be a powerful source for competitive advantage, but it must be analysed carefully how it can be maintained (Wirtz & Torregrosa, 2020). Following the purpose of this thesis, focus will lie on the continuous development of BMs in start-ups, therefore incremental changes will play a major role in the analysis.

#### **2.1.4 Business Models and Start-Ups**

Technology-based start-ups are considered new ventures where new products and services are used to exploit know-how and advanced technological discoveries (Klofsten, 1994). However, the creation of new ventures can be a complex and demanding task where many variables must be taken into account (Ries, 2011; Trimi & Berbegal-Mirabent, 2012). In particular, decision-making can be difficult due to restricted access to resources (van Riel et al., 2011). While it is

important that new ventures make good and fast decisions in correspondence with their resources, it often results in trade-offs. This holds particularly true for technological firms, operating in volatile industries where innovation and speed are key (Trimi & Berbegal-Mirabent, 2012). The volatile and unpredictable nature of new technologies makes the process of developing a technology-based firm entail a high level of uncertainty (Aldrich & Fiol, 1994).

According to Teece (2010), all businesses, including start-ups, have a particular BM which is either explicitly or implicitly expressed. In fact, companies compete through their BMs and are therefore a powerful tool for founders who are creating a venture or who are in the stage of modifying it (Anthony, 2012; Casadesus-Masanell & Ricart, 2010). An experimentation of BMs can thereby rapidly aid the testing of the market, and validation or rejection of a business opportunity (Trimi & Berbegal-Mirabent, 2012). BMs prove useful in these initial stages due to their exploratory strength in regard to the value creation potential of the start-ups (Chesbrough & Rosenbloom, 2002), the plans to generate revenue and profit in the long run (Afuah & Tucci, 2003), and how the business will endure over time. Notably, a perfect BM is unlikely to exist in the initial stages of a firm (Teece, 2010), and according to Shirky (2008), it is rather those firms that have a flexible BM – where the entrepreneur can introduce change and adjustments – that are more likely to succeed. Hence, founders must be able to modify their operational processes and organizational structure easily in order to efficiently transform their BM according to market demands (Trimi & Berbegal-Mirabent, 2012). Often, firms develop strategies that include the offering of secondary products or leveraging the existing product to different contexts (Christensen, 1997), which might only be small changes on the one hand, but might be the key to BM modification on the other. Hence, start-ups have the same need for properly understanding their BM and the possibilities to modify it as incumbent players, especially when operating in a technology driven and volatile industry.

## **2.2 Fundamentals of Dynamic Capabilities**

### **2.2.1 Evolution of Dynamic Capabilities**

A firm's competitive advantages can be analysed from different perspectives (O'Reilly & Tushman, 2008). For example, two common dominant paradigms are the market-based view (Porter, 1985) and the resource-based view (Barney, 1991). However, these theories fall short

when it comes to frequent changes in the market. A strategy derived from a product-market analysis at a given point in time often fails to achieve a competitive advantage since the market requirements change frequently (Cordes-Berszinn, 2013). Similarly, RBV misses to identify why some companies perform better than others although they have the same resources, nor does it explain what resource configuration is required in a changing environment (ibid.). To address these shortcomings regarding organizational success in dynamic environments, Teece, Pisano and Shuen (1997) developed the theory of *dynamic capabilities* (DC). They combine aspects of VRIN and Five-Forces but argue that a company's long-term success relies on a firm's capabilities to *adapt, integrate and reconfigure* its assets and therefore is able to address change (ibid.). The term DC can be segregated into *dynamic* and *capabilities*. The term *dynamic* is utilized in the context of organizational renewal in combination with changing processes and reconfiguring processes (Agarwal & Helfat, 2009; Eisenhardt & Martin, 2000; Teece, Pisano & Shuen, 1997). The term *capability* refers to the power or ability to do something. In this context it refers to the ability to conduct the organizational renewal (Eisenhardt & Martin, 2000; Teece, 2007; Teece, Pisano & Shuen, 1997; Zollo & Winter, 2002). Together, DCs seek to explain the sources of competitive advantage over time and to provide guidance to managers in times of change (Teece, 2007). DC-theory is an integrative approach that aims to explain newer sources of competitive advantage in changing environments. DCs are therefore a strong complement to the established theory of VRIN and Five-Forces. According to Schoemaker et al. "they entail the collective skills that organizations need when pursuing disruptive innovation, radically new business models, and strategic leadership" (2018, p.3). DCs become crucial when competitive environments require timely innovative responses to rapidly changing technologies, especially when the future is difficult to determine (Teece, Pisano & Shuen, 1997).

Although large amounts of literature exist regarding DCs, the terminology is not yet standardized and many definitions exist (Katkalo, Pitelis & Teece, 2010). As stated in Di Stefano et al. (2010) the most influential papers (based on co-citation) in this field are written by Teece, Pisano and Shuen (1997), Eisenhardt and Martin (2000) and Zollo and Winter (2002). In order to develop an understanding of DCs and to find a working definition, an overview of some popular definitions is provided in Table 2 below.

All authors understand DCs differently although they are based on the same idea. Eisenhardt and Martin (2002) define DCs as *processes* while Zollo and Winter (2002) call them *patterns*.

Many of the definitions have shortcomings, for example, one shortcoming of Helfat’s and Zollo’s definitions is that they do not state *how* a company can adapt to a changing environment. However, in Teece’s broader understanding this is answered by identifying three important abilities: *to sense*, *to seize*, and *to adapt* (to) change. Additionally, Teece, Peteraf and Leih (2016) include the aspect of rapidly changing environments. This is an integral part for answering this thesis’s research question, hence, the following reflects on their definition of DCs.

Author	Definition
Eisenhardt & Martin (2002)	“Processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources – to match and even create market change and organizational and strategic routines by which firms achieve new resource configurations as markets emerge.”
Zollo & Winter (2002)	“Learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness.”
Teece, Pisano & Shuen (2007)	“The firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.”
Helfat et al. (2007)	“A dynamic capability is the capacity of an organization to purposefully create, extend or modify its resource base.”

Table 2: Definitions of Dynamic Capabilities

Teece (2016), Winter (2003) and Helfat (2011) distinguish between *ordinary* and *dynamic* capabilities. *Ordinary* capabilities allow a firm to earn money in the short-run and to conduct everyday business operations and to maintain the *status quo* (Helfat & Winter, 2011; Winter, 2003). They stem from for example, a firm’s human resources, (in-) tangible assets, processes and administrative systems. However, they do not allow a firm to creatively respond to volatility or surprises (Teece, Peteraf & Leih, 2016).

*Dynamic capabilities* enable an organization to alter the way it generates value (Di Stefano, Peteraf & Verona, 2010; Eisenhardt & Martin, 2000; Teece, Pisano & Shuen, 1997; Zollo &

Winter, 2002). Firms can use DCs, for example, to modify the *operational capabilities* or resources (Winter, 2003), to alter features of the external environment (Teece, 2007), or to conduct M&A activities, create strategic alliances or develop new products (ed. Dosi, Nelson & Winter, 2000; Eisenhardt & Martin, 2000; Iansiti & Clark, 1994). The line between *ordinary* and *dynamic* capabilities is blurry because change is always occurring to some extent. Hence, the degree of change differs, depending on the perspective and expertise. Furthermore, some capabilities can be used for either operational or dynamic purposes (Helfat & Winter, 2011).

In 2014, Teece pointed out that a more granular typology of capabilities, as considered by other academics, is of little benefit and that it is sufficient to distinguish between ordinary and dynamic capabilities (Collis, 1994; Teece, 2014; Winter, 2003). However, later, Teece begins to distinguish between second-order and higher-order DCs (Teece, 2018). The former refers to sales strategies, product development and other managerial decisions, while the latter guides the former through organizational processes and changed BMs (Teece, 2018). However, this is a new perspective on the theory of DCs and we have decided not to pay more attention to this distinction since it appears to be very blurry and only little research was found.

### **2.2.2 Dynamic Capabilities Framework**

To deepen the understanding of DCs, a conceptual framework developed by Teece (1997; 2007; 2009) which seeks to explain how firms achieve competitive advantage is introduced (Harris, Kaefer & Salchenberger, 2013). The dynamic capabilities framework (DCF), as presented in Figure 1 below, synthesizes various theoretical perspectives and additionally, integrates conceptual and empirical knowledge (Teece, 2011). It combines different concepts regarding adaptability, flexibility, integration and reconfiguration of internal and external competences (Teece, Peteraf & Leih, 2016). It includes the need for the understanding of technological and organizational change, since processes are shaped by organizational structure and external evolution (Teece, Peteraf & Leih, 2016). The framework explores how changes in the world are resulting in changes in firms, and how firms shape their environments.

Furthermore, the DCF acknowledges the difference between risk and uncertainty. Risk is typically associated with outcomes that can be determined with some certainty (“known probabil-



ities”), whereas uncertainty is about the “unknown unknowns” (ibid.). The former can be managed by e.g., insurances, hedging contracts or other risk management procedures. The latter, arises from today’s innovation economy and creates threats and opportunities to an organization’s BM. DCs, BM renewal, and leadership must be tightly connected to be able to survive in VUCA conditions (Schoemaker, Heaton & Teece, 2018). According to Teece (2018), BMs can be protected better through strong DCs. Through the crafting, refinement, implementation, and transformation, lasting competitive advantages and a resilient BM can be achieved (Teece, 2018).

According to Teece (2007), DCs can be clustered into the capacities of *sensing*, *seizing*, or *transforming*. Other authors refer to these capacities as dynamic managerial capabilities (Helfat & Martin, 2015) or absorptive capacity (Cohen & Levinthal, 1990; Griffith, Redding & Van Reenen, 2003; Qian & Acs, 2013). Since the focus for this thesis lies on the DCF by Teece, we refer to them as *sensing*, *seizing*, and *transforming*. After reviewing literature on the DCF, a lack of distinction of the three capabilities became apparent. We therefore aim to distinguish clearly between them to ensure consistency throughout this study. Therefore, our understanding of sensing, seizing and transforming is presented below.

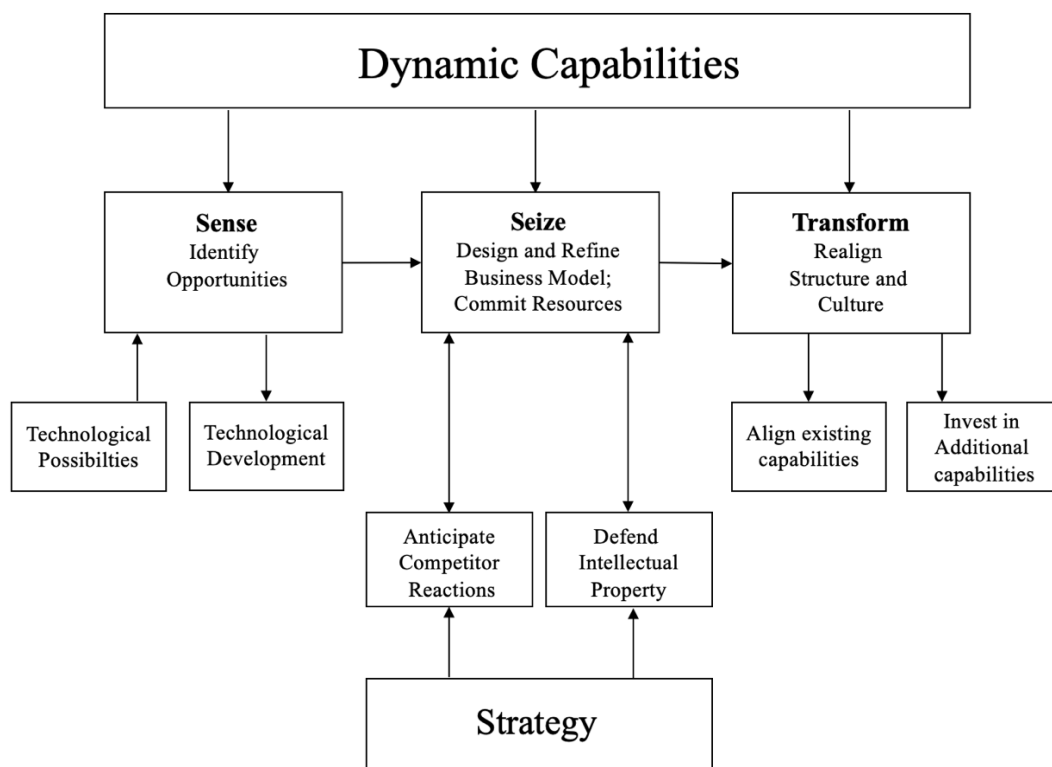


Figure 1: The Concept of Dynamic Capabilities (Teece, 2018, p. 4)

### 2.2.3 Sense, Seize and Transform

#### *Sense*

Sensing refers to activities that focus on identifying new opportunities and threats (Teece, 2007). Examples for sensing include the scanning of the environment for (technological) trends, the monitoring of customer/supplier needs or the observation of competitor behaviour (Teece, 2007). In his earlier work, Teece accentuated the sensing of opportunities and threats derived from technological innovation (2007), later he shifted it to a broader, more general perspective, namely identification of opportunities in the firm's competitive environment (2014; 2016). Especially in uncertain environments, firms must generate options for growth before its competitors (Teece, Peteraf & Leih, 2016). This can be done through different activities, such as, managers scanning and interpreting the existing information as well as new data, which in turn leads to the identification of opportunities (Cohen & Levinthal, 1990). Additionally, networking is considered an important activity in discovering the root of a problem, allowing firms to stay ahead of rivals and sense opportunities before they fully materialise (Teece, 2016). Organizations should include these activities into their everyday operations through the utilisation of an analytical framework, scenario planning, or hypothesis building (Harris, Kaefer & Salchenberger, 2013; Teece, 2007; Teece, Peteraf & Leih, 2016). Alternatively, firms can consider the purchase of real options in order to stay flexible and preserve opportunities for the future (Teece, Peteraf & Leih, 2016). Firms should try to anticipate competitors' actions and customers' and suppliers' responses. Hence, sensing is about identifying, interpreting and shaping business opportunities from the surrounding environment (Teece, 2007, 2014; Teece, Peteraf & Leih, 2016).

#### *Seize*

Seizing relates to addressing the beforehand sensed opportunities through new products, services or processes (Teece, 2007). Therefore, seizing requires the mobilization of resources to be able to capture value from the new opportunities (Teece, 2007, 2014). It involves the development of BMs, changes in the decision-making process and heavy investments in new technology (Harris, Kaefer & Salchenberger, 2013). A firm must invest in R&D and technologies that are most likely to succeed and achieve market acceptance (Teece, 2007). In order to capture value from the technology, it is extremely important that a company has a viable BM

(Katkalo, Pitelis & Teece, 2010; Teece, 2007). A BM must define a firm's investment and commercialization strategies and must be aligned with its technology. Therefore, a BM must be designed and adapted when seizing opportunities. In his later work, Teece, Peteraf and Leih (2016) stress the relevance of incorporating flexibility into a BM to be able to adjust to changes quickly. This can be done through a licensing model or outsourcing of manufacturing, open innovation processes and strategic alliances with suppliers, customers and competitors (Teece, Peteraf & Leih, 2016). In order to sustain a competitive advantage, a firm must undertake adequate measures to defend a BM by protecting their IP with patents and trade secrets, or by vertically integrating (Teece, 2018).

There was a lack of distinction between the different activities within seizing, as there was a shift in relevance from technology and resource allocation to BM renewal and strategies that support flexibility. We focus the concept of seizing on the BM and strategy aspect, as a change in a BM often results in a change in process or resource allocation due to the purpose of this thesis. Furthermore, Teece, Peteraf and Leih (2016) stress the relevance of organisational agility through self-organised employees and a decentralised organisational structure. However, due to inconsistencies in the categorisation of organisational structure, this aspect will be further discussed in the section of transformation, below.

### *Transform*

Transformation regards a semi-continuous activity of renewal, aiming to maintain a strategic competitive advantage. It is commonly referred to as *reconfiguration*, as it allows a firm to recombine and reconfigure assets and organizational structures as markets and technologies change (Teece, 2007). For example, the innovation and decision-making processes can be improved through the organizational structure. Teece (2007), urged the necessity of a relatively flat and decentralised organisational structure, otherwise responsiveness and flexibility could be at stake. In 2016, the concept of a flat organisational structure was associated with *reengineering rule bound hierarchies*. As previously mentioned, this was however, not mentioned in transformation, but rather within seizing. Teece reinforces the significance of organisations and their structures by explaining, “to avoid organisational inertia, transformation must be a semi-continuous activity” (2018, p.46) of which was previously stated by Agarwal and Helfat in 2009. Despite organisational structure being mentioned in seizing in 2016, it has for the majority been mentioned as an aspect of transforming. Hence, we classify it under transformation.

Furthermore, the “lean start-up” method has been acknowledged as important to building agility in the new product development process (Teece, Peteraf & Leih, 2016). The methodology allows the firm to “pivot, or, in other words, to quickly test, discard, and replace ideas and business models that do not work” (Teece, 2018). Transformation thereby allows for the “best configuration for the organisation based on its existing form and the new plans for the future” (Teece, 2018).

With regards to entrepreneurial management it is important to mention that the DCF mainly addresses high-level routines (Winter, 2003) and is therefore rather relevant for high-level managers and entrepreneurs than managers on the operational level (Teece, 2018). Teece states the entrepreneur/manager in the DCF is partially Schumpeterian and partially evolutionary, as it is their task to propose novelty and to promote learning. They must think creatively, act entrepreneurially, and must eventually override routines. In other words, managers matter in the DCF and have to orchestrate assets and competences (Teece, Peteraf & Leih, 2016).

### **2.3 Resilience**

Today’s environment in which businesses operate has arguably become more and more volatile, uncertain, complex, and ambiguous, ultimately establishing a higher degree of encountered turbulence (Schoemaker, Heaton & Teece, 2018). Larger firms are failing more frequently. Hamel and Välikangas (2003) claim there is a *resilience gap*, whereby the “world is becoming turbulent faster than firms are becoming resilient”. In the past, momentum was considered a strong force for firm success. However, today it appears this force is not enough due to multiple forces undermining the advantages of incumbency, such as but not limited to, technological discontinuities, regulatory upheavals and geopolitical shocks (Hamel & Välikangas, 2003). Therefore, the concept of resilience has risen to attention.

As defined by Holling (1996) and refined by Folke et al. (2010), resilience broadly regards the capacity to change, in order to maintain presence in an industry. Acquiring a state of resilience requires continuous dedication in overcoming hindrances such as, cognitive challenges by conquering denial; strategic challenges by valuing variety; political challenges by liberating resources; and ideological challenges by embracing paradox (Hamel & Välikangas, 2003). Therefore, resilience is built up over time whereby strategy is forever morphing with a focus

on the future, rather than the past. Resilience in the form of a competitive advantage will be enjoyed by any firm that enables the ability to sense the environment, create strategic options and adjust its resources, faster than its competitors in turbulent times (Hamel & Välikangas, 2003). However, many firms in today's environment are not resilient (ibid.). For it to become an autonomic process, firms must dedicate as much energy to perpetual renewal, as they do for establishing the foundations of operational efficiency (ibid.).

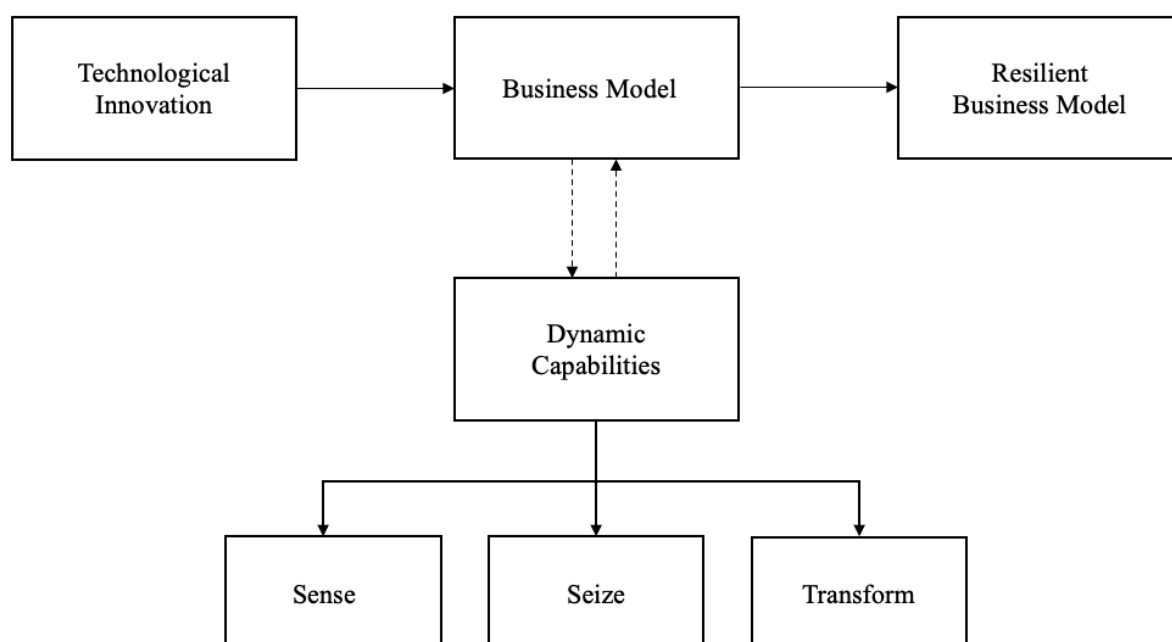
## 2.4 Preliminary Framework

When reviewing the literature regarding business model change, three relevant theoretical fields were identified, namely *business models*, *dynamic capabilities*, and *resilience*. Furthermore, the individual sections were put into perspective and related to each other. The synthesis of these theoretical fields comprises the basis for the preliminary framework.

It is recognized that technological innovation is one of the most important drivers of change (Brynjolfsson & McAfee, 2011; Schilling, 2017), resulting in rapidly changing environments. These environments come with uncertainty that companies have to cope with (Teece, Peteraf & Leih, 2016). Often, these destabilizing effects are the source of BM failure if it is not addressed appropriately (ibid.). In order to break the reactive approach to change, organizations need proactive BM modification along with organisational renewal (Schoemaker, Heaton & Teece, 2018).

Whether it is a new venture or an established player, a good BM remains crucial for the success of an organisation. The appreciation of dynamic environments, its effects on companies, and the need for a robust BM led us to the question how managers cope with it. Thus, the field of DCs was explored. More specifically, it was realized that the capacity of sensing, seizing and transforming allows a firm to become aware of the changes in their (competitive) environment. This enables a firm to adjust the different components of its BM and allocate resources accordingly. Following the understanding of resilience, it can be assumed that companies need well developed DCs in order to build a resilient BM. Strong DCs in turn, allow a company to pursue different strategies, that protect their value proposition from competitors while appreciating the trade-off between agility and efficiency. The synthesis of the literature review and the derived theory is visualized in the theoretical framework below.

This framework addresses the identified theoretical gap that previous studies have put limited emphasis on BM change and how firms are enabled to modify or expand it successfully. By focusing on one broad theory of change in combination with BMs, we believe it enhances the depth of the study, while at the same time, it is at the expense of not exploring other ideas. Therefore, the developed framework provides a roadmap for the following analysis and aims to answer the research question, while it must be emphasized that it is preliminary and not final.



*Figure 2: Preliminary Framework of an Approach to Create Resilient Business Models in Times of Technological Change*

### 3 Methodology

The following elaborates on the methodology chosen to address the research question and fulfil the purpose of the study. First, the research design is motivated, providing both advantages and disadvantages of the chosen approach. Second, the method utilised for collecting data will be explained, along with the incentive behind the chosen industry and appropriate cases. Third, the process of data analysis will be discussed, elaborating on the steps taken to convert the gathered data into findings that address the aforementioned RQ. Fourth, a reflection on the validity and reliability of the research is provided, thus assessing the quality of the study. Last, ethical considerations are identified.

#### 3.1 Research Design

A research design is considered as a plan, of how the link between the initial RQ and data is to be collected and how it will be addressed (Saunders, Lewis & Thornhill, 2011; Yin, 2009). Comprehending the nature of the question is thereby significant in deriving an appropriate research approach (Alvesson & Sköldbberg, 2018). Hence, the RQ is reinforced and reflected upon below: How do entrepreneurial firms use dynamic capabilities in order to create resilient business models in times of technological change?

The RQ is derived from the aforementioned literature gap lacking the aspect of change in regard to BM theory. A lack of previous research frequently results in the need to explore, which subsequently needs to be reflected in the research design (Creswell & Creswell, 2018). As the question insists on an *observation* and *explanation* of decisions made by firms in regard to this phenomenon, a *qualitative* approach was chosen to address this question. This approach allows for an interpretive and naturalistic way of making sense of strategic decision-making (Alvesson & Sköldbberg, 2018), beneficial to understanding the underlying aspects behind a phenomenon (Robson & McCartan, 2016). A qualitative approach enables us to *comprehend* the concept of BM change. This approach was thereby preferred over quantitative. However, it is important to understand the reasons for dismissing a *quantitative* approach. Primarily, the RQ deals with operational links over a period of time, rather than mere frequencies or incidences (Yin, 2009), of which are more appropriately addressed through a quantitative study. Additionally, as highlighted by Creswell and Creswell (2018), a quantitative study examines the relationship among

variables. However, as BM change and resilience are fuzzy topics, and the field is rather underexplored, the multitude of factors and variables for the chosen case were not exhaustively known from the start of the study. A qualitative approach thereby allows for the examination of any and all relevant information. Thus, the relationships between any chosen factors will not be quantitatively tested, making conclusions subject to further research.

Moreover, the role of theory plays a crucial role in the research design (Bryman & Bell, 2011). As proclaimed by Bryman and Bell (2011), a *deductive* approach regards testing established theory, thus, deducing the operational terms of how data is collected. This approach as a stand-alone aspect is disregarded as it mainly encompasses testing and falsifying hypotheses, which does not suffice to the entirety of this study. As data is collected, the study moves to an *inductive* approach, generating theory from the empirical research. Although both approaches are applicable to an extent, there are certain associated limitations. Therefore, an *abductive* approach provides an appropriate alternative, suitable to this study. An abductive approach provides a systematic combination of both theory and literature with empirical data (Creswell & Creswell, 2018).

Within the domain of qualitative research designs, a multiple case study approach was chosen. The *form* and *substance* of the RQ hint at the appropriate research design for the study (Yin, 2009). Beginning with “how”, the formulation of the question suggests an attempt to illuminate a decision or set of decisions (Schramm, 1971). Furthermore, the question is derived from the aforementioned literature gap, addressing the concept of change within BM theory. Therefore, the substance of the question regards testing the theoretical concept of resilient BMs, which we have identified as the ability to adapt and change, in the form of DCs. This implies the question desires to understand and explore a complex social phenomenon (Yin, 2009). Due to this complex nature, one of the great strengths of a case study approach is that it allows for aspect richness (Larsson, 1993; Yin, 2009). Additionally, it takes into consideration the contextual conditions of which are pertinent to the phenomenon of the study. Furthermore, a multiple-case study was chosen over a single-case study. The reasons for this are twofold. Firstly, many consider the evidence obtained from multiple cases is more compelling and thereby more robust, than that of single cases (Bryman & Bell, 2011; Herriott & Firestone, 1983). Secondly, multiple-case studies support a broader exploration of theory, and allow for creating more convincing theory since the suggestions are more sound (Eisenhardt & Graebner, 2007).



Multiple-case studies must be chosen with caution if researched by a single student or investigator due to the study's required use of extensive resources and time (Yin, 2009). Despite this disadvantage, being two investigators has allowed us to conquer this challenge. Further advantages of a multiple case study approach include its ability to deal with a full variety of evidence sourced via interviews, observations, documents, etc. going beyond a conventional historical study (Yin, 2009).

Despite the many advantages of the multiple case study approach, it is important to acknowledge the associated limitations as well. Arguably the greatest concern regarding case studies, is the lack of consistency and rigour. There are no specific procedures for investigators to follow, hence sloppiness and allowance of equivocal evidence or biased views, may influence the direction of the findings and conclusions. Utilising other methods may leverage such rigour as the process is more controlled. Secondly, many see case studies as unsuitable methods in drawing scientific generalisations in causal relationships as it is not an experimental approach (Yin, 2009). Thirdly, Eisenhardt (1989) acknowledges difficulty in distinguishing between the most important relationships and those that are particular to a specific case, hence, a tendency to create theory that is overly complex, whereby investigators attempt to capture everything. Alternatively, building theory from cases may result in theory that is too narrow and rather idiosyncratic.

### **3.2 Choice of Cases**

Previously, the choice of case study and the reasons why a multiple case study is appropriate to approach the research question and the thesis's purpose, were discussed. This section addresses the choice of the case companies. The companies within the lab-grown food and dairy industry appear to be especially relevant for several reasons.

The industry the companies are competing in is very uncertain. This uncertainty arises from a lack of dominant technology and the different players are still racing towards technological maturity. Additionally, this industry is entirely new and disrupting the strong and old industry of livestock farming. Thus, there exists different challenges and barriers that start-ups in the lab-grown food and dairy industry have to cope with. All these factors exert pressure on their BMs, which must therefore be modified frequently. Hence, it seems to be reasonable to analyse

these companies' capabilities to adapt their BMs in a changing environment. Following this logic, different companies were approached for this case study, utilising the DCs present, as the unit of analysis. In order to analyse a larger variety of barriers the companies are facing, we tried to approach different companies. The approached companies can be categorized into their field of expertise, mainly differentiated by being some form of *end-product manufacturer*, or an *ingredient supplier*. Additionally, the companies use different technologies within the field of lab-grown food and dairy. The two dominant technologies in this field are *precision fermentation* and *cell cultivation*. One interview was conducted with an industry expert working for a consulting firm specialized in the food industry. This interview provided an outside as well as holistic perspective on the entire industry. This selection of cases ensures that a better understanding of the whole industry is provided and how they might differ in the use of DCs. Hence, these companies seem to be suitable cases in order to analyse how DCs guide a company to build a resilient BM.

### **3.3 Data Collection**

#### **3.3.1 Primary Data Collection**

The gathering of primary data is crucial when conducting research, it contributes to a deeper understanding of the preliminary framework (Bernard, 2018). For this research, primary data is collected by conducting expert interviews with a semi-structured design. It was decided to use semi-structured interviews since they allow for some flexibility while at the same time covering important aspects of the theory and the preliminary framework (Bell et al., 2019). In total, ten interview partners from ten different companies were talked to. All companies and respondents were selected purposefully, in order to provide a holistic account for the research (Creswell & Creswell, 2018). A database of 145 companies was created by extensive research on the internet and later the method of purposive sampling was applied (Dolores & Tongco, 2007). We categorized the companies according to their location on the value chain, their technologies and to their phase of lifecycle to generate a sample that covers the different fields of expertise of the industry. The interview partners were chosen based on their job description and then approached on LinkedIn. Since all companies of the sample are in the entrepreneurial phase, most of the approached persons were CEOs, Heads of Strategy or Heads of Business Development. This ensured that the respondents have the adequate strategic insights required

to answer the questions and that the gathered information will be suitable to address the research question.

Before conducting the interviews, a questionnaire was developed by integrating secondary data and the selected theories needed for the preliminary framework. The questions aim to identify what activities companies undertake to carry out *sensing*, *seizing* and *transforming*. Hence, the derived questions are addressing the RQ collectively (Creswell & Creswell, 2018). This guide was used for all interviews with the same recurring questions. However, the guide was customised for each interview regarding company-specific questions and the interviewees field of expertise. After conducting the first interviews, the answers were analysed shortly after and as a result, a few adjustments were made to the interview guide in order to generate more valuable data. Hence, an iterative research design was pursued which corresponds with data processing, insights and the researchers learning during the empirical study (Eisenhardt, 1989). Throughout the study, all interview partners were asked in the end, *what impact they have on their competitive environment* in order to analyse both perspectives of DCs and to generate a fuller industry perspective. After conducting ten interviews, we felt confident that we have gained enough insights to address the research question appropriately. Thus, we reached a saturation level that seems to be adequate for the scope of this thesis. However, it is important to mention that additional interviews could have generated further insights.

Each semi-structured interview took approximately 30-90 minutes. They were conducted in form of a video conference (Google Meet), due to the geographical distance to the companies and the ongoing pandemic. Both of us have participated in the interviews, which allows for different perspectives on the generated data and it also increases confidence in the findings (Eisenhardt, 1989). Additionally, the interviews were recorded and transcribed simultaneously and automatically after the consent was given by the interviewees. This allowed us to fully concentrate on our interview partners instead of taking notes on the side.

No.	Company	Interview Partner & Position	Field of Expertise	Country	Date and Time	Time in min.
1	TurtleTree Labs	CEO	Cultivated milk	Singapore	21/04/2021 18:00	60:00:00
2	BioTech Foods	CEO	Cultivated meat	Spain	26/04/2021 09:00	49:00:00
3	CellulaREvolution	CEO	Peptide coating and bioreactors	UK	27/04/2021 10:00	33:00:00
4	Aleph Farms	Head of Sustainability	Cultivated meat	Israel	28/04/2021 10:00	57:00:00
5	Cultured Decadence	CEO	Cultivated seafood	USA	28/04/2021 14:00	36:00:00
6	Cubiq Foods	CEO	Cultivated meat	Spain	28/04/2021 16:00	53:00:00
7	Company X	Head of Business Development	Fermented dairy proteins	Israel	02/05/2021 14:00	55:00:00
8	Nourish Ingredients	CEO	Fermented fats and oils	Australia	03/05/2021 07:30	52:00:00
9	NX Foods	Head of Strategy	Food innovation hub/Consulting	Germany	04/05/2021 14:00	90:00:00
10	Air Protein	Head of Business Development	Fermented flour, oil and chicken	USA	07/05/2021 17:30	41:00:00

*Table 3: List of Interviewees*

### 3.3.2 Secondary Data Collection

For this thesis, secondary and primary data was used. The secondary data collected stems mainly from industry reports published by NGOs (e.g. GFI), consulting firms, or government organizations (e.g. Food Safety Agency). When searching grey literature, for example newspaper articles, reliability is hard to measure. To increase the trustworthiness of these sources, only established newspapers were taken into account. Further data was obtained from the companies' official websites, press releases, annual reports, and other official documents.

### 3.4 Data Analysis

Following data collection, the data was analysed. Creswell and Creswell (2018) claim the intent of the analysis is to segment and take apart the collected data, in order to make sense of it. In this study, the analysis was conducted utilising the sequential steps as proposed by Creswell and Creswell (2018) as a guideline, beginning with preparation and organisation of analysis as

described in section 3.3 regarding transcription over Google Meet through an extension called Tactiqs. Secondly, the data was reflected over to ensure coherence and that a general sense of the information was provided. Thirdly, we filtered relevant information from that of the irrelevant, organising it into different activities, evident in the codes of *sense*, *seize* and *transform* (Rossman & Rallis, 2012). This avoided the pitfall of trying to include everything – whereby everything may not be applicable – in the results and discussion section. We utilised a computer software program (NVivo) to code the data enhancing its organisation. These activities stem from the literature review, of which is reflected in the preliminary framework (Figure 2). Nigel King refers to this as the template approach (Symon & Cassell, 2012). Utilising this process revealed inefficiencies in the pre-determined categories and themes; hence, the insertion, depletion, or alteration of certain codes occurred after an exploration of the data. Lastly, categories and sub-categories were applied to build additional layers of complex analysis, thus structuring the following sections. Within these sub-categories, pattern-matching was conducted. We analysed whether the empirical results matched or did not match the theoretical aspects portrayed in the literature review (Yin, 2014). Carrying out an iterative process as such ultimately resulted in the establishment of the final framework.

There are various reasons for choosing an approach as such. Primarily, the initial template for data analysis allows for a form of structure as a starting point. In addition, the format allows for the comparison of multiple views deriving from various interviewees (Symon & Cassell, 2012), applicable to this particular study. However, there is also much criticism regarding such an adaptable process. For instance, having too few or too many codes may distort the data collected and either result in overwhelmingly rich and complex data, or too defined data preventing exploration of more pertinent issues, respectively (Symon & Cassell, 2012; Waring & Wainwright, 2008). Additionally, many debates concern whether there is ever a clear distinction between descriptive and interpretive coding (Symon & Cassell, 2012).

Furthermore, it is important to note why other data analysis techniques were not selected. Another commonly used technique is that of grounded theory. Grounded theory differs from the template approach as literature review is delayed, and codes and categories are developed from the data, not from preconceived hypotheses (Charmaz, 2006; Corbin & Strauss, 1990). Some claim this technique is naïve (Haig, 1995), and others claim it encourages researchers to look *for* data, rather than look *at* data (Robrecht, 1995). Others have also raised concerns regarding

the technique (Dey, 1999; Layder, 1998; Thomas & James, 2006). Moreover, interpretive phenomenological analysis (Smith & Shinebourne, 2012) and more generic forms of thematic analysis (Braun & Clarke, 2014), are also concluded less applicable to the study due to a lack of flexibility of the coding structure, no utilisation of a priori themes, and the absence of the initial template (Symon & Cassell, 2012).

### **3.5 Validity and Reliability**

Essential aspects of any research design are validity and reliability (Creswell & Creswell, 2018). However, scholars put different emphasis on these two concepts depending on the research method (Bell et al., 2019). Therefore, the understanding of validity and reliability in this thesis will be based on concepts focusing on case study research. Validity is concerned with the accuracy of a study and its results, while reliability refers to the consistency of the research design and the generated results (Creswell & Creswell, 2018). Yin (2009) describes several tests for judging the quality of a case study: *construct validity*, *external validity*, and *reliability*.

*Construct validity* refers to the identification of correct operational measures for studied concepts (Yin, 2009). It is criticized that case study researchers fail “to develop a sufficiently operational set of measures and that subjective judgements are used to collect the data” (Yin, 2009, p.41). For this study, it should be ensured that the concepts of BMs, DCs and resilience are fully understood by the reader, as well as the composition of the preliminary framework. Hence, many sources were used to establish a chain of evidence and to clarify the relation between the research question and the chosen research design.

*External validity* is concerned with the question whether a study’s findings can be analytically generalized beyond the undertaken case study (Yin, 2009). According to Bryman & Bell (2011) however, this is not the primary goal of case-study research since it is about depth rather than breadth and focuses more on analytical generalization than on statistic probabilities. Furthermore, this is less of a concern in a multiple-case study approach since the evidence is considered more compelling and more robust than in a single-case study design (Yin, 2009). However, we adhered to Creswell’s (2014) advice to incorporate triangulation to ensure external validity. “Triangulation uses evidence from different sources to corroborate the same fact or

finding” (Rowley, 2002, p.23). Therefore, we used different sources of data to add validity to our findings. For example, (sub-) categories in the results were determined based on convergence of several interviewees’ responses. Moreover, a thorough description of the cases enables the reader to better understand the context of the findings.

*Reliability* refers to the repeatability of the conducted operations and results. It is the objective of a researcher to ensure that a later researcher can follow the same procedures conducted earlier and generate similar findings and conclusions (Yin, 2009). For this purpose, the conducted steps should be documented. We have followed this advice by describing the method thoroughly in this chapter and by also adding our interview guides in the Appendix. It still worth mentioning that an exact replicability of a qualitative study is hardly possible according to Bryman and Bell (2011). This might be due to the researcher’s characteristics (age, personality, gender, etc), the unstructured nature of qualitative data and the researcher’s subjective interpretations and tacit knowledge (Bryman & Bell, 2011; Easterby-Smith et al., 2021). Therefore, it is of very high priority to be transparent and realistic when analysing the collected data. Furthermore, we see it as an advantage to be working as a pair which will help avoid biases. Additionally, conducting a multiple case study is time consuming and could therefore have a negative impact on a study’s results (Easterby-Smith et al., 2021). The timeframe of two months is quite short for a multiple-case study. Therefore, we narrowed it down to one very small and specific industry and put focus on only one specific unit of analysis, namely DCs. Hence, a multiple-case study is an appropriate rationale for this thesis.

### **3.6 Ethical Considerations**

Ethical issues might arise during research and must be anticipated by the researchers (Creswell & Creswell, 2018). Accordingly, research participants must be protected. In the following, these considerations will be taken into account and measures on how to overcome them will be defined. The participants might feel stressed or uncertain about things they have said. Therefore, we ask every participant if they wish to be anonymized in the study to protect their privacy. Additionally, when direct quotes are being used, they will be sent to the respondent beforehand to ensure it is not harmful to the participant in any way. To avoid additional stress, due to the different time zones people live in, we asked the participants to suggest a preferred

date and time. According to Bryman and Bell (2011), another critical effect refers to the informed consent. To overcome this problem and provide the participants an additional option to opt-out, the research purpose has been stated again at the beginning of each interview. Furthermore, the respondents were given the opportunity to deny answers to certain questions.



## 4 Empirical Data

In this chapter, the analysed industry will be introduced to provide the reader with a thorough understanding of the environment the companies are competing in. Then, the studied cases will be introduced and an overview of the empirical findings of the ten conducted interviews will be provided. Additionally, this primary data will be supported by secondary data gathered from publicly available documents and industry reports. The collected data was analyzed by using the constructed preliminary framework and organizing the interviewees' statements according to *sense*, *seize*, and *transform*. Different categories were identified and ~~then~~ used as more specific categories of sensing, seizing and transforming. Hence, this chapter focuses on the collected empirical data and is crucial for answering the RQ.

### 4.1 Case Description

In order to understand the collected data better, it is first important to introduce the case companies. For a general understanding of similarities and differences among the interviewed firms, Table 4 below identifies the various products, technologies, regions, and position on the supply chain, of each of the companies, followed by a brief description of the various technologies. NX Food has been taken out of the list of interviewees due to the nature of the company being a consulting firm for the industry, rather than an industry player themselves. Following, in Table 5, each of the firm's current phase in a company lifecycle is identified. The contextual implications of the firms are significant for interpreting the results as they influence a company's strategic decisions.

<b>Company</b>	<b>Technology</b>	<b>Position on Supply Chain</b>	<b>Product</b>
<b>BioTech Foods</b>	Cell cultivation	Manufacturer	Sausages, burger patties
<b>Aleph Farms</b>	Cell cultivation	Manufacturer	Whole cut steak
<b>Cultured Decadence</b>	Cell cultivation	Manufacturer	Lobsters
<b>TurtleTree Labs</b>	Cell cultivation	Manufacturer	Milk
<b>Cubiq Foods</b>	Cell cultivation	Supplier	Fats and oils
<b>CellulaREvolution</b>	Cell cultivation	Supplier	Peptide coating and bioreactors
<b>Nourish Ingredients</b>	Precision Fermentation	Supplier	Fats and oils
<b>Company X</b>	Precision Fermentation	Supplier	Milk proteins
<b>Air Protein</b>	Fermentation	Manufacturer	Protein flour, oil, "chicken"

*Table 4: General Company Overview*

#### **4.1.1 Technologies**

##### *Cellular Cultivation*

Cellular cultivation is a biological process, where cells are grown outside of a living organism. Stem cells are extracted from an animal, and then grown in bioreactors in a nutrient rich solution called media, imitating the environment inside the animal's body. This technology does not only reduce the required production time in comparison to livestock farming, but also uses significantly less land and water, and emits less greenhouse gases (Schwartz & Bomkamp, 2019). In fact, this technology is not entirely new. The concept of cell growth in bioreactors has been used in the pharmaceuticals industry for decades (Merck Group, 2021). However, one of the main problems is that this process is expensive and currently not applicable for large scale production. Therefore, intense R&D work is required to bring cultivated meat products to the market.

## *Fermentation*

The second technology that we consider as part of lab-grown food technology is precision fermentation. Traditional fermentation has been used in food production for centuries. They create products such as cheese, yogurt, beer, or tempeh. Precision fermentation, however, uses microbes to produce specific ingredients (Specht, 2021). The microbes are thereby genetically modified to produce the desired target. These targets can then be used for plant-based or cultivated products to enhance sensory characteristics and functional attributes (ibid.). This can be, for example, a specific protein that is responsible for the typical milk (casein or whey) or meat flavour (haemoglobin). A slightly different approach based on fermentation is pursued by the company Air Protein. They recycled a technology originally developed by NASA. Utilising a specific type of bacteria called, hydrogenotrophs, CO<sub>2</sub> coupled with water, oxygen and nitrogen can be transformed into nutritious protein that can then be used to create meat or oil (Air Protein, 2021).

### **4.1.2 Lifecycle Phases**

Evident in Table 5, the criteria utilised in determining the phase at which each of the companies is currently at in regard to the company lifecycle, was purposely chosen. Over time, the average firm increases in size, hence, the year founded, and current number of employees gives a general idea of the stage of the firm. However, a justified conclusion cannot be based on solely this. Hence, the amount of investment and the round of funding are critical factors to compare. “As the business becomes increasingly mature, it tends to advance through the funding rounds; it’s common for a company to begin with a seed round and continue with A, B and then C funding rounds” (Reiff, 2020). Evidently, Cultured Decadence and CellulaREvolution appear to be at an earlier phase than the rest of the companies, with 8 employees each, around \$1 million investment, gathered at an early funding round. The authors have thereby distinguished between Phase 1 and Phase 2 companies, to better comprehend the results.

<b>Company</b>	<b>Employees</b>	<b>Founded</b>	<b>Investment (\$)</b>	<b>Round</b>	<b>Phase</b>
<b>BioTech Foods</b>	25	2017	5.1 M	A/Grant	<b>2</b>
<b>Aleph Farms</b>	35	2017	14.4 M	A	<b>2</b>
<b>Cultured Decadence</b>	8	2020	1.6 M	Pre Seed	<b>1</b>
<b>TurtleTree Labs</b>	22	2019	9.4 M	Seed	<b>2</b>
<b>CellulaREvolution</b>	8	2018	1 M	Pre Seed/Seed	<b>1</b>
<b>Cubiq Foods</b>	37	2018	15 M	?	<b>2</b>
<b>Nourish Ingredients</b>	21	2019	11 M	Seed	<b>2</b>
<b>Company X</b>	21	2019	11.3 M	A	<b>2</b>
<b>Air Protein</b>	20	2019	32 M	A	<b>2</b>

*Table 5: Lifecycle Phase of Interviewed Firms (Source: Crunchbase and interviewees)*

The following sections present the findings of activities undertaken by the interviewed firms regarding sensing, seizing and transforming. The findings were synthesised to reveal commonalities and differences within the three categories. Hence, these overarching activities were broken down into further categories and sub-categories.

## **4.2 Sensing**

Presented in the following sub-sections are the findings collected from the semi-structured interviews that relate to the undertaken activities by firms in regard to sensing their environment. Hence, the findings have been organised into the sub-categories of networking, identifying barriers and identifying strategic opportunities.

## 4.2.1 Networking

### *Communication*

Networking allows many firms to keep up to date with the industry, and how they can learn from it. In order to network, many interviewees attend and/or speak at conferences (Aleph Farms; BioTech Foods; CellulaREvolution; Cubiq Foods; Cultured Decadence; Nourish Ingredients; TurteTree Labs). The CEO of Nourish Ingredients points out, it's "more than the conference itself, it's the ecosystem that is around [it]". Regarding the lab-grown food and dairy industry, networking allows managers to converse with investors and other companies. Managers can therefore scan the environment for technological trends by recognising the innovations that are occurring in the industry (TurteTree Labs) and observe competitive behaviour by seeing "how [others] are doing with their technology" (CellulaREvolution). Moreover, the CEO of TurtleTree Labs further reflects the importance of communication as "there are some big mistakes that [they] have already avoided, just by opening up, talking and learning from other people in the industry". The industry expert (NX-Food) highlights the significance of communication as "one of the most important things is just talking to people". One can ask what they see, what they have heard, and thus gain an important indication of what's going on in the industry (NX-Food). Head of Business Development from Company X further illustrates the "supportive and non-competitive environment" amongst the players in the industry, as they all know each other, and they talk.

Word-of-mouth is also considered a useful asset in terms of finding customers, as everyone became quickly aware of the solutions, they needed to solve their problems. In addition, discussing frequently with customers can allow for better understanding of what it is the firms actually need (Nourish Ingredients). On another note, reaching out to lawmakers is also considered an important aspect, regarding enhanced awareness of labelling rules and regulatory requirements (Cultured Decadence). Personal relationships with global partners (TurtleTree Labs), or conversations with investors (BioTech Foods), are further considered significant to keep up to date with industry changes, as they usually know what is going on.

### *Other Sources of Information*

As society moves to a more digital environment, much interaction between professionals now occurs online (Source). Hence, the utilisation of social media platforms, such as LinkedIn, have

become a focal point for exchanging information. This is evident in the lab-grown food and dairy industry as managers find the platform to be a good source for communication and keeping up to date through news (CellulaREvolution; Cultured Decadence). Other forms of collecting data includes the utilisation of newspaper blogs (Cultured Decadence), food technology websites (CellulaREvolution), industry reports provided by for instance the Good Food Institute (Aleph Farms; Cultured Decadence), market research on consumer behaviour (BioTech Foods), Wall Street papers (Air Protein), and podcasts (NX Food).

#### **4.2.2 Identifying Barriers**

##### *Scalability*

Identifying barriers is crucial for the interviewees as it makes them aware of the external obstacles, they need to overcome and anticipate. Scalability is a major barrier for many of the interviewed firms due to the costly nature of various technologies (Aleph Farms; BioTech Foods; Company X; Nourish Ingredients; TurtleTree Labs). Firms carrying out cellular cultivation, such as, BioTech Foods, explain the capital-intensive nature of the industry, as it takes “a lot of investment in R&D and... capital expansion” to make products that are nutritious, safe, and sustainable, as well as at a reasonable price attractive for consumers. Also carrying out cellular cultivation, Cultured Decadence still see scalability as a future concern, however, feel they are at an advantage due to the structural simplicity of their products, in comparison to those creation products such as salmon or steak. On another hand, firms such as Company X and Nourish Ingredients undergoing precision fermentation, also face a challenge in reaching scale. Company X argues that cellularly cultivated foods are expensive due to the media necessary for growth. They believe the company’s products are thereby more scalable, as their processes for isolating and purifying the protein are much simpler. They believe the company has the ability to create certain products “really efficiently and produce at scale”, while for other products, “they still need to crack that technological barrier” (Company X). CEO of Nourish Ingredients emphasises the need to sense opportunities regarding scalability, as otherwise “you are going to bleed to death on your cost of goods”. Other firms such as Air Protein utilise a different technology of which “[they] see as highly scalable and [something they] can get competitive with”. It is believed that the “unit costs for protein could be reduced to the cost of handling the final product, with almost no variable costs for the inputs required” (Witte et al., 2021), if foods produced utilising a technology as such, become a reality. Due to the novelty

of the industry, no technology has so far been proclaimed dominant. Hence, firms are currently competing with an additional threat of potential disruptive technologies by firms such as Air Protein and Solar Foods as their technology is arguably more scalable and cost efficient (Witte et al., 2021). The major barrier these companies are facing regarding scalability is the large amount of renewable energy required for production (Southey, 2020).

### *Consumer Acceptance*

Moreover, consumer acceptance has also been identified as a common challenge for many of the interviewees (BioTech Foods; Cubiq Foods; Cultured Decadence; NX-Food; TurtleTree Labs). CEOs of companies such as Cultured Decadence, look at “what has happened with other food products or new food technologies in the past and see what that ramp up has been”, as well as discusses with their “advisors and people that have maybe seen a couple cycles of product development and product launch” in the past. Others look forward and acknowledge that despite rising interest in alternative proteins in countries such as Singapore (Sriram & Ling, 2021), the novelty of the industry creates a lot of scepticism among consumers in different regions around the world, making them potentially “hesitant to buy it” (NX-Food). The BCG report (2021), forecasts concern regarding sustainability, health, and safety of the food, may impair consumer interest. Hence, there are rising concerns of how consumers are going to accept this (BioTech Foods). The CEO of BioTech Foods claims “probably only 3 or 4 out of 10, will tell you that they know what [cultivated food] is”. By acknowledging this uncertainty or potential lack of understanding and awareness among consumers, good marketing, labelling, communication, and education, have become focal points that firms have recognised as important to address (BioTech Foods; TurtleTree Labs). For instance, if the sustainability aspects of lab-grown food are communicated properly, both consumer and investor concern for the climate can be satisfied (BCG). The BCG report further suggests that opportunities can be sought through collaborations among stakeholders along the value chain (Witte et al., 2021).

### *Regulations*

Furthermore, regulation may be a potential barrier (BioTech Foods; TurtleTree Labs). Due to the novelty of the products, there are no legislations in place, however, approval from federal agencies must still be granted. According to an industry expert, concerns regarding regulatory approval are thereby twofold (NX-Food). Firstly, this can be a major barrier for firms due to the utilisation of genetically modified organisms (GMO). For instance, according to Regulation

(EC) No. 1829/2003 of the European Parliament and of the Council on genetically modified food and feed, “regulation should cover food and feed produced ‘from’ a GMO, but not food and feed ‘with’ a GMO” (EU, 2003). There is a fine line between the two and questions arise over which of these applies to firms undergoing precision fermentation, such as Nourish Ingredients and Company X, utilising GMOs in the process, but not the final product. Secondly, there is a potential risk of new regulations arising, regarding the practices in creation of lab-grown food. Firms such as Cubiq Foods, have acknowledged these barriers and sense opportunities in mitigating them, by focusing on the production of an ingredient such as oil, rather than a final product. This is due to the similarities in the nutritional profile of already approved algae produced oils, thus making it arguably easier to get approval, compared to when producing a whole new end-product. On another note, currently, lab-grown food and dairy is solely available for consumers in Singapore. Through this acknowledgement, firms can seize the opportunities and plan accordingly, as seen by the Californian company Eat Just, with their release of the lab-grown chicken in a restaurant in Singapore (NX-Food).

### **4.2.3 Identifying Strategic Opportunities**

#### *Change in Demographics*

Examination of the external environment allows managers to identify strategic opportunities. For instance, many have acknowledged a window of opportunity from a change of demographics. A rising world population (United Nations, 2021), and increasing prosperity across the globe (National Geographic, 2014), has resulted in an increased demand for agricultural products. However, water supplies are exhausted by current production rates and pollutants are at a high, hence current resources will not be able to feed the additional demand in the future. Many lab-grown food and dairy companies have acknowledged this change and hence see major opportunities in filling this gap between supply from agricultural firms, and the demand by society (Aleph Farms; BioTech Foods; Cubiq Foods; Cultured Decadence; Nourish Ingredients).

#### *Trends Among Younger Generations*

Furthermore, many have acknowledged strategic opportunities from trends among younger generations. Through analysis of consumer behaviour, it is evident that younger generations



are more environmentally aware and “more willing to do something about the sustainability of the planet” (BioTech Foods). In Singapore alone, more than 78% of respondents to a survey conducted by Shiok Meats, are willing to try cell-based seafood, and that 43% of the appeal arose from the lower environmental footprint compared to traditional counterparts (Sriram & Ling, 2021). It is believed there will be a generational shift (CellulaREvolution), hence, willingness to eat alternative proteins will most likely increase among younger generations.

### *Market Exploitation*

Firms such as Company X explain the variety of products within the dairy industry, hence, by looking at the products with high margins, one can identify where “there’s a lot of room for someone like [them] to get involved”. Others such as Nourish Ingredients, have examined the risks and difficulties involved in creating an entire product, and thus acknowledged the benefits of specialising in a sole ingredient of fats. The firm is provided with several strategic opportunities as they can supply multiple products at various companies, as well as serve different industries such as plant-based alternatives, cellular cultivated or precision fermentation foods. Additionally, Nourish Ingredients does not have to deal with end consumers directly.

A summary of the results regarding sensing is evident in Table 6 below.

Activity	Category	Sub-Category	Companies	Supply Chain	Phase
<b>Sensing</b>	Networking	Conferences	All	Supplier & Manufacturer	1 & 2
		Communication with Other Stakeholders	All	Supplier & Manufacturer	1 & 2
		Other Sources of Information	All	Supplier & Manufacturer	1 & 2
	Identifying Barriers	Scalability	Aleph Farms BioTech Foods Company X Nourish Ingredients Turtle Tree Labs	Supplier & Manufacturer	2
		Consumer Acceptance	BioTech Foods Cubiq Foods Cultured Decadence TurtleTree Labs	Supplier & Manufacturer	1 & 2
		Regulation	BioTech Foods Company X Nourish Ingredients TurtleTree Labs	Supplier & Manufacturer	2
	Identifying Strategic Opportunities	Change in Demographics	Aleph Farms BioTech Foods Cubiq Foods Cultured Decadence Nourish Ingredients	Supplier & Manufacturer	1 & 2
		Trends Among Younger Generations	BioTech Foods CellulaREvolution	Supplier & Manufacturer	1 & 2
		Market Exploitation	Company X Nourish Ingredients	Supplier	2

Table 6: Sensing Summary

### 4.3 Seizing

While analysing the obtained data, sub-categories within seizing became evident that seem to be relevant to all interviewees. These categories, namely, business model protection, open innovation, strategic partnerships, and manufacturing and commercialization strategies will be described below.

### 4.3.1 Business Model Protection

#### *Patents and Trade Secrets*

In the BCG report (2021, p. 32), it is claimed that a company that solves “a key technological challenge will likely become the go-to firm for that specific step along the value chain”. Therefore, it is important that companies protect their intellectual property (IP).

In general, the interviewed companies try to use a combination of patents and trade secrets to protect their IP (BioTech Foods; Aleph Farms). CellulaREvolution, Nourish Ingredients and Air Protein have filed several patents in the last years. However, most interviewees stated that there are certain risks involved. According to CellulaREvolution it is a very strategic decision when using patents. “Sometimes it’s better not to apply for patents or sometimes apply for patents delayed. Because the longer you wait, the longer it takes for someone to be able to see what’s written in the patent documentation. [However], it is important to actually have because otherwise you can’t protect yourself” (CellulaREvolution). Therefore, it is important to find the optimal timing for filing a patent. Similarly, Air Protein keeps their “secret sauce”, the bio- and fermentation process as trade secrets since they believe “it is a powerful way to protect your competitive advantage”. Company X also states that “IP protection is crucial to them and that there are several levels of protection”. Since there is a “very fine line and balance between patents and trade secrets” it is important to find the right route for each specific product.

TurtleTree Labs on the other hand says that “patents alone are not enough to protect you these days. You have to move, and you have to iterate quickly, and you have to be very close to your customers, very close to your team if you want to have a strategic advantage over other potential competitors”. Therefore, TurtleTree Labs still uses patenting, since it is also required by investors, but they do not see this alone, as a powerful tool to protect their technology. “Although we are continuing to build IP and patents we also understand that as a team we must continue to execute and not just rely on patents” (TurtleTree Labs). Nourish Ingredients sees a similar risk here: “You can file a patent and it acts as disclosure. But if you don’t follow through and demonstrate enablement, a patent can be self-defeating in a sense”. Hence, protecting knowledge is very important but whether to use patents or trade secrets is a very strategic choice for each company, since a patent can create a dilemma between revealing knowledge and protecting knowledge.

### *Dependency*

Company X mentioned an alternative strategy to protecting a BM, namely creating dependency. They would like to create a certain dependency between them and their partners who are used to working with their products, distribution channels and relationships. This helps them stay relevant in the market and strengthens their competitive positioning.

### **4.3.2 Strategic Partnerships**

According to our interviewees, strategic partnerships are essential in the industry of lab-grown food and dairy and are needed to reduce time to market. It is important for companies to have partners when “you are working on disruptive innovation, you really need to collaborate [along the value chain]” (BioTech Foods). Collaborations even go across industries, from food to pharmaceutical and from biotechnology to the chemical industry (NX-Food; Cultured Decadence). This is supported by TurtleTree Labs: “We are working with an entire ecosystem, from media companies to bioreactor and dairy companies”. According to the interviewees, it is not reasonable to own all resources yourself because there is already so much knowledge out there, that can be used (BioTech Foods; TurtleTree Labs). Start-ups must consider their R&D, marketing and sales strategy, financing, and scalability, so they have to collaborate with other companies in these fields in order to improve their processes, machinery and efficiency. In the end, collaborations are highly important because “who can fully cover the entire value chain?” (BioTech Foods).

### *R&D Collaborations with Universities*

Many partnerships involve R&D activities to decrease the time to market of their products. Therefore, the companies partner a lot with universities (BioTech Foods; CellulaREvolution; Nourish Ingredients; TurtleTree Labs). For example, TurtleTree Labs’s R&D Headquarter is in Davis, California despite being a Singapore based company. This decision was made because the researchers at the University of California, Davis are considered world leaders in milk and human milk research (TurtleTree Labs). TurtleTree Labs is a pioneer in the field of lab-grown milk and thus, expertise aiding R&D work is still nascent globally. Nourish Ingredients even started with almost fully outsourced R&D activity. “We had research agreements with a research institute from a university, but we got to the point where we were no longer

satisfied with that, and we decided that it was going too slowly. I think it's an appropriate way for a start-up to begin, but you reach a point where you need to move faster and have more control” (Nourish Ingredients). After raising enough capital, they internalized all their critical R&D work, except for some long-term projects. Similarly, Company X is not actively collaborating with universities either. They prefer to hire scientists from the best universities and to conduct all R&D work in-house, in “hope that [they] can afford their talent and bring them here” (Company X). The industry expert from NX-Food, underlines the importance of R&D collaborations within this industry, especially for start-ups that are limited in financial resources. However, he believes that as a company gets bigger, the more they will do in-house, thus reducing collaborations. This supports the approach by Nourish Ingredients as discussed above. For example, Impossible Foods hired over 100 researchers last year to foster the development of their products (Lucas, 2020).

#### *R&D Collaborations with Companies*

Besides R&D collaborations with universities, strategic partnerships are also pursued between companies. Collaborations with, for example, suppliers or customers, can help to further develop products or to scale production (BioTech Foods). For example, TurtleTree Labs collaborates with big existing food companies to learn from their experience within specific fields, such as, fermentation. TurtleTree Labs also mentioned that a partnership is always two-sided. Larger players in the industry hope to benefit from the innovation work start-ups are conducting, and that they might be able to deliver needed products. Air Protein is collaborating a lot with Kiverdi, the company that developed their core technology<sup>1</sup>. Currently, the final consumer products, for example chicken, is being developed with other companies that have more expertise in this field.

The firms’ processes thereby include high levels of iteration in product development, whilst working closely with customers. This was evident among several of the interviewed firms. For instance, Nourish Ingredients “certainly have a high level of iteration built into [their] processes where [they] receive feedback from [customers], make some changes, then give [the products] back, and do some further testing”. Company X echoes this approach as they utilise customer feedback in order to continuously improve or develop a new line of a product altogether, if

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<sup>1</sup> Lisa Dyson founded Kiverdi in 2008 and later launched Air Protein, in 2019, and is the CEO of both firms (Air Protein).

need be. CellulaREvolution undergoes a similar process by working together with different companies, testing various sales with their technology and “seeing how efficiently it works with their specific cell types”. Similarly, the CEOs of BioTech Foods and Cubiq Foods, explain they meet a certain criterion that “fits or meets consumer demand”, and then further develop the products over time. The industry expert explains the importance of taste, texture, and price, when it comes to consumer goods, hence one should not lose sight of the wants and needs of the end customer. The CEO of TurtleTree Labs echoes this perspective as “you have to get everything just right”, thus if not 100% successful on the first try, iteration and moving quickly are highly important.

Financially, partnerships are also very important. These start-ups need investors to fund their R&D work until they are able to sell products. Some interviewees said that their investors do not just fund them but are strategic partners at the same time (Aleph Farms; Air Protein). For Aleph Farms this is, for example, the US food corporation, Cargill, or Switzerland’s largest retailer, Migos. Similarly, Air Protein can call ADM, the American food processing corporation, their lead investor and partner. They hope that this partnership will help them de-risk some of their barriers and scale their production. Additionally, these experienced partners can give start-ups guidance and connect them with other firms of the industry.

### *Open Innovation*

Open innovation is another form of R&D collaboration that can be pursued by companies to share knowledge and decrease development cycles. BioTech Foods is part of a large research project called “Culturedmeat” which is funded by the Spanish government (Morrison, 2021). Along with seven other companies, BioTech Foods will collaborate with universities on cell-cultivated meat for the coming three years. Their objective is to develop cultured meat with healthy fats and functional ingredients (Morrison, 2021). This project is led by BioTech Foods and according to their CEO, this collaboration can be considered as open innovation, especially due to the time horizon, the investment sum, and the research objective. However, this does not mean that BioTech Foods is going to reveal all their knowledge because “if not, you obviously will have no value as a company”. In general, they support the idea of open innovation and that it can be useful to share certain things since some companies just might be able to develop it into something better than you could do. The rest of the interviewees are not part of such open innovation projects.

NX-Food argues that open innovation is not actively pursued in this industry unless there is large public interest and funding, since this kind of R&D work requires tremendous amounts of money. Therefore, it would be difficult to find non-public investors for such projects if they cannot reap the benefits afterwards. Most companies' goal is to create a USP with their IP and to sell final products or license out their technology at some point to generate a return on their investment. Hence, in the expert's opinion, open innovation is only possible when there is public funding for research projects.

### **4.3.3 Manufacturing & Commercialization Strategy**

#### *Manufacturing Strategy*

During the interviews, different sales and production strategies became apparent. All the analysed companies pursue a B2B business model, however the degree of vertical integration varies when it comes to large scale production. TurtleTree Labs and BioTech Foods will most likely pursue a licensing model in the future. They will allow other companies to use their technology to produce cultivated meat or milk. In TurtleTree Labs' case, this could mean that "all of the big dairy companies use our technology to produce milk". Alternatively, CEO of BioTech Foods proclaims they can also envision joint ventures to scale up the production as, "this is a huge market, and you need to install production capacity to really expand in the future... [thus], a licensing model or joint ventures are a very good option". Aleph Farms is also focusing on founding joint ventures in many countries to build up capacity. They will build BioFarms, where the cultivated meat will be grown, with local strategic partners. Aleph Farms argues that a joint venture has the benefit, that the local partner knows how to secure local financing, understands the country specific regulations better, and already has a network of suppliers and customers. In fact, they are even planning on founding joint ventures with livestock farmers. Eventually, some of the BioFarms will be fully owned by Aleph Farms. Cultured Decadence would also like to vertically integrate as much of the production process as possible. A third approach is pursued by Air Protein or CellulaREvolution. They are planning on outsourcing their manufacturing of their products to stay more capital light (Air Protein; CellulaREvolution). The products will still be sold under their name and brand. Hence, the companies pursue three different manufacturing strategies, namely licensing, in-house/joint venture, and contract manufacturing (outsourcing).

### *Commercialisation Strategy*

When it comes to commercialisation the companies also pursue different approaches, namely gastronomy first vs. retail first. For example, Aleph Farms is focusing primarily on “food service companies” as target customers, which are, for example, restaurants. They chose this commercialization strategy for several reasons. One, they can be sure that their steaks will be prepared in the right way. Second, it helps to educate consumers and show them what a cultivated steak is supposed to taste like, and it reduces their scepticism when it is produced by a chef. Third, it is a rather slow market release which allows them to always be aligned with the consumer and the demand. Fourth, it helps them to connect in the food industry and to arouse interest for their product. At a later stage, Aleph Farms might pursue a retail strategy if the restaurant strategy was successful.

A similar approach has already successfully been pursued by Impossible Foods. In 2016 a celebrity chef advocated Impossible Food’s burger patty and put it on his restaurant’s menu and eliminated carnivores concerns about plant-based burgers (Dallaire, 2020). After public interest was aroused, they started supplying other top restaurants in the US and then slowly expanded to smaller burger chains and eventually even expanding to fast food restaurants like Burger King (Dallaire, 2020). In fact, this is a strategy that the industry expert calls “gastronomy first”. He thinks this strategy is appropriate to convince hesitant consumers. Especially when consumers are sceptical, it is extremely important that the product is cooked the right way to make a good first impression. This is easier to achieve “in the controlled environment of a food expert”. Another argument for this strategy is that it allows companies to receive feedback quickly, make changes and create demand before going into retail. Additionally, it will be easier to find space in a retailer’s shelf if the consumer demand has already been created and public attention was raised (NX-Food).

Air Protein, however, will pursue the retail first strategy. Although they will outsource the production, they want to sell their product under their brand, for example, Air Protein Chicken. This decision was made during the pandemic when people started to enjoy cooking at home. Beyond Meat was highly successful with this strategy during the pandemic. They pivoted from foodservice to retail by repackaging large amounts of their products to meet the increasing customer demand. Air Protein wants to raise similar customer interest and hopes people will continue enjoy cooking at home, even after the pandemic is over. The industry expert thinks



that the retail first strategy is a valid approach, but at the same time it is a gamble, especially for established companies with known brands. Often consumers will try things only once and then make a judgment whether they like it or not. Recurring purchases are based on that judgment.

Alternatively, Air Protein might pursue a second BM if the first one turns out to be too difficult or time consuming. In that case they will focus on becoming a supplier for plant-based meat and dairy manufacturers that will use their protein ingredient to produce more nutritious products (Air Protein). However, they want to own the category design as opposed to fitting in where the other plant-based or lab-grown meat products are. Similarly, TurtleTree Labs is pursuing a second BM to reduce time to market and to generate turnover. Starting in 2021, they want to supply plant-based milk producers and dairy manufacturers with their proteins and complex sugars to create more sustainable, but at the same time nutritious, and consumable products. Most likely, these products will have a small TurtleTree Lab logo.

A summary of the results regarding seizing is evident in Table 7 below.

Activity	Category	Sub-Category	Companies	Supply Chain	Phase
<b>Seizing</b>	BM Protection	Patents	All	Supplier & Manufacturer	1 & 2
		Trade Secrets	All	Supplier & Manufacturer	1 & 2
		Dependency	Company X	Supplier	2
	Partnerships	Open Innovation	BioTech Foods	Manufacturer	2
		R&D Collaborations with Universities	BioTech Foods CellulaREvolution Turtle Tree Labs Cultured Decadence	Supplier & Manufacturer	1 & 2
		R&D In-House	Air Protein Aleph Farms Company X Nourish Ingredients	Supplier & Manufacturer	1 & 2
		Industry Collaborations	All	Supplier & Manufacturer	1 & 2
		Government Collaborations	Aleph Farms BioTech Foods TurtleTree Labs	Manufacturer	2
	Manufacturing Strategy	Licensing	BioTech Foods TurtleTree Labs	Manufacturer	2
		In-house/Joint Venture	Aleph Farms BioTech Foods Cultured Decadence	Manufacturer	1 & 2
		Contract Manufacturing	Air Protein CellulaREvolution Company X	Supplier & Manufacturer	1 & 2
	Commercialisation Strategy	Gastronomy First	Aleph Farms	Manufacturer	2
		Retail First	Air Protein	Manufacturer	2

*Table 7: Seizing Summary*

#### 4.4 Transforming

Presented below are the activities undertaken by the interviewees and their respective firms regarding “transformation”. The firms’ organisational structures and agility appear particularly relevant and are thus discussed below.

#### **4.4.1 Organisational Structure**

The interviewed firms appeared to all have a similar organisational structure. CellulaREvolution, BioTech Foods, and Cubiq Foods, all describe their organisational structure as flat and decentralised. CellulaREvolution explains there is “not really a hierarchy in place” and every week they have meetings where they can discuss “what needs to be done and what are the priorities... [according] to the rest of the team”. Similarly, Cubiq Foods explains the flat hierarchy allows everyone to excel in their respected roles. Cultured Decadence, TurtleTree Labs, and Company X, echo a similar structure through evidence of high integration across firm divisions. Cultured Decadence explains the internal structure is “very collaborative and very intertwined”. He tends to do much work in the lab, despite being on the managerial team. The CEO of TurtleTree Labs elaborates on a similar concept: “We prefer to have our business and science teams together as we learn from each other quite a bit. We enjoy the bond, company culture and as founders do not have an office because we don't like to be segregated from our team.” At Company X, it is argued that despite having a CEO and CTO in place, the organisational structure is “much more eye-level after that”. The interviewee argues that “not in any way, [is there] some sort of large distance between [them all]”. As new projects come up regularly at Company X, the flexibility enabled from the firm’s organisational structure, allows people to take on new assignments when they arise.

#### **4.4.2 Organisational Agility**

Evidence – or in some cases, aspiration – of a lean start-up method was apparent among several of the interviewees. Many of the interviewed firms have acknowledged the importance of being flexible, and easily adapt to any changes in the environment in order to keep up with competitors. For instance, Air Protein is conscious of their need to stay aware of changes in the environment and have made themselves flexible by being able to “shift to trends, change or if competing technologies come in” (Air Protein). Furthermore, the interviewee from CellulaREvolution explains that “the processes [they] have, focus on being able to adjust more easily, [in case they] need to take a different approach”. This was acknowledged as an advantage of being a “smaller company” (CellulaREvolution).

The CEO of TurtleTree Labs echoes this observation as by being a start-up, it is possible to adjust quickly. “We are always exploring new technologies so we can stay ahead of the curve. If we see something interesting, we are eager to explore and possibly adopt it” (TurtleTree Labs). TurtleTree Labs thereby plans to move with technologies, as they are looking to position themselves as “a category king” rather than excelling in a particular process. Hence, they are currently “enabling technologies to help [them] dominate that category”, as they are “still in a position where [they] can actually make a move very quickly”. TurtleTree Labs recently acquired biotechnology firm, Dyadic, and expanded their processes into the branch known as TurtleTree Scientific. The expansions of the firm are efforts in exploring and improving the processes, in order to lower the respective costs. The CEO explains that if one wants to be pioneers in a space “[they] can’t just wait for everybody else to build solutions for [them]”. A summary of the results regarding transformation is evident in Table 8 below.

Activity	Category	Sub-Category	Companies	Supply Chain	Phase
<b>Transforming</b>	Organisational Structure	Flat and Decentralised	BioTech Foods CellulaREvolution Cubiq Foods Nourish Ingredients Company X Cultured Decadence TurtleTree Labs	Supplier & Manufacturer	1 & 2
	Organisational Agility	Lean Start-up Method	Air Protein CellulaREvolution TurtleTree Labs	Supplier & Manufacturer	1 & 2

*Table 8: Transforming Summary*

## **5 Discussion**

Building on the empirical results, this chapter aims to address the RQ by discussing the findings and comparing the fit to previous research. We have identified the most salient insights within the aforementioned categories of sense, seize and transform. This allows for a holistic overview of the insights the empirical results suggest. The chapter is concluded with the presentation of the final framework.

### **5.1 Sensing**

Teece, Peteraf and Leih (2016, p.21) define sensing as the ability to “sense or generate options for growth before the market logics of those options become apparent to all”. In order to achieve this outcome, sensing requires the capabilities of networking, hypothesis building, and identification of barriers and strategic opportunities. Below includes a cross-examination of the findings with the mentioned capabilities, analysing how the answers fit relative to the existing body of literature.

#### **5.1.1 Networking**

“Generative-sensing capabilities involve undertaking actions to proactively create hypotheses about the future implications of observed events and trends and testing these hypotheses to grease the pathways for new products, services and business models” (Teece, Peteraf & Leih, 2016, p.21). Within sensing, Teece, Peteraf and Leih emphasise the significance of networking “to discover the real capability to sense opportunities before [companies] fully materialise” (2016, p.21) in order to become ahead of rivals. They further discuss the importance of not only listening to competitors, but also listening to customers and bringing together multiple disciplines and perspectives in the process. The case supports this theoretical aspect, as evident in Table 6, all companies utilise some form of networking in order to keep up to date with events and trends in the industry.

Many of the firms communicate with stakeholders, gathering information on the wants and needs of their customers, investors, and so forth. This can be seen as a form of inductive reasoning, or sensemaking, whereby firms may fall into a trap and assume if some investors or

customers desire something, then all investors and customers will desire it. Cultured Decadence may currently be reliant on such logic as they focus a great deal on how certain food products or technologies have gone about in the past (Cultured Decadence), possibly assuming this may be the case for the future as well. In fact, several of the interviewees highlighted the significance of observing best practices, where they look at what others do (Air Protein; Cultured Decadence; NX-Food). Firms as such include Perfect Day, Eat Just, and Beyond Meat. This is primarily applicable for companies categorised as manufacturers in the supply chain. The firms developing an end product have also highlighted their efforts in gathering and examining information on consumer behaviour through public research. However, by acknowledging for instance a sustainability trend among younger generations, several interviewees assume the consumption and desire of their products due to the associated sustainability aspects, thus carrying out deductive reasoning. Although still highly significant to consider, neither inductive nor deductive logic could generate anything truly new, due to their reliance on the past (Teece, Peteraf & Leih, 2016). Hence, abductive reasoning is emphasised when carrying out generative sensing in a highly uncertain environment, of which is commonly pursued through imaginative hypothesis building, as discussed in the following section (Teece, 2007; Teece, Peteraf & Leih, 2016).

Furthermore, March and Simon (1958), and Nelson and Winter (1982), as cited by Teece (2007), highlight the importance of constant scanning, searching, and exploring across technologies and markets, both 'local' and 'distant'. Analysis of the lab-grown food and dairy industry supports this theoretical aspect. The industry is still relatively small, despite increases in companies every year. As the firms are scattered across the globe, it is essential that they actively connect with distant markets and firms, otherwise they can miss something important when carrying out the act of sensing. Due to the COVID-19 pandemic, the usage of digital communication methods has increased (Statista, 2021), making it more common to reach out to others online. This may be seen as an enabler of distant communication with markets and firms, as prior to the pandemic, some may have felt limited or restricted due to the large geographical barriers between them.

### **5.1.2 Hypothesis Building**

In pursuit of imaginative hypothesis building, scenario planning can be utilised, thus aiding generative sensing (Teece, Peteraf & Leih, 2016). Schoemaker (1995, p.25) defines scenario planning as “a disciplined methodology for imaging possible futures in which organisational decisions may be played out”. Utilisation of a tool as such was lacking among the interviewed firms, thus raising several questions. It can be assumed that the complexity and uncertainty of the environment is too great for firms to be capable of scenario planning, or whether unconsidered scenarios are unnecessary due to the start-ups’ general lack of resources to accommodate them. “Scenarios can be beneficial in shaping the focus of decision makers and draw attention to areas that would have been otherwise overlooked” (Teece, Peteraf & Leih, 2016, p.22), hence, the interviewees may be at a disadvantage by not considering this aspect. However, there may be a reason to why these companies are not utilising scenario planning. For instance, it became evident in our empirical results that start-ups commonly have a lack of resources to make major changes. Thus, planning for scenarios they do not have the resources to accommodate for may appear unnecessary. The interviewees thereby seemed to prioritise flexibility and being capable of quick adjustments, over foreseeing scenarios with low probabilities. Additionally, the aspect of scenario planning may not be as applicable in practice despite theoretically being a sufficient tool for planning, as it is crucial to look into the future. Essentially, if the execution of the activity is not sufficient, there will be little benefit that firms gain from it.

### **5.1.3 Identification of Barriers and Strategic Opportunities**

Furthermore, Teece (2007) emphasises the employment of an analytical framework in aid of highlighting important threats and opportunities. The interviewed firms put little emphasis on the utilisation of such tools. CellulaREvolution was the only firm that mentioned utilising a framework such as the SWOT analysis, to examine the environment. However, it was nothing that they used daily (CellulaREvolution). Nonetheless, all interviewees were aware of the barriers they faced and sensed strategic opportunities. Evident in the results, the interviewees discussed the barriers of scalability, consumer acceptance and regulations. Notably, the firms categorised as suppliers, did not find consumer acceptance to be a major barrier. Company X explained that this is more a barrier for the food production companies, and that although they themselves are affected by consumer trends at large, they are not consumer facing. Thus, the

choice of the position on the supply chain, makes a difference in the factors sensed by the companies. Furthermore, scalability and regulations were not major concerns for those firms categorised as being in Phase 1 of the company lifecycle. It can thereby be argued that companies have different concerns at different stages of their development, thus making the degree of the need to sense barriers, potentially vary at different stages as well. Nonetheless, by acknowledging barriers, the individual firms are able to plan their strategy around them. In addition, identification of the barriers can allow firms to address the root causes of these inhibitors and remove them.

As lab-grown food and dairy is a technology intensive industry, several of the interviewees acknowledged the threat of new technologies that may enter the market. As previously mentioned, the CEO of TurtleTree Labs said they would be “all over it” if a new technology was to come about. However, little emphasis was put on the threat of companies such as Solar Foods or Air Protein, despite the BCG report’s emphasis on the potential of these firms in regard to industry disruption. The report was referenced as significant according to the industry expert. Although various factors may be involved, one can question whether there is a correlation between the utilisation of an analytical framework and a holistic overview of the threats and opportunities in the respective environment. Alternatively, the BCG report may be presenting an opinion of which many disagree with, by urging a matter of which may not be relevant at this moment in time (Witte et al., 2021).

After consideration of the results acquired from the case, it became clear that sensing threats and barriers is highly significant for firms within an industry. The identification of threats and barriers allowed many of the firms to sense strategic opportunities. For instance, TurtleTree Labs’ acknowledgement of regulation as a barrier, influenced their decision to become a Singapore based firm, where approval of lab-grown food has already been granted, and support from the Singaporean government is significant. Opportunities as such would not be sensed without the acknowledgement of the barriers the companies face. Teece put emphasis on sensing both opportunities and threats in his paper in 2007, however primarily focused on opportunities in his later work (Teece, Peteraf & Leih, 2016; Teece, 2018). The authors argue the significance of barriers in terms of sensing, thereby proposing the refinement of theory, to emphasise the aspect of both barriers and opportunities once again.



Furthermore, the interviewees sensed strategic opportunities. As previously mentioned, Teece (2007; 2016; 2018) puts great emphasis on the sensing of opportunities, in order to later seize them. Many of the interviewees acknowledged the coming of a change in demographics, the market and its technological opportunity, and a few identified opportunities regarding trends and profit margins. The identified opportunities were quite general, but nonetheless important for the interviewees. Many of them based their vision or goal on filling the gap of food supply and demand, as they saw an opportunity due to a change in demographics worldwide. The novelty of the industry may influence the lack of firm specific opportunities, however, does not take away from the importance of sensing them. Therefore, the case supported the theoretical aspect identified by Teece.

Arguably, firms could utilise frameworks such as PESTEL, Porter's Five Forces, and SWOT Analysis, etc. to become more aware of their external environment. However, much critique revolves around the use of such frameworks as companies may be framed and think within the borders of the framework, missing the interrelations between threats and opportunities, as well as any factors that do not fit within the categories of the framework. Moreover, this form of analysis can be criticised due to its analytical nature, based on detail and precision, and relying on past knowledge and tangible elements. This method may result in a linear-causal approach, applicable solely to a rule-based environment. Due to factors such as integration and globalisation, the 21<sup>st</sup> century has become a complex environment with high levels of volatility, uncertainty, and ambiguity. Thinking in this form of environment requires integrating interactive, interdependent, vague and fuzzy, intangible information. Here, for firms to thrive, free-thinking whereby firms are not framed or restricted to a framework, may be more suitable. As the interviewees did not describe their sensing methods in the form of framework or model, they may thereby be allowing themselves the freedom to sense, more than they would if restrained by an analytical framework.

In conclusion, we emphasize the importance of sensing barriers and threats in addition to the identification of opportunities. Additionally, it became evident that hypothesis building, or the utilisation of frameworks are not actively pursued by the firms in order to sense environmental change. Instead, firms rather focus on networking. Therefore, we argue that theory should put more emphasis on threats and barriers as well as networking and the distinction between its different forms.

## **5.2 Seizing**

Seizing relates to addressing the beforehand sensed opportunities through new products, services or processes (Teece, 2007). It is “about implementation and getting things done” (Teece, Peteraf & Leih, 2016, p.15). This can be conducted by implementing the right BM that supports flexible sourcing arrangements, defines the right commercialization strategy, and allows for the right partnerships. Below, the findings are discussed and related to existing theory.

### **5.2.1 Dominant Design**

Sensed opportunities are thereby seized by undertaking the right actions (Teece, 2014). In the lab-grown food and dairy industry, the entrepreneurs address these opportunities through product and process innovations. Specifically, they apply already known technology, precision fermentation and cell cultivation, to a new industry. The analysed industry consists mainly of newly founded companies and incumbents are only slowly entering the market (NX-Food). Alternative proteins will eventually replace protein from livestock, but this will most likely take decades (Witte et al., 2021).

According to Teece (2007), multiple competing investment paths are possible in the beginning when new technologies emerge. Due to limited resources and high uncertainty, he suggests firms stay flexible until a dominant design becomes visible and then invest heavily. However, some firms have to invest beforehand, otherwise a dominant design will not emerge at all. This R&D work is often conducted by start-ups (Teece, 2007). The interviewed start-ups in the lab-grown food industry place their bet on one technology. Nonetheless, it became apparent that Phase 2 companies try to stay flexible and hope to be capable of shifting quickly if a dominant design becomes apparent (Air Protein; TurtleTree Labs). However, we question if the theory of the dominant design is applicable in the context of lab-grown food and dairy. We argue that the start-ups have to be quick on their feet in order to thrive and exploit market opportunities. Still, we think that it is most likely that technologies will exist parallel to each other. This became evident during the interviews and when reading market reports. One, precision fermentation will most likely reach cost parity with traditional protein before cell-cultivated meat. Two, the technologies target slightly different customer segments in terms of consumable food products, and three, the market is already extremely big and continues to grow. Therefore, we argue that the theory of the dominant design is not generalizable, and firms should not put too

much emphasis on it and rather consider the specific industry context or they might be missing opportunities. In fact, we argue that this logic is restraining and might hinder a firm's capability to sense. Due to these new circumstances and the uncertainty the firms are facing, it is important to choose the right architecture to accommodate a firm's technology in order to generate financial benefits from it (Teece, 2007).

### **5.2.2 Business Models**

Designing and implementing BMs is as fundamental to a firm's success as the chosen technology itself or it will not provide commercial success to the innovating firm (Teece, 2007). Important decisions, when selecting or adjusting a BM, include, what market segments to target, what sales and manufacturing strategies to pursue, and which partners to collaborate with (ibid.). Selecting the right BM is complex and requires knowledge about the available choices and the right assembling of those. This is especially complex in an industry that is still very new and evolving (NX-Food). Since the lab-grown products are only allowed to be sold in very few markets it can be quite complex for the start-ups to decide on commercialisation strategies and customer segments.

According to theory, BMs need time to catch up to technological innovation since they are more context dependent (Teece, 2007). Especially in this industry, there are still many new players coming to the market every year and the value chain has not been established yet (Cultured Decadence). The technology is the linchpin of every firm's BM and profitability is highly dependent on it (NX-Food). Therefore, a firm must carefully select its positioning on the supply chain and consider advantages and disadvantages. To diminish risks, it can be useful to pursue two BMs. For instance, TurtleTree Labs is going to supply the plant-based dairy companies with proteins and complex sugars. This reduces the time to market, allows them to receive customer feedback earlier and helps them to become profitable faster. Once the technology matures, they will produce and sell whole milk that is identical to cow milk or human breast milk.

CellulaREvolution, Company X, Cubiq Foods and Nourish Ingredients can all be described as suppliers for the alternative protein industry. The companies are cospecialised<sup>2</sup> and meant to complement the manufacturers (Teece, 1986, 2007). Their advantage is that they stay focused by only working on one specific ingredient that is required for the final consumable product, for example specific proteins or fatty acids (NX-Food). Focusing on one specific ingredient is less complex and less capital intensive, than producing the whole final product in-house. Additionally, their BM might be less risky as they can serve several different customer groups. However, they face the risk of losing sight of the end-customer. They can mitigate those risks by frequently talking to their customers to receive consumer insights (CellulaREvolution, Nourish Ingredients). They have their products tested in their customer's products to see how their fats work in a burger patty. This allows for an iterative development process which facilitates quick learning and reduces costs. Hence, these focused companies might help the industry to reduce time to market since it opens up for more collaborations and shared knowledge.

A successful BM enables a firm to achieve a price for their products that allows them to cover all costs and to make a satisfactory profit (Teece, 2007). Staying light-footed and keeping the ability to quickly make changes to a BM is at the core of DCs (Teece, Peteraf & Leih, 2016). Thus, the results support established theory.

### **5.2.3 Business Model Protection**

Especially when it comes to rapid technological changes it is important to set the firm's boundaries and to defend the BM. An innovation must be protected, or it will be imitated by rivals and not generate benefits for the innovating firm (Teece, 1986, 2007). In fact, the control and use of IP rights is a major factor when designing BMs (Teece, 2018). This became evident when talking to the interviewees. The industry expert said that the firms' technology is their unique selling proposition (USP) and must be protected. A strategic analysis must be conducted to identify "isolating mechanisms" that conserve profitability (Rumelt, 1984). This was supported by CellulaREvolution, who said that the decision to file patents or to keep something as a trade secret is a very strategic choice. It is about choosing the right mechanism at the right time to make the most out of it (Nourish Ingredients). Evident in the results, all firms protect

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<sup>2</sup> As defined by Doz and Hamel, cospecialisation regards "an alliance in which partners come together to combine specialised resources and create value by bundling them together" (1998).

their IP with patents and trade secrets. However, there are some disadvantages when it comes to patents. According to Teece (2018), IP rights are not sufficiently protected to defend a BM and the value capture appropriately. Once a patent is published, it is accessible to everyone, and a firm reveals what they are doing (Air Protein; CellulaREvolution). Although the IP is protected for 20 years, sometimes companies find ways to go around them (Nourish Ingredients). Another threat is that companies might get lazy and hide behind their patents because they feel protected (TurtleTree Labs). TurtleTree Labs' CEO does not consider patenting as a sufficient protection method, if done on its own. They acknowledge it is usually a requirement by investors, however, must be packed up by other forms of protection to preserve the BM. Therefore, often companies decide to keep the "secret sauce" to themselves as trade secrets (Aleph Farms; BioTech Foods; Company X; Nourish Ingredients).

Another strategy to protect a BM is to capture a large market share by rapidly scaling and generating cost advantages before the competitors (Teece, 2018). A firm that becomes the first mover will most likely become the "go-to" firm (Witte et al., 2021). This strategy is implied by TurtleTree Labs' ambition to become the first mover and to dominate the category of cultivated milk. They will succeed if they stay ahead of the game by being close to their customers and by reacting to market changes quickly (TurtleTree Labs).

Furthermore, switching costs and customer lock-ins can help firms strengthen their market position and stay competitive (Teece, 2018). Company X actively uses such a strategy to protect their BM and to stay relevant. They try to create dependency between them and their partners, for example suppliers and customers, who value their products, processes, and distribution channels.

Alternatively, companies can pursue an *integration strategy* that internalizes parts of the value chain to capture value. However, this strategy requires significant investment (Teece, 2018). Firms that are in Phase 2 of the company lifecycle and categorized as manufacturers, pursue this strategy in order to stay competitive (Air Protein; Aleph Farms; BioTech Foods; TurtleTree Labs). However, they do not actively use it as a strategy to protect their BM but rather as a manufacturing strategy. A strategy to protect the BM must be carefully selected and the right combination of patents and trade secrets must be chosen. Thus, the results support theory. However, the interviewees do not apply vertical integration as a means of protection, despite theory's suggestion.

#### 5.2.4 Manufacturing Strategy

When it comes to manufacturing, there are different strategies that can be pursued by companies which have advantages and disadvantages and some facilitate flexibility, others do not. According to Teece (2007), typical options include vertical integration vs. licensing vs. joint ventures. Beginning with vertical integration, a company tries to produce nearly everything in-house and owns their suppliers and distributors. As previously mentioned, this allows a company to keep all the IP in-house and protects a BM. During the industrialisation era, economies of scale were highly important and vertical integration allowed for a very efficient process (Teece, Peteraf & Leih, 2016). Especially when qualified partners are limited, it can be useful to integrate up- and down-stream activities (Teece, 1976). In this still very small industry, finding adequate partners is difficult. They either have a different research scope, or they are geographically too far apart which can make a collaboration complex. Most interviewed companies are vertically integrated to some extent; but the degree varies. For example, Aleph Farms (Phase 2 company) is currently producing everything in-house from bioreactors, to media, to the final consumable product. They plan on scaling their cell cultivation by founding joint ventures all over the world. This ensures that they still control everything but benefit from their partners' networks and country-specific knowledge. However, the downside of vertical integration is inflexibility and the required large, fixed investments. This might hinder companies from adjusting quickly to changing conditions (Teece, Peteraf & Leih, 2016).

TurtleTree Labs recently acquired their partner, Dyadic, which is a common practice for integration strategies. Dyadic is researching specific cell culture media for the dairy industry which is supposed to lower the manufacturing costs. When it comes to large scale production however, TurtleTree Labs and BioTech Foods are planning for a licensing model where large dairy companies will be allowed to produce dairy with their technology. In fact, licensing is a viable BM when a company has strong IP rights, even if a big share is ceded to the licensee (Teece, 2018). This holds true when developing complementary assets is very expensive and the time horizon is short (Teece, 2018). Especially in this industry, where it is about capturing a large market share quickly, this is possibly the fastest way to scale production (TurtleTree Labs; BioTech Foods).

Air Protein and CellulaREvolution plan on outsourcing their production to contract manufacturers. This strategy provides them with maximum flexibility and it is easier to adjust to

changes, since it is easier to break ties with a contract manufacturer than with one's own manufacturing plant (Teece, Peteraf & Leih, 2016). Hence, in order to facilitate DCs, companies are well advised to consider outsourcing the manufacturing, or licensing their technology in order to stay agile in uncertain environments.

No clear differentiation between Phase 1 and Phase 2 companies could be made for this section, except that vertical integration can be hard to pursue for Phase 1 companies, since it is a capital-intensive strategy. However, it was observed that companies that are categorized as manufacturers (Aleph Farms; BioTech Foods; Cultured Decadence; TurtleTree Labs), prefer to integrate more than the suppliers (CellulaREvolution; Company X; Cubiq Foods; Nourish Ingredients).

### 5.2.5 Commercialization Strategy

A BM must also define a firm's commercialization strategy (Teece, 2007). Otherwise, the innovation will not result in financial success for the innovating firm. This decision depends highly on the manufacturing strategy that the firms have chosen and whether they want to provide the final product or only ingredients to alternative protein producers. This is something that became very clear when analysing the interviewed manufacturers Aleph Farms and Air Protein, as well as other firms such as Impossible Foods and Beyond Meat. They are planning to produce their meat either in-house or via contract manufacturers. The two strategies that became evident when analysing the obtained data are *retail first* and *gastronomy first*. According to the industry expert this is a very vital decision the firms must make, especially when it comes to new products where consumer scepticism is high (NX-Food). When firms decide on *retail first*, they must be aware that they are not controlling the presentation of the product to the end customer, which can have detrimental consequences (Teece, 2007). Another disadvantage is that if consumers do not like a product, they are unlikely to buy it again, unless a rebranding occurs. On the other hand, this strategy allows firms to capture a large market share quickly by expanding the distribution (NX Food). Therefore, *retail first* can be a great, but risky one-shot opportunity.

*Gastronomy first* has the advantage that consumers will most likely have a good impression of the product if it is prepared by a chef. Once a popular chef is convinced, people automatically

become curious and want to try it which leads to increased demand (Impossible Foods). The downside of this strategy is the limited exposure in the beginning. Hence, scaling takes longer than when pursuing *retail first*. Both strategies have proven successful to Impossible Foods and Beyond Meat. This is a very essential and individual decision for each firm to make, therefore it must be evaluated carefully and should be aligned with the BM, customer demand, market saturation and production capacity.

In DC theory, Teece (2007) does not put a lot of emphasis on commercialization strategies. In fact, he only mentions that a BM must define it. However, we argue that for this industry, it is extremely vital and might decide on success or failure of a product. Therefore, firms should not make hasty decisions and rather consider it carefully, and search for references in their industry. However, this is again, highly context dependent and not generalizable to all firms or industries, since for example firms, categorized as suppliers, do not have to worry about it as much as the manufacturers.

### **5.2.6 Strategic Partnerships**

As mentioned before, partnerships are very important, especially when companies are not vertically integrated to a large extent. Partnerships do not only allow companies to stay up to date with the industry settings, but they also allow them to overcome sensed barriers such as scale, and time to market. Pisano, Shan, and Teece (1988) illustrated that R&D outsourcing can help overcome barriers since the required knowledge might be outside the firm's internal environment. This was confirmed by the interviewees as existing knowledge is extensive, and it is difficult to do everything yourself (BioTech Foods). The findings revealed that especially Phase 1 companies rely on R&D collaborations with universities, because they do not have the financial means to do it in-house (CellulaREvolution; Cultured Decadence; Nourish Ingredients; NX-Food). TurtleTree Labs, a Phase 2 company and a pioneer in the industry of lab-grown dairy, is intensifying their R&D collaborations with UC Davis. Although they are a Singaporean firm, it was a strategic choice to go to California for their R&D, as only few researchers in the world have the required knowledge. Hence, the choice can be limited for a pioneering company.



It was found that once companies enter Phase 2 of their lifecycle, it becomes more important to protect their IP. Hence, the firms shift their R&D in-house (Aleph Farms; Company X; Impossible Foods; Nourish Ingredients; NX-Food). At this point, they should have acquired the necessary investments to afford the researchers and to bring them inside the organization.

Aside from collaborations with universities, it was found that the start-ups also collaborate with customers and suppliers. Often, these focus on optimizing their products with the goal to satisfy the consumer's needs. The collaborations between start-ups and incumbents can be particularly valuable as they might have a big impact on shaping this industry's value chain. The incumbents have years of expertise in large-scale fermentation and manufacturing processes. Hence, collaborations among start-ups and incumbents might generate economies of scale (NX-Food). The interviewed companies already partly pursue such collaborations but did not talk about them in detail since many of those deals are still confidential. Once the incumbents enter the market and recognize new business opportunities, the whole industry might excel (NX-Food). In fact, this is what Teece (1986) and Mitchell (1991) implied when they argued incumbents do not need to be the first movers. They have a superior positioning in terms of experience, knowledge, resources, and complementary assets which allows them to enter a market at a later stage (Teece, 2007). They let start-ups do the pioneering work and once there are less risks and a technology seems promising, they will enter. Therefore, the incumbents' bets on firms can be an indicator for which technology might succeed in the race of dominance.

According to Teece (2020), open innovation can decrease a firm's R&D costs and enrich a firm's knowledge. Furthermore, it can enhance a firm's ability to sense changes and trends in the environment and competitive advantages can be derived (Teece, 2020). However, this is not supported by this thesis's findings. Only one company pursues an open-innovation activity. BioTech Foods leads a project where several firms are trying to solve a key societal issue by developing healthier fatty acids together with universities. The interviewees' major concerns were the large costs related to open innovation (NX-Food) and the risk of revealing too much knowledge and losing a competitive advantage (Aleph Farms; BioTech Foods). Hence, currently there must be specific circumstances for companies to participate in such activities, for example large public interest and funding (BioTech Foods; NX-Food). Open Innovation does not seem to be a very common R&D strategy yet, since it can be risky if firms do not manage to derive a competitive advantage from it.

It can be concluded that R&D collaborations are important, especially in the beginning of a technology focused firm's lifecycle. Such collaborations might help overcome barriers and reduce the time to market and eventually generate competitive advantages. However, there seems to be a dilemma between the generated advantages and the knowledge that is being revealed. Firms must carefully evaluate the trade-off between protecting IP and R&D collaborations.

## **5.3 Transforming**

According to literature, transformation regards changing a firm over time (Teece, Peteraf & Leih, 2016). Change as such regards altering a firm's organisational structure to allow for flexibility. The interviewed firms' internal structures are discussed below, followed by the authors' personal interpretation of transformation as a concept and its applicability to start-ups. Hence, the concept of shaping is proposed.

### **5.3.1 Organisational Structure**

Organisational transformation occurs rather periodically, in contrast to sensing and seizing of which occur continuously (Teece, 2018). The activity regards a firm's capacity to pivot and proactively reposition itself to address newer threats and opportunities as they arise to avoid inertia. In order to transform, a firm's organisational structure plays a major role. According to Teece, Peteraf and Leih (2016), a decentralised structure allows for more agility as information flow among employees is faster and less distorted. This is essential in rapidly changing environments. In addition, hierarchical organisations have a tendency to become rather bureaucratic and rule bound which leaves little room for flexibility. A system as such can be time consuming to change. Hence, a level of self-organisation can support firm agility (Teece, Peteraf & Leih, 2016).

When analysing the empirical results, it became apparent that Teece had large organizations in mind, and not start-ups, when he writes about the DC of transformation. The interviewees acknowledged and understood the need for organisational transformation; however, it was not applicable to the firms. The term transformation implies that there is already something in place that can be changed. Even the firms in Phase 2 of the company lifecycle claimed they are still too immature to think about changing routines if none have been installed in the first place.

There is a reason why people say “you are wearing a lot of hats” when working for a start-up (Air Protein). People are involved in a lot of different projects and are not constraint to their area of responsibility (Company X). It was highlighted that the exchange among all employees is extremely important and that the culture is very collaborative and intertwined (Cultured Decadence). In fact, through regular exchange across different competencies, problems can be avoided or solved, and new projects started (TurtleTree Labs). This element of self-organization implies that agile structures are already in place (Teece, Peteraf & Leih, 2016).

All firms acknowledged their flat organisational structures by being start-ups and highlighted the importance of it. They try to keep the flexibility through an open environment whereby opinions are not suppressed and there is generally a greater sense of responsiveness. The risk of unexperienced people making the wrong decisions can be mitigated by this open culture, since they can ask colleagues for advice without hesitation. Another factor influencing the decision-making is the employees’ motivation. Most of the employees working in the lab-grown food and dairy industry are not just driven by the money they are earning. Many people want to have an impact with the work they are doing (NX-Food). By actively shaping the future of food they see the purpose of their work and are typically more committed to a company, and thus make more responsible decisions. Unlike in a large organization with a hierarchical structure, where employees have limited freedom and primarily work for the money. People with this intrinsic motivation can be referred to as members of a network rather than employees, and are typically more self-organised, results in greater agility and responsiveness (Teece, Peteraf & Leih, 2016). Additionally, due to a start-up’s size, it can be beneficial to include all employees when sensing the environment.

According to Teece (2014), the management plays an important role when it comes to transformation. A good manager must be creative and act entrepreneurially without being too framed by the routines in place (ibid.). The findings reveal that CEOs and founders play a very important role in start-ups, however they do not have to act to be entrepreneurs, because that is what they are. In the end, they are responsible for the success of the firm and make the final decisions regarding BM, strategies, and resource allocation (Air Protein; Nourish Ingredients). The interviewees emphasized how important it is that the CEO is close to the employees (Air Protein; Cultured Decadence; TurtleTree Labs). Networking and exchanging information within a firm seems to be as important as networking with other industry players. Therefore,

exchange and communication inside and outside the firm are extremely important for start-ups working in new industries under a lot of uncertainty.

The flat structure of the firms can be seen as an enabler of a methodology known as the “lean start-up method” which allows a firm to carry out the act of transformation. The method is known to favour experimentation and prefers learning to elaborate planning (Teece, Peteraf & Leih, 2016). Here, failing fast and re-grouping is essential, thus change is considered iterative and incremental. One of the firms showing clear signs of the lean start-up method for firm development was TurtleTree Labs. The CEO talked about being “king of the category”, hence sticking to one product or technology is not the goal, rather the firm is trying to keep up with industry disruptions.

### **5.3.2 Shaping**

The analysed data revealed that transformation is not a suitable DC for firms in the entrepreneurial phase when they are facing change and uncertainty. Start-ups already have a flat structure, making them lean and agile, which is what large corporations are trying to achieve by transforming their organization. However, as a company grows, it is important to prevent rigidity and organizational inertia (Agarwal & Helfat, 2009). Hence, the entrepreneur must actively shape the organization to avoid hierarchies and bureaucracy. Flat structures and decentralization should be promoted (Teece, Peteraf & Leih, 2016). Simple routines and processes for decision making as well as reporting structures may help to keep the start-up mentality (Agarwal & Helfat, 2009).

Furthermore, the firm’s culture seemed to be very important to our interviewees. Hence, it should be shaped as well to avoid large distances between managers and employees. Everyone should be given a voice, and diversity should be supported to avoid biases and to foster reflective thinking. It should be the objective that employees identify themselves with the firm. They should feel as members of a team with a common purpose instead of competing against each other. This increases intrinsic motivation, leads to more responsible decision-making, fosters their work ethics, and drives the organization as a whole. Therefore, we suggest altering the dynamic capability framework for entrepreneurial firms by replacing *transforming* with *shaping*.

Firms in this still emerging industry do not only have to adapt to changes coming from their competitive environment, but they can also shape it (Teece, 2018). If one of the firms becomes a first mover and has a successful commercialization strategy, they might have a strong impact on consumer acceptance and increase the market demand. Furthermore, the larger companies are actively collaborating with several food agencies to speed up the regulatory process and open more markets for the whole industry. Open-innovation projects might generate valuable technological progress that society at large might profit from once healthier and more nourishing dairy and meat products will become available for affordable prices.

In our interpretation, it is important to connect shaping with transaction cost economics, as defined by Coase (1937) and Williamson (1979). By comparing the transaction costs of outsourcing with that of internal production costs, firms can weigh the pros and cons of sourcing from the market. The transaction cost can therefore determine the processes of a firm, and its relationship with other industry players. We argue that firms can actively shape their industry by pursuing collaborations, thus further reducing transaction costs. Within the lab-grown food and dairy industry, the potential for this is high, as the industry players do not see each other as mere competitors, but rather as allies in pursuit of a more sustainable world (Aleph Farms; BioTech Foods; Company X; Nourish Ingredients; NX-Food).

## 5.4 Summary

In this section, the preliminary framework will be revised, and a final framework will be introduced. The goal of this thesis is to explain how entrepreneurial firms use DCs to create a resilient BM in times of technological change. Therefore, the lab-grown food and dairy industry was analysed and discussed. The interview questions referred to the micro-foundations of DCs with the purpose to identify how the firms use DCs in order to accommodate change and create a long-term competitive advantage.

In the discussion it became apparent that *sensing* is about sensing opportunities, threats and barriers from technological change and the competitive environment. Start-ups mainly conduct sensing through networking, secondary sources and exchange with stakeholders. It became apparent that limiting this to opportunities, as a review of existing literature suggests, is too

constraining and that it is just as important to sense barriers and threats, coming from the competitive environment or other factors, such as governments and regulators, as well. If threats and barriers are not sensed, they can overwhelm a firm and ruin their competitive advantage. Furthermore, threats and barriers can be turned into strategic opportunities if seized correctly. The main opportunities, threats and barriers commonly regard the firms' technologies, as technological innovation is a driver of change that puts pressure on firms' BMs. Hence, the DC of sensing is now placed directly below technological innovation, as can be seen in Figure 3.

Moreover, the relation between BMs and *seizing* is essential to understand if a company wants to achieve resilience. The BM must turn the technological innovation into financial success to sustain the firm in the long run. Since the design of a BM is more context specific, it takes time to catch up to the technological innovation. Especially in an emerging industry, where structure and value chain are not yet set in stone, it is important that entrepreneurs pay attention to the available choices and stay light-footed when making strategic decisions. Therefore, we argue that it is necessary for entrepreneurs to think about their BM at an early stage and consider multiple commercialization and manufacturing strategies while acknowledging the available resources. They must be aware that some strategies commit more resources than others and therefore may favour less flexibility. Moreover, entrepreneurs must recognize that a change in one area of the BM might lead to changes in another. The strategic decisions must be in line with the level of protection that is pursued by the firm. Protecting the linchpin of the business, which is the technology in the discussed industry, is extremely important and must be carefully considered when collaborations are anticipated. These interdependencies of the BM segments are complex, and entrepreneurs must be aware of it when seizing opportunities.

Hence, the seizing of opportunities directly influences a firm's BM, interdependencies must be considered carefully and strategic choices supporting flexibility should be favoured. Therefore, *seizing* is located directly underneath business models in the final framework.

Another finding of the conducted case studies is that *transformation* is not a suitable capability for an entrepreneurial firm. If hardly any organizational structure exists, it cannot be transformed. Therefore, we argue that actively shaping the organizational structure is important as the company grows. The entrepreneur should try to facilitate agility by keeping the structures flat and pursuing a decentralized organisational form while having efficient work streams.

Moreover, the culture must be actively shaped, and employees should continue to feel as “members” of the organization which promotes intrinsic motivation and responsible decision-making. Furthermore, the firm’s competitive environment can be shaped through their actions and decisions.

We argue that shaping is directly connected to sensing and seizing because we do not see it as a sequential process as displayed in Figure 1 by Teece (2018). Instead, we understand sensing, seizing and shaping as continuous processes that must occur simultaneously. Firstly, we think that an appropriate organizational infrastructure and culture must be shaped to encourage employees to actively sense opportunities, threats and barriers. Secondly, we believe simple processes and routines allow firms to seize quickly. However, it goes both ways. The other way around, sensed opportunities and seized changes in the BM, will often imply changes within the organizational structure and culture. It may even have the potential to shape the industry as a whole. Hereby, we acknowledge the interrelations between sensing, seizing and shaping.

A firm that senses the environment, creates strategic options, and seizes them through adjustments in the business model while shaping culture and organizational structure in times of technological change and uncertainty, will eventually create long-term competitive advantages and thus acquire a resilient business model.

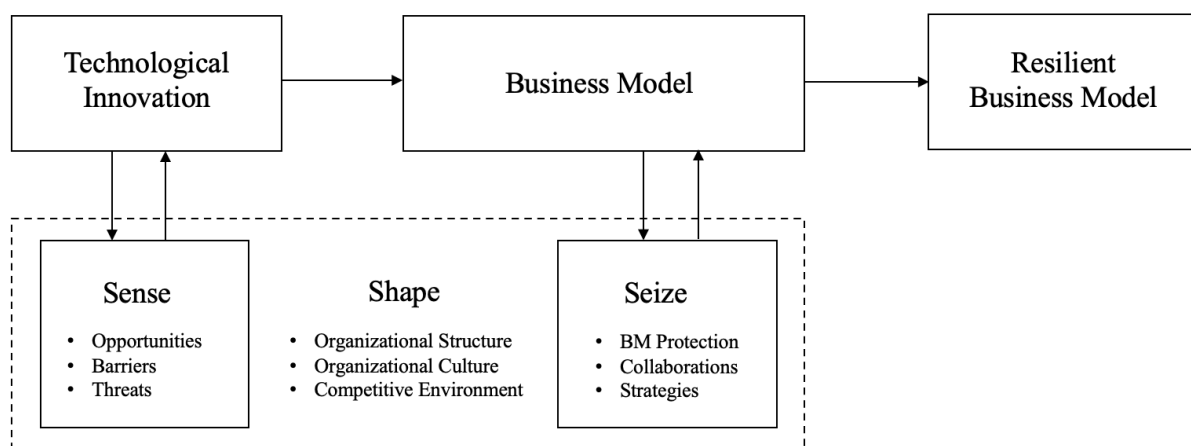


Figure 3: Final Framework

## 6 Conclusion

The purpose of this study was to enhance understanding of business model change by exploring the decisions made or intended by firms in the entrepreneurial context. To achieve this, the following research question was formulated: How do entrepreneurial firms use dynamic capabilities in order to create resilient business models in times of technological change?

Based on a multiple case study, the research question was addressed by identifying the various activities undertaken by firms in regard to the dynamic capabilities of sense, seize, and transform. The empirical results led to the replacement of transform, with shape, in the final framework. This puts Teece's (2018) framework into the perspective of start-ups. This was carried out due to the results obtained from the interviewees, acknowledging the lack of transformation as the firms are still in a developmental phase. The analysis led to several other main findings, resulting in the following conclusions.

One of the findings regards the utilisation of business models to address change. It is evident from the study that a business model is too limiting as it is often seen as a blueprint of the organisation, rather than a changing mechanism (Demil & Lecocq, 2010). To address this shortage, we suggest that firms apply the dynamic capabilities of sensing, seizing, and shaping, which foster organizational agility and allow a firm to implement changes in their business model quickly.

Secondly, in regard to sensing, networking comes forth as one of the most prominent mechanisms, rather than the highly emphasised activities of hypothesis building and utilisation of frameworks, as emphasised in past literature (Teece, 2007; Teece, Peteraf & Leih, 2016). These were lacking among the interviewees, questioning their relevance to practice, as identification of opportunities and threats were still apparent. Notably, just as much emphasis was put on the identification of threats and barriers, as on opportunities.

Thirdly, in regard to seizing, the results support theory by emphasising the relevance of careful selection of an appropriate business model, and the implications of any changes made. It is also supported regarding (i) the protection of intellectual property; (ii) the careful selection of a manufacturing strategy, as some facilitate more agility than others; and (iii) the relevance of



collaborations. Furthermore, despite emphasis on open innovation in past literature (Teece, Peteraf & Leih, 2016; Teece, 2020), the empirical results revealed it is rarely pursued in practice. The results allow us to draw the conclusion that more emphasis should be put on the selection of a firm's commercialisation strategy, as it can have an impact on a firm's success. However, this may be specific to this industry. Additionally, we argue that the logic of the dominant design should be considered with care, as firms might miss the right timing to invest in a certain technology.

Fourthly, in terms of shaping, firms should focus on creating an organisational structure and culture, that facilitates agility and efficient work streams, as well as enhances a firm's ability to sense and seize. Additionally, firms can shape their external environment through the actions they pursue. In conclusion, a resilient business model can be achieved by firms that sense the environment, seize opportunities, and shape internal culture and organisational structure.

This theoretical contribution is a refinement of established theory. Thus, the study enhances the understanding of business model change through the application of dynamic capabilities in entrepreneurial firms.

## **6.1 Practical Implications**

In addition to theoretical implications, the study contributes to practice. Firstly, from a managerial perspective, the study contributes to an understanding of why certain actions are taken or decisions are made, in a firm's respective place within their lifecycle. The study's findings can enhance entrepreneurial understanding of the relevance of business model selection in the early stages of a firm's development. Secondly, entrepreneurs can actively pursue the activities of sensing, seizing and shaping, to allow a firm to pivot quickly in changing environments, and thus continuously shape organisational structure and culture.

Furthermore, this study highlights the threats and barriers this industry is currently facing, shedding light on the need for further research to overcome these challenges. In addition, it may guide entrepreneurs in strategic decision making when it comes to the selection of manufacturing and/or commercialisation strategy. Moreover, incumbents of the existing meat and dairy industries, may find the insights valuable as it allows them to evaluate the potential threat

of uprising technologies. This may also open opportunities for further collaborations as incumbents must take actions to continue to avoid becoming obsolete.

## **6.2 Limitations and Future Research**

It is significant to acknowledge the limitations of the study, as well as possible areas for future research. For instance, one limitation regards the methodological approach to the study. As a qualitative research approach was selected, the work is not intended to quantitatively test the correlation between various capabilities and firm resilience. Rather, the study explores what activities start-ups undertake in order to undergo change and be resilient in the long-term, thus addressing the identified research gap. Therefore, the authors suggest a quantitative approach to test the relationship between various activities and firm resilience.

A second limitation regards the generalisability of the study. The multiple case study was based on the lab-grown food and dairy industry; hence, the findings may be particular to solely this industry, or similar industries regarding consumer goods. However, the study regarded the organisational concept of dynamic capabilities and the managerial activities undertaken within, rather than the technology itself. Thus, this concept can be further investigated to test its applicability across a variety of industries.

Third, the format of the interviews may have limited the potential of information gathered. For instance, as solely one representative from each interviewed company was spoken to, this provides indirect information filtered through the eyes of the interviewees. There may also be a difference in the interviewees articulate and perceptive ability. Therefore, future research can include multiple interviewees from each firm, to gather a more holistic overview of the activities undertaken.

Fourth, the collection of a variety of secondary sources may limit the study. The novelty of the industry limited the amount and quality of available, public information. The documents may also not be authentic or accurate. Furthermore, many firms prefer to keep information private. Fifth, due to the chosen interview questions, some aspects of dynamic capabilities may not have been addressed in this study. Thus, further research could include asking other questions that this study did not address.

Further fields of future research were identified. First, it may be of interest to analyse whether there is a difference between the activities undertaken by start-ups originating from incubators, compared to stand-alone ones. Path dependency is highly relevant for change in incumbents, affecting the managerial decisions and capabilities of the firm, but considered irrelevant for start-ups as they do not have much of a past. However, an incubator might have some influence on the resources and capabilities of a start-up, thus further analysis could be conducted. Second, the companies in the lab-grown food and dairy industry have not been around for a long time, hence the finding of absence of transformation identified in the discussion. It may be of intrigue to follow the firms as they grow, thus, over a longer time horizon. This would analyse further changes a firm may undergo, determining if they have achieved a state of resilience.

**Word Count: 24,835**

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# Appendix

## Appendix A – Interview Guide

1. Can you please elaborate on your supply chain/value chain?
2. How do you keep track of what's going on around you/in your industry?
  - a. How do you sense what will happen in ten year's time?
    - i. Do you use scenario planning?
    - ii. Have you used analytical frameworks such as a PESTEL analysis?
  - b. How do you interpret the information collected?
    - i. Do you derive strategies from it?
3. How do you bring in customers/suppliers when developing a product?
  - a. Or other third parties?
  - b. Do you consider consumer acceptance?
4. What barriers are you facing? Is anything threatening your BM/Value Proposition?
  - a. For example: regulations, technologies, consumer acceptance, branding, reaching mass scalability
  - b. Do you think it's realistic that new technologies will enter this market?
    - i. Are you prepared? What precautions have you already taken?
    - ii. What do you plan to do?
  - c. Is there anything else that makes your BM fragile?
5. Do you personally feel that you can adjust to environmental changes quickly if they were to occur?
  - a. For example: new technology comes and makes yours obsolete, commercialisation barriers/regulations stay high
  - b. What are your strengths and weaknesses here?
6. How do you protect your BM?
  - a. For example: patents, strategic alliances, diversification of investors, product and/or project diversification, etc.
  - b. Are you also pursuing collaborations with larger firms or even competitors?
    - i. If no, is it an option?
    - ii. If yes,
      1. Why do you do it?
      2. What are the benefits?

3. What are the risks?
    - c. When did you start collaborating?
  
7. When it comes to production, do you produce in-house, or do you outsource certain aspects?
  - a. Or have you bought another company to carry out certain tasks?
    - i. Is it something you would consider?
  - b. If you outsource, e.g., for scalability purposes, what do your supplier relations look like?
  
8. What does your organisational structure look like?
  - a. Is it decentralised?
  - b. What kind of control mechanisms do you have in place? For example, division of authority, power, etc. Or are they all equal?
  - c. Are your employees self-organised?
  - d. Do your employees speak up when they have an opinion?
  - e. Do your employees contribute to discussions regarding the future of the firm?
  - f. Do you have an organisational culture whereby failure is accepted?
  - g. How do you organise to get the most out of your competencies and technical capabilities?
  
9. What does your innovation process look like?
  - a. Is open innovation an option for you? à how do you define open innovation? (Especially since knowledge is so widely dispersed)
  - b. Is it being pursued by others?
  
10. What does your product development strategy look like?
  - a. Is a lean start-up method an option for you?
    - i. Introducing a not perfect product and then make alterations according to customer feedback?
  - b. Or would you rather make the perfect product before market release?
  
11. What kind of impact do you think you are having on the industry?
  - a. Are you able to shape it?